



2016 Minerals Yearbook

NITROGEN [ADVANCE RELEASE]

NITROGEN

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In 2016, U.S. ammonia production contained 10.2 million metric tons (Mt) of nitrogen, 6% more than production in 2015, and apparent consumption increased slightly from that in 2015 (table 1). According to the U.S. Census Bureau, exports of ammonia nearly doubled compared with those in 2015, and imports decreased by 11% from those of 2015 (tables 8, 9). Export quantities of ammonia were small at 182,000 metric tons (t) compared with 3.84 Mt of imports. Most of the imports in 2016 were from Canada and Trinidad and Tobago. About 88% of the domestically produced and imported ammonia consumed in the United States was used in fertilizer applications. Global ammonia production in 2016, which was estimated to contain 144 Mt of nitrogen, was slightly lower than that in 2015. China, India, Russia, and the United States were the leading producers, together accounting for about 55% of the total. In the United States, the increased supply of shale gas has lowered prices for domestic natural gas, which is an essential feedstock for nitrogen production, and has prompted the development of new nitrogen capacity to replace higher cost imports.

Nitrogen is an essential element of life and a part of all plant and animal proteins. Some crops, such as alfalfa, garden peas, peanuts, and soybeans, can convert atmospheric nitrogen into a usable form in a process called fixation. Most nitrogen available for crop production, however, comes from decomposing animal and plant waste or from commercially produced fertilizers.

All commercial fertilizers contain nitrogen in the form of ammonium and (or) nitrate or in a form that is quickly converted to these after the fertilizer is applied to the soil. Commercial production of anhydrous ammonia is based on reacting nitrogen with hydrogen under high temperatures and pressures. The source of nitrogen is air, which is almost 80% nitrogen. Hydrogen can be derived from a variety of raw materials, including water and crude oil, or coal, but it most often comes from natural gas hydrocarbons. Other nitrogen fertilizers are produced from ammonia feedstock through a variety of chemical processes.

Legislation and Government Programs

The U.S. International Trade Commission (ITC) instituted a 5-year review in June 2016 to determine whether revocation of the antidumping duty order on ammonium nitrate from Russia would likely lead to the continuation or recurrence of material injury to the domestic ammonium nitrate industry. Effective August 16, 2016, the ITC revoked the antidumping duty order because the interested domestic parties did not participate in the 5-year review (U.S. International Trade Commission, 2016).

In November 2016, the ITC announced that it was removing antidumping duties from PJSC PhosAgro's urea. The ITC determined that PhosAgro (Russia) was selling its high-quality fertilizers in full compliance with antidumping regulations (Green Markets, 2016b).

On November 1, 2016, the ITC initiated a 5-year review of the antidumping duty orders on solid urea from Russia and Ukraine. Effective December 20, 2016, the ITC revoked the antidumping orders because the interested domestic parties did not participate in the review (U.S. International Trade Commission, 2017).

Production

Industry statistics for anhydrous ammonia and derivative products from 2012 through 2016 were developed by The Fertilizer Institute and adjusted by the U.S. Geological Survey. In 2016, production of anhydrous ammonia (82.2% nitrogen) increased by 6% to 10.2 Mt of contained nitrogen compared with 9.59 Mt in 2015 (table 1). Of the total produced, 88% was used as fertilizer and 12% was used in other chemical and industrial sectors (table 2).

The United States was a leading producer and consumer of elemental and fixed types of nitrogen. In decreasing order of contained nitrogen, urea, ammonium nitrate, nitric acid, ammonium phosphates [diammonium phosphate (DAP) and monoammonium phosphate (MAP)], and ammonium sulfate were the major downstream products derived from domestic and imported ammonia in the United States. Their combined estimated production was 8.91 Mt of contained nitrogen, with urea accounting for about 34% of the total production; ammonium nitrate, 29%; nitric acid, 17%; ammonium phosphates, 13%; and ammonium sulfate, 7% (table 3).

Ammonia producers in the United States operated at about 76% of design capacity in 2016; this percentage included capacities at plants that operated during any part of the year and did not include plants that were idle for all of 2016. More than 70% of U.S. ammonia production capacity was concentrated in Louisiana (36%), Oklahoma (16%), Iowa (9%), Georgia (5%), and Texas (5%), where large reserves of feedstock natural gas occur. CF Industries Holdings, Inc.; PCS Nitrogen, Inc.; Koch Nitrogen Co., LLC; and Dyno Nobel Inc., in descending order, accounted for almost 74% of total U.S. ammonia production capacity (table 4).

Grannus, LLC, a company formed in 2012 to develop "next generation" ammonia technology based on partial oxidation rather than steam reforming as a means of generating lower emission levels (particularly for nitrogen oxides), contracted with Air Liquide Global E&C Solutions to license Lurgi technology and provide engineering for hydrogen production at Grannus' new 227-metric-ton-per-day (t/d) ammonia plant in Kern County, CA. The plant was expected to produce 82,500 metric tons per year (t/yr) of ammonia and provide 40% of California's agricultural ammonia requirements and was expected to be operational in 2019 (Nitrogen + Syngas, 2017a).

Midwest Fertilizer Co. LLC contracted with thyssenkrupp Industrial Solutions AG to design and build a new nitrogen

fertilizer plant in Posey County, IN, at a cost of \$2.0 billion. The plant was expected to produce 730,000 t/yr of ammonia, 730,000 t/yr of urea, 1.4 million metric tons per year (Mt/yr) of urea-ammonium nitrate (UAN) solutions, and diesel exhaust fluid. The plant was expected to be fully operational in 2020 (Nitrogen + Syngas, 2016f).

Fortigen Geneva LLC broke ground on a \$75 million ammonia plant in Geneva, NE. The small-scale 90-t/d (30,000-t/yr) plant would supply ammonia to local farmers in the State. Construction was expected to be completed by the third quarter of 2017 (Nitrogen + Syngas, 2016d).

LSB Industries, Inc. began ammonia production at its El Dorado, AR, facility in May 2016. LSB expected that the total cost of the project, which included a 340,000-t/d ammonia plant and a new nitric acid plant, would be approximately \$830 million (Green Markets, 2016c).

Phibro LLC (Philipp Brothers Fertilizer and a group of investors) acquired SG Solutions LLC's clean-coal gasification plant located outside West Terre Haute, IN. The coal gasification plant, which formerly produced syngas, would be converted by Phibro to produce 500,000 t/yr of ammonia. Petroleum coke sourced from local refineries would be used as a feedstock. The conversion and addition of an ammonia 'back end' to the plant would cost \$450 million. The plant was expected to be completed in mid-2018 (Nitrogen + Syngas, 2016e).

CF Industries' new ammonia plant at the company's Donaldsonville, LA, nitrogen complex became operational in September 2016. Total ammonia production capacity at the Donaldsonville complex was 4.3 Mt/yr up from 3.1 Mt/yr after the completion of the expansions. The Donaldsonville complex was considered to be the largest nitrogen facility in the world (Nitrogen + Syngas, 2017b).

In October, Dyno Nobel Inc. completed a new \$850 million ammonia plant at its Fortier facility in Waggaman, LA. The plant would produce 800,000 t/yr of ammonia, which in turn would be used to produce explosives at another location. The plant was expected to produce the lowest emissions of any ammonia facility operating in the United States (Nitrogen + Syngas, 2016c).

In December, CF Industries announced that the new ammonia and urea plants at the Port Neal, IA, nitrogen complex had been commissioned. The ammonia capacity would be 1.09 Mt/yr, up from 345,000 t/yr, and the urea capacity would be 1.3 Mt/yr, up from 45,000 t/yr. The UAN capacity would remain the same at 726,000 t/yr (CF Industries Holdings, Inc., 2016).

Environment

Hypoxia, or oxygen depletion, is caused by excess nutrients in bodies of water. The nutrients can come from many sources including fertilizers, soil erosion, sewage discharge, and deposition of atmospheric nitrogen. Hypoxia has become a controversial environmental concern for the fertilizer industry and an issue that spawned significant research efforts to determine its cause. Hypoxia occurs where water near the bottom of an affected area of a large body of water, such as the Gulf of Mexico, contains less than 2 parts per million dissolved oxygen. Hypoxia can cause stress or death in bottom-dwelling organisms that cannot move out of the hypoxic or "dead" zone.

Dead zones in coastal oceans have been reported in more than 400 ecosystems, affecting a total area of more than 245,000 square kilometers worldwide. The number of dead zones has approximately doubled each decade since the 1960s. More recently, dead zones have developed in continental seas, such as the Baltic Sea, Black Sea, East China Sea, Gulf of Mexico, and Kattegat (Virginia Institute of Marine Science, 2017).

The Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) was established in the fall of 1997 as a partnership among five Federal agencies; tribes; and environmental quality, agricultural, and conservation agencies working together to address the issue of nutrient pollution and the dead zone in the Gulf of Mexico. In February 2016, the HTF released its first report on point source processes in the 12 HTF States: Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin. The report documented permitting requirements for major sewage treatment plants, including nitrogen and phosphorus monitoring and discharge limits. In December 2016, the HTF issued an updated Federal strategy to provide guidance and continued scientific support to the HTF States (U.S. Environmental Protection Agency, 2017, p. 11).

Consumption

In 2016, U.S. apparent consumption of ammonia was 13.8 Mt of contained nitrogen, a slight increase from that of 2015. Apparent consumption is calculated as production plus imports minus exports, adjusted to reflect any changes in stocks.

Consumption of nitrogen fertilizers in the United States for the 2016 crop-year (ending June 30, 2016) is listed in table 5. Consumption of fertilizers was estimated to be 11.9 Mt of contained nitrogen, which was slightly less than that of 2015. Anhydrous ammonia and nitrogen solutions, mostly UAN solutions containing 29.8% to 29.9% nitrogen, were the principal nitrogen fertilizer products, representing 24% and 27% of fertilizer consumption, respectively. Urea (45.9% nitrogen) constituted 23% of the nitrogen fertilizer consumption during the 2016 crop-year. Ammonium nitrate (33.9% nitrogen) constituted 2% and ammonium sulfate constituted 3% of 2016 nitrogen fertilizer consumption. The remaining 21% consisted of multiple-nutrient (various combinations of nitrogen, phosphate, and potassium) and other nitrogen fertilizers. The leading nitrogen-consuming States in the 2016 crop-year were, in descending order, Iowa, Illinois, Nebraska, North Dakota, Minnesota, Kansas, and Indiana, accounting for about 50% of total fertilizer consumption (J.V. Slater, Association of American Plant Food Control Officials Inc., written commun., November 14, 2017).

Transportation

Ammonia was transported by refrigerated barge, rail car, pipeline, and tank truck. Three companies served 11 States with 5,090 kilometers (km) of pipelines and 4,800 km of river barge transport; rail and truck were used primarily for interstate or local delivery.

NuStar Energy L.P. continued to operate an ammonia pipeline. The 3,200-km ammonia pipeline originated in the Louisiana

Delta, where it had access to three marine terminals and three anhydrous ammonia plants on the Mississippi River. The capacity of this pipeline was about 2 Mt/yr of ammonia, with a storage capacity of more than 1 Mt. In 2016, about 1.04 Mt of ammonia was shipped through the Gulf Central ammonia pipeline (NuStar Energy L.P., 2017, p. 7).

Magellan Midstream Partners, L.P. owned a common carrier ammonia pipeline system. The 1,770-km pipeline system, which transported and distributed ammonia from production facilities in Oklahoma and Texas to various distribution plants in the Midwest, had a delivery capacity of about 820,000 t/yr (Magellan Midstream Partners, L.P., 2017, p. 1).

Tampa Pipeline Corp. operated the 135-km Tampa Bay pipeline system, which moved ammonium phosphate and nitrogen compounds for fertilizer producers in Hillsborough and Polk Counties, FL.

Prices and Stocks

Midyear and yearend prices for nitrogen materials are listed in table 6. According to Green Markets, the average Gulf Coast ammonia price began 2016 at \$420 per short ton (the high for the year) and remained at this price through late January. Ammonia prices reached a low of \$208 per short ton in early October. At yearend, the price was \$245 per short ton, a 42% decrease in yearend price from that of 2015.

The average Gulf Coast granular urea price fluctuated throughout 2016, beginning the year at \$218 per short ton. The average price reached a high of \$266 per short ton in mid-April. At yearend, the average urea price was \$237 per short ton.

The average ammonium nitrate price, which began 2016 at \$283 per short ton, decreased throughout the year. The average price declined to \$250 per short ton by yearend.

Ammonium sulfate prices do not necessarily follow the same trend as other nitrogen products, which correlate to natural gas prices, mainly because a substantial amount of ammonium sulfate is produced as a byproduct of caprolactam production. Caprolactam, an organic compound, is the precursor to Nylon 6, a widely used synthetic polymer. The average price of ammonium sulfate, which began 2016 at about \$275 per short ton, fluctuated throughout the year. By yearend, the price averaged \$230 per short ton.

In 2016, the annual average price paid index for all types of fertilizers decreased by 8% from the 2015 index (U.S. Department of Agriculture, Economic Research Service, 2017a). Fertilizer prices decreased as a result of decreased feedstock prices, which led to increased supply and lower global cost of nitrogen fertilizers.

Stocks of ammonia at yearend 2016 were estimated to be 400,000 t, a 5% decrease from comparable stocks at yearend 2015 (table 7).

Foreign Trade

Ammonia exports nearly doubled compared with those in 2015 (table 8). The Republic of Korea, Mexico, Morocco, and Turkey were the leading destinations for United States exports of ammonia, accounting for 97% of the total quantity.

Ammonia imports decreased by 11% compared with those in 2015 and dwarfed the quantity of exports. The average value of ammonia imports decreased to about \$336 per metric ton from \$488 per metric ton in 2015 (table 9). Trinidad and Tobago (67%) continued to be the leading import source. Canada (27%) was another significant import source.

Tables 10 and 11 list trade data for other nitrogen materials and include information on principal destination or source countries. Exports of ammonium nitrate, ammonium sulfate, DAP, and urea decreased in 2016, whereas those of anhydrous ammonia and MAP increased. Imports of nitrogen materials in 2016 decreased by 10% compared with those in 2015. However, imports of ammonium nitrate and limestone mixtures, MAP, and potassium nitrate and sodium nitrate mixtures increased.

World Review

Anhydrous ammonia and other nitrogen materials were produced in more than 60 countries. Global ammonia production in 2016, estimated to be 144 Mt, was slightly lower than that of 2015 (table 12). China, with 32% of total production, was the leading world producer of ammonia. Asia contributed 47% of total world ammonia production, and Eastern Europe produced 16% of the global total. North America produced 11% of the total; the Middle East, 9%; Western Europe, 8%; the Caribbean, Central America, and South America, 5%; and Africa and Oceania contributed the remaining 4%.

In 2016, world ammonia trade was 15.2 Mt of contained nitrogen, which increased slightly compared with that in 2015. Russia and Trinidad and Tobago accounted for 43% of world exports. Asia (primarily India) imported about one-third of global ammonia trade, followed by North America and Western Europe (International Fertilizer Association, 2017).

China.—In December 2016, the Government of China released its 2017 export tariff rates for many products, including anhydrous ammonia and urea. The 2017 export tariff rate for ammonia would remain the same at zero. The export rate for urea was reduced to zero from 80 Renminbi per metric ton in 2016 (CRU Group, 2016).

Egypt.—KBR, Inc. was awarded a contract to supply proprietary equipment for a new 1,200-t/d ammonia plant in Aswan. The contract was awarded by Tecnimont S.p.A., and the plant was to be built by Chemical Industries Holding Co. The plant was being built in order to support regional development plans in Aswan, as well as Egypt's drive to build modern fertilizer complexes. No timetable for the completion of the plant was announced (Green Markets, 2016e).

Iran.—Shiraz Petrochemical Co. of Iran began operations at the Marvdasht ammonia-urea plant, which would produce 680,000 t/yr of ammonia and 1.1 Mt/yr of urea. The project was completed at a cost of \$750 million. With the addition of the Marvdasht plant, Iran's total nitrogen capacity increased to 4.5 Mt/yr of ammonia and 5.5 Mt/yr of urea (Nitrogen + Syngas, 2016b).

Rashtriya Chemicals & Fertilizers Ltd. and Gujarat State Fertilizer Corp. of India formed a joint venture with Iranian partner Faradast Energy Falat Co. to develop a 1.1-Mt/yr

ammonia-urea plant at Chabahar in southern Iran. The plant was expected to cost \$970 million, and the urea would be exported to India (Nitrogen + Syngas, 2016a).

Nigeria.—Indorama Eleme Fertilizer & Chemicals Ltd.'s new \$1.4 billion ammonia and urea plant at Port Harcourt was set for commissioning. The plant was designed to produce 2,300 t/d of ammonia and 4,000 t/d of urea. KBR, Inc. supplied the purifier process technology for the ammonia plant, whereas the urea plant was designed to use Toyo Engineering Corp.'s synthesis technology. An 83-km pipeline to supply natural gas was completed as part of the project. The output from the plant would replace some urea imports to Nigeria and other West African countries, as well as address the growing demand for fertilizer (Green Markets, 2016d).

Russia.—Acron inaugurated its new 700,000-t/yr ammonia plant at Veliky Novgorod. Construction of the Ammonia-4 plant started in June 2014 and was completed at a cost of \$500 million. With the Ammonia-4 plant operating, the annual ammonia output at the Veliky Novgorod production site could reach 1.9 Mt of ammonia (Green Markets, 2016a).

Outlook

Large corn plantings increase the demand for nitrogen fertilizers. According to the U.S. Department of Agriculture (USDA), U.S. corn growers intend to plant 36.4 million hectares (Mha) of corn for all purposes in the 2017 crop-year, a 4% decrease from that in 2016. Corn acreage utilization is expected to decrease across most of the major corn producing States with the exception of Kansas. Reduction in planted corn acreage for 2017 is due to expected lower returns on corn compared with other crops (U.S. Department of Agriculture, National Agricultural Statistics Service, 2017, p. 30).

According to long-term projections from the USDA, plantings for the eight major field crops (barley, corn, oats, rice, sorghum, soybeans, upland cotton, and wheat) in the United States are expected to decrease slightly in the next few years. During the remainder of the projection period (2016–26), plantings are expected to remain near 100 Mha, down from about 103 Mha in 2016. Corn, soybeans, and wheat are expected to account for about 90% of acreage utilization for the eight major field crops during this 10-year period, and the amount of acreage planted in corn is expected to remain high. Soybean planting likely will increase during the projection period because growth in domestic and foreign demand keeps prices high, which could result in higher profits for producers. Wheat plantings are likely to remain stable as gains in food use are balanced with declines in feed use.

Domestic corn-based ethanol production is projected to increase slightly in the next few years, then will decrease owing to the decrease in U.S. gasoline consumption and little to no growth in the use of 15% or 85% ethanol blended gasoline. Most U.S. ethanol production used corn as a feedstock; about 35% of total corn produced is expected to go to ethanol production through 2026. No gains for corn-based ethanol are projected during the 10-year period compared with those of past years (U.S. Department of Agriculture, Economic Research Service, 2017b, p. 19).

In 2016, as a result of strong gains in domestic shale gas production, natural gas prices were about \$2.52 per million British thermal units compared with \$2.62 per million British thermal units in 2015 and \$4.37 per million British thermal units in 2014. Natural gas prices in the United States have typically been higher than those in the rest of the world, and lower natural gas prices made U.S. ammonia production more competitive with offshore imports. Depending on its price, natural gas can account for approximately 70% to 85% of the U.S. cash cost of producing ammonia. Favorable natural gas prices continued to provide North American producers with a delivered-cost advantage to domestic markets over most offshore suppliers, prompting the announcement of several regional expansions and greenfield nitrogen projects. In addition to the United States, the Middle East, North Africa, and Russia have large supplies of lower cost natural gas compared with other countries, which give them a cost advantage in producing and exporting ammonia. China and Europe have experienced rising natural gas prices; thus, producers in these regions were higher cost suppliers and played an important role in setting prices in the world marketplace (Potash Corp. of Saskatchewan Inc., 2017, p. 20). The U.S. Department of Energy projected that the Henry Hub natural gas spot price in the United States, in dollars per million British thermal units, would average \$2.99 in 2017 (up 47 cents from a 17-year low in 2016) and \$2.88 in 2018 (U.S. Energy Information Administration, 2018, p. 12).

The future of U.S. ammonia production depends on the variability in natural gas prices and construction costs. The United States is the world's leading importer of ammonia and the second-ranked consumer. Recent low prices for natural gas in the United States have prompted some companies to upgrade existing U.S. plants and other companies to begin construction of new U.S. nitrogen projects. Ammonia capacity will continue to grow in 2017 and 2018, following a 2-Mt expansion in 2016. The increase in U.S. ammonia capacity is expected to change the supply structure and flows of ammonia and nitrogen products in the United States, which would translate into lower U.S. imports of nitrogen products (such as ammonia, urea, and some UAN) and the potential for increased exports of urea and UAN (Prud'homme, 2017, p. 16–17).

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TABLE 1
SALIENT AMMONIA STATISTICS¹

(Thousand metric tons of contained nitrogen unless otherwise specified)

	2012	2013	2014	2015	2016	
United States:						
Production ²	8,730	9,170	9,330	9,590	10,200	
Exports ³	31	196	111	93	182	
Imports for consumption ³	5,170	4,960	4,150	4,320	3,840	
Consumption, apparent ⁴	13,900	13,900	13,300	13,700	13,800	
Stocks, December 31, producers	180 ^e	240 ^e	280	420	400	
Average annual price, free on board Gulf Coast ⁵	dollars per short ton	579	541	531	481	267
Net import reliance ⁶	percent of apparent consumption	37	34	30	30	26
Natural gas price, wellhead, average price ⁷	dollars per million British thermal units	2.75	3.73	4.37	2.62	2.52
World:						
Production ^e	139,000 ^r	144,000	141,000 ^r	147,000 ^r	144,000	
Trade ⁸	15,500	15,000	15,100	15,100	15,200	

^eEstimated. ^rRevised.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits.

²Source: The Fertilizer Institute; data adjusted by the U.S. Geological Survey.

³Source: U.S. Census Bureau.

⁴Defined as production plus imports minus exports; adjusted for industry stock changes.

⁵Source: Green Markets.

⁶Defined as imports minus exports; adjusted for industry stock changes.

⁷Source: Natural Gas Monthly, U.S. Energy Information Administration.

⁸Source: International Fertilizer Industry Association Statistics, World Anhydrous Ammonia Trade.

TABLE 2
ANHYDROUS AMMONIA SUPPLY AND DEMAND IN THE UNITED STATES¹

(Thousand metric tons of contained nitrogen)

	2014	2015	2016
Production: ²			
Fertilizer:			
January–June	4,170	4,220	4,450
July–December	4,030	4,220	4,480
Total	8,210	8,440	8,930
Nonfertilizer:			
January–June	569	576	608
July–December	550	575	611
Total	1,120	1,150	1,220
Grand total	9,330	9,590	10,200
Exports:			
January–June	66	68	29
July–December	45	25	154
Total	111	93	182
Imports for consumption:			
January–June	2,040	2,330	2,100
July–December	2,110	1,980	1,740
Total	4,150	4,320	3,840
Stocks, end of period:			
January–June	190	320	320
July–December	280	420	400
Apparent consumption: ³			
January–June	6,770	7,020	7,230
July–December	6,560	6,650	6,590
Total	13,300	13,700	13,800

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Source: The Fertilizer Institute; data adjusted by the U.S. Geological Survey.

³Defined as production plus imports minus exports; adjusted for industry stock changes.

Source: U.S. Census Bureau.

TABLE 3
MAJOR DOWNSTREAM NITROGEN COMPOUNDS PRODUCED IN THE UNITED STATES^{1,2}

(Thousand metric tons)

	2015						2016					
	January–June		July–December		Total		January–June		July–December		Total	
	Gross weight	Nitrogen content	Gross weight	Nitrogen content	Gross weight	Nitrogen content	Gross weight	Nitrogen content	Gross weight	Nitrogen content	Gross weight	Nitrogen content
Urea ^c	2,890	1,330	2,640	1,210	5,540	2,540	3,460	1,590	3,160	1,450	6,610	3,040
Ammonium nitrate ^c	3,640	1,230	3,600	1,220	7,240	2,450	3,890	1,320	3,850	1,300	7,740	2,620
Ammonium phosphates ³	4,120	573	4,160	580	8,280	1,150	4,130	576	4,150	579	8,280	1,160
Nitric acid ^c	3,340	735	3,310	728	6,650	1,460	3,410	750	3,380	743	6,780	1,490
Ammonium sulfate ⁴	1,590	338	1,550	328	3,140	666	1,540	327	1,330	281	2,870	608

^cEstimated.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Ranked in relative order of importance by nitrogen content.

³Diammonium phosphate and monoammonium phosphate.

⁴Excludes coke plant ammonium sulfate.

Source: The Fertilizer Institute; data adjusted by the U.S. Geological Survey.

TABLE 4
DOMESTIC PRODUCERS OF ANHYDROUS AMMONIA IN 2016¹

(Thousand metric tons per year of ammonia)

Company	Location	Capacity ²
Agrium Inc.	Borger, TX	490
Do.	Kenai, AK ³	280
Do.	Kennewick, WA ³	180
CF Industries Holdings, Inc.	Donaldsonville, LA	3,900
Do.	Port Neal, IA	1,090
Do.	Verdigris, OK	1,020
Do.	Woodward, OK	435
Do.	Yazoo City, MS	508
Coffeyville Resources Nitrogen Fertilizers, LLC	Coffeyville, KS	375
Dakota Gasification Co.	Beulah, ND	355
Dyno Nobel Inc.	Cheyenne, WY	178
Do.	St. Helens, OR	101
Do.	Waggaman, LA ⁴	800
Green Valley Chemical Corp.	Creston, IA	32
Honeywell International Inc.	Hopewell, VA	530
Koch Nitrogen Co., LLC	Beatrice, NE	265
Do.	Dodge City, KS	280
Do.	Enid, OK	930
Do.	Fort Dodge, IA	350
LSB Industries, Inc.	Cherokee, AL	159
Do.	El Dorado, AR ⁴	340
Do.	Pryor, OK	210
Mosaic Company, The	Faustina (Donaldsonville), LA	508
OCI Partners LP	Beaumont, TX	331
PCS Nitrogen, Inc.	Augusta, GA	785
Do.	Geismar, LA	450
Do.	Lima, OH	612
Rentech Energy Midwest Corp.	East Dubuque, IL	337
Total		15,800

Do. Ditto.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to total shown.

²Engineering design capacity adjusted for 340 days per year of effective production capability.

³Idle.

⁴Not fully operational in 2016.

TABLE 5
U.S. NITROGEN FERTILIZER CONSUMPTION, BY PRODUCT TYPE^{1,2}

(Thousand metric tons of contained nitrogen)

Fertilizer material ³	2015 ^p	2016 ^c
Single-nutrient:		
Anhydrous ammonia	2,880	2,850
Nitrogen solutions ⁴	3,280	3,240
Urea	2,740	2,710
Ammonium nitrate	260	257
Ammonium sulfate	336	333
Aqua ammonia	47	47
Other ⁵	581	575
Total	10,100	10,000
Multiple-nutrient ⁶	1,870	1,850
Grand total	12,000	11,900

^cEstimated. ^pPreliminary.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Crop-years ending June 30.

³Ranked in relative order of importance by product type.

⁴Principally urea-ammonium nitrate solutions, 29.8% to 29.9% nitrogen.

⁵Includes other single-nutrient nitrogen materials, all natural organics, and statistical discrepancies.

⁶Various combinations of nitrogen (N), phosphate (P), and potassium (K): N-P-K, N-P, and N-K.

Source: J.V. Slater, Association of American Plant Food Control Officials Inc., written commun., November 14, 2017.

TABLE 6
PRICE QUOTATIONS FOR MAJOR NITROGEN COMPOUNDS AT END OF PERIOD¹

(Dollars per short ton)

Compound	2015		2016	
	June	December	June	December
Ammonium nitrate, free on board (f.o.b.) Corn Belt ²	335–340	285–295	260–270	245–255
Ammonium sulfate, f.o.b. Corn Belt ²	300–325	265–290	220–255	210–250
Anhydrous ammonia:				
F.o.b. Corn Belt ²	505–590	445–470	340–450	290–405
F.o.b. Gulf Coast ³	460	420	275–280	245
Diammonium phosphate, f.o.b. central Florida	430	380–390	325	315
Urea:				
F.o.b. Corn Belt, ² prilled and granular	380–415	265–295	215–240	255–275
F.o.b. Gulf Coast, ³ granular	290–360	225–230	175–182	232–242

¹Table includes data available through April 5, 2018.

²Illinois, Indiana, Iowa, Missouri, Nebraska, and Ohio.

³Barge, New Orleans, LA.

Source: Green Markets.

TABLE 7
U.S. PRODUCER STOCKS OF FIXED NITROGEN
COMPOUNDS AT END OF PERIOD¹

(Thousand metric tons of contained nitrogen)

Material ²	2015	2016
Ammonia:		
January–June	320	320
July–December	420	400
Nitrogen solutions: ³		
January–June	460	330
July–December	470	450
Urea:		
January–June	NA	NA
July–December	NA	NA
Ammonium phosphates: ⁴		
January–June	42	39
July–December	42	43
Ammonium nitrate:		
January–June	NA	NA
July–December	NA	NA
Ammonium sulfate:		
January–June	27	44
July–December	49	56
Yearend total ⁵	981 ^r	949

¹Revised. NA Not available.

²Table includes data available through April 5, 2018.

³Ranked in relative order of importance.

⁴Urea-ammonium nitrate and ammoniacal solutions.

⁵Diammonium and monoammonium phosphates.

^rCalendar year ending December 31.

Source: The Fertilizer Institute; data adjusted by the U.S. Geological Survey.

TABLE 8
U.S. EXPORTS OF ANHYDROUS AMMONIA, BY COUNTRY OR LOCALITY¹

(Thousand metric tons and thousand dollars)

Country or locality	2015		2016	
	Gross weight	Value ²	Gross weight	Value ²
Belgium	34	14,200	(3)	1,120
Canada	2	1,140	(3)	260
Chile	49	19,300	1	140
Korea, Republic of	(3)	1,660	26	6,520
Mexico	17	12,000	61	13,100
Morocco	--	--	115	25,800
Netherlands	11	3,160	--	--
Sweden	--	--	4	1,080
Turkey	--	--	13	2,140
Other	(3)	1,480	(3)	2,080
Total	113	53,000	222	52,200

-- Zero.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Cost, insurance, and freight value.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 9
U.S. IMPORTS OF ANHYDROUS AMMONIA, BY COUNTRY OR LOCALITY¹

(Thousand metric tons and thousand dollars)

Country or locality	2015		2016	
	Gross weight	Value ²	Gross weight	Value ²
Canada	1,130	717,000	1,250	629,000
Russia	438	200,000	46	19,400
Trinidad and Tobago	3,280	1,460,000	3,120	852,000
Ukraine	165	79,900	--	--
Venezuela	153	69,300	108	28,900
Other	79	36,500	144	37,700
Total	5,250	2,560,000	4,670	1,570,000

-- Zero.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Cost, insurance, and freight value.

Source: U.S. Census Bureau.

TABLE 10
U.S. EXPORTS OF MAJOR NITROGEN COMPOUNDS¹

(Thousand metric tons)

Compound	2015		2016		Principal destinations in 2016
	Gross weight	Nitrogen content	Gross weight	Nitrogen content	
Ammonium nitrate ²	448	152	320	108	Canada, 66%; Mexico, 32%.
Ammonium sulfate ²	973	206	936	198	Brazil, 51%; Peru, 14%; Canada, 9%.
Anhydrous ammonia	113	93	222	182	Morocco, 52%; Mexico, 27%; Republic of Korea, 12%.
Diammonium phosphate	2,120	381	1,720	309	India, 32%; Brazil, 15%; Mexico, 12%; Peru, 9%.
Monoammonium phosphate	2,280 ^r	251	2,580	284	Canada, 37%; Brazil, 35%; Australia, 10%.
Urea	380	174	321	147	Canada, 78%; Brazil, 9%.
Total	6,320	1,260	6,100	1,230	

^rRevised.

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes industrial chemical products.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS OF MAJOR NITROGEN COMPOUNDS¹

(Thousand metric tons and thousand dollars)

Compound	2015			2016			Principal sources in 2016
	Gross weight	Nitrogen content	Value ²	Gross weight	Nitrogen content	Value ²	
Ammonium nitrate ³	494	167	145,000	365	124	88,600	Canada, 81%; Netherlands, 8%; Russia, 5%.
Ammonium nitrate and limestone mixtures	40	11	11,000	61	16	11,300	Netherlands, 88%; Germany, 9%.
Ammonium sulfate ³	545	116	113,000	477	101	98,400	Canada, 44%; China, 35%.
Anhydrous ammonia ⁴	5,250	4,320	2,560,000	4,670	3,840	1,570,000	Trinidad and Tobago, 67%; Canada, 27%.
Calcium nitrate	78	13	11,400	52	9	9,330	Norway, 84%; Slovakia, 10%.
Diammonium phosphate	599	108	290,000	586	105	213,000	Morocco, 63%; Russia, 27%.
Monoammonium phosphate	582	64	300,000	853	94	334,000	Morocco, 51%; Russia, 43%.
Nitrogen solutions	3,110	930	792,000	2,810	840	511,000	Russia, 40%; Trinidad and Tobago, 24%; Canada, 16%; China, 9%.
Potassium nitrate	122	17	92,000	66	9	45,800	Chile, 74%; Germany, 19%.
Potassium nitrate and sodium nitrate mixtures	2	(5)	563	4	(5)	1,990	Canada, 77%; China, 18%.
Sodium nitrate	114	19	40,300	67	11	33,700	Chile, 63%; China, 14%; Germany, 13%.
Urea	7,190	3,300	2,390,000	6,580	3,020	1,640,000	Qatar, 19%; Canada, 14%; Saudi Arabia, 13%; United Arab Emirates, 11%.
Total	18,100	9,060	6,750,000	16,600	8,170	4,550,000	

¹Table includes data available through April 5, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Cost, insurance, and freight value.

³Includes industrial chemical products.

⁴Includes industrial ammonia.

⁵Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 12
AMMONIA: WORLD PRODUCTION, BY COUNTRY OR LOCALITY¹

(Thousand metric tons of contained nitrogen)

Country or locality ²	2012	2013	2014	2015	2016
Afghanistan	51 ^r	76	60	44 ^r	--
Algeria	713	580	1,130	1,130 ^c	1,130 ^c
Argentina	600	600	500 ^r	500 ^{r,c}	500 ^c
Australia	1,250	1,250	1,250	1,300	1,300 ^c
Austria ^c	400	400	400	400	400
Bahrain	341	378	454	416	420 ^c
Bangladesh ³	700	600 ^r	600 ^r	600 ^r	600 ^c
Belarus	950	967	1,019	1,060	1,060 ^c
Belgium	830	890 ^r	820 ^r	860 ^r	860 ^c
Brazil	980 ^r	1,000 ^r	870 ^r	1,000 ^r	1,000 ^c
Bulgaria	269	300	313	313	313 ^c
Canada	3,942	3,942	3,807 ^r	4,140 ^r	4,140 ^c
China	45,520	48,326	45,642	49,706	46,000 ^c
Croatia	342	343	376	375	375 ^c
Cuba	59	64	59	59	59 ^c
Czechia	116	153	175	180	180 ^c
Egypt	2,924	2,655	2,200	1,800	1,800 ^c
Estonia	14	99	30	35	35 ^c
Finland	78	78	78	78	78 ^c
France	2,644	2,640 ^c	2,600 ^c	2,600 ^c	2,600 ^c
Georgia ^c	150	150	170	190	190
Germany	2,823	2,757	2,540	2,500	2,500 ^c
Greece	88 ^r	105 ^r	119 ^r	119 ^r	119 ^c
Hungary	350 ^r	295 ^r	343 ^r	340 ^r	340 ^c
India ⁴	10,650	10,840	10,780	10,800	10,800 ^c
Indonesia	5,100	5,000	5,000	5,000 ^c	5,000 ^c
Iran	2,610 ^r	2,404 ^r	2,446 ^r	2,642 ^r	2,640 ^c
Iraq	143	146	182	165 ^c	165 ^c
Italy ^c	590	570	570	570	570
Japan	867	828	787	790	790 ^c
Kazakhstan	83	95	139	152	150 ^c
Korea, North	NA	NA	NA	NA	NA
Kuwait	451	552	542	450	450 ^c
Libya	67	124	208	266	270 ^c
Lithuania	918	693	815	876	1,460
Malaysia	940 ^r	990 ^r	980 ^r	990 ^r	990 ^c
Mexico	772	1,136	1,089	1,100 ^c	1,100 ^c
Netherlands	2,200 ^r	2,300 ^r	2,200 ^r	2,300 ^r	2,300 ^c
New Zealand ^c	125	125	125	125	125
Nigeria	210	130	90	150	340
Norway ^c	300	300	300	300	300
Oman ^c	1,600	1,700	1,700	1,700	1,700
Pakistan	2,300	2,700	2,600	2,600	2,600 ^c
Peru	12 ^r	12 ^r	13 ^r	5	5 ^c
Poland	2,026	2,119 ^r	2,200	2,200	2,200 ^c
Qatar	2,619	2,986	2,972	3,048	3,050 ^c
Romania ^c	115	85	100	28	28
Russia	11,401 ^r	11,879 ^r	12,030 ^r	12,485 ^r	12,500 ^c
Saudi Arabia	3,250	3,190	3,600 ^c	4,100 ^c	4,100 ^c
Serbia	170	202	109	89	89 ^c
Slovakia	486	480	486	468	468 ^c
South Africa ^c	620	620	620	620	620
Spain	810 ^r	790 ^r	810 ^r	840 ^r	840 ^c
Switzerland	30	20 ^r	20 ^r	30	30 ^c
Syria	50	50	50	--	--
Trinidad and Tobago	4,466	4,640	4,730	4,905	4,914
Turkey ^c	280	280	300	300	300
Turkmenistan	280	285	293	309 ^c	309 ^c
Ukraine ^c	3,440 ^r	2,890 ^r	2,010 ^r	1,800 ^r	1,800
United Arab Emirates	330	658	995 ^r	995 ^{r,c}	995 ^c

See footnotes at end of table.

TABLE 12—Continued
 AMMONIA: WORLD PRODUCTION, BY COUNTRY OR LOCALITY¹

(Thousand metric tons of contained nitrogen)

Country or locality ²	2012	2013	2014	2015	2016
United Kingdom ^c	800	800	800	800	800
United States ⁵	8,730	9,170	9,330	9,590	10,200
Uzbekistan ^c	1,300	1,350	1,200	1,200	1,200
Venezuela	1,200	1,200	1,100	1,000	1,000 ^e
Vietnam	830 ^r	1,000 ^r	1,100 ^r	1,100 ^r	1,100 ^e
Zimbabwe	25	27	22 ^r	15 ^r	15 ^e
Total	139,000 ^r	144,000	141,000 ^r	147,000 ^r	144,000

^cEstimated. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through November 23, 2017. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²In addition to the countries and (or) localities listed, Taiwan and Tajikistan produced ammonia, but available information was inadequate to make reliable estimates of output levels.

³May include nitrogen content of urea.

⁴Production is based on fiscal year, with a starting date of April 1.

⁵Synthetic anhydrous ammonia; excludes coke oven byproduct ammonia.