



2010 Minerals Yearbook

NITROGEN

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The world production table was prepared by Glenn J. Wallace, international data coordinator.

In 2010, U.S. ammonia production contained 8.29 million metric tons (Mt) of nitrogen, about an 8% increase from production in 2009, and apparent consumption increased by about 12% from that in 2009. Exports of ammonia doubled from those in 2009, and imports increased by about 22% compared with those of 2009. Most of the imports in 2009 were from Canada, Trinidad and Tobago, and Ukraine. About 86% of the domestically produced ammonia consumed in the United States was used in fertilizer applications. Global ammonia production in 2010, which was estimated to contain 131 Mt of nitrogen, was higher than that in 2009. China, India, Russia, and the United States were the leading producers, together accounting for about 54% of the total.

Legislation and Government Programs

In accordance with a January 2009 Clean Water Act determination and a consent decree with Florida Wildlife Federation to settle a 2008 lawsuit, the U.S. Environmental Protection Agency (EPA) proposed numeric water-quality standards for lakes and flowing waters in Florida in January and established final standards in November (U.S. Environment Protection Agency, 2010, p. 75805–75806). Implementation of the standards for inland water bodies was delayed for 15 months from November in order to give agencies and organizations the opportunity to review the standards and develop flexible strategies for implementation. However, in December, The Fertilizer Institute (TFI) filed a legal challenge to EPA's rule to establish numeric nutrient criteria for nitrogen and phosphorous for waters in the State of Florida. TFI stated that the rule was unlawful because it established water-quality criteria that ignored causation, regulated water bodies that were achieving their designated use, and restricted nutrients that do not cause impairment. The federally directed nutrient rule signed on December 6 would replace the nutrient criteria that were already being used by Florida's Department of Environmental Protection (Fertilizer Week, 2010g).

The U.S. International Trade Commission and the U.S. Department of Commerce International Trade Administration filed Federal Register notices on December 1 regarding the 5-year sunset review of solid urea imports from Russia and Ukraine (U.S. International Trade Commission, 2010). The review was to determine whether terminating the antidumping duty order on solid urea would lead to continuation or recurrence of material injury to the industry in the United States. Urea from Russia and Ukraine has been subject to dumping duties since 1987. The investigation was expected to be completed by yearend 2011.

Under EPA's Greenhouse Gas Reporting Program, owners and operators of facilities that manufacture ammonia were to report emissions from ammonia manufacturing processes and all other

source categories located at their facilities beginning in 2010. EPA's rule for the mandatory reporting of greenhouse gases (GHG) from large GHG emissions sources in the United States was published October 30, 2009. Owners or operators were required to collect emission data; calculate GHG emissions; and follow the specified procedures for quality assurance, missing data, recordkeeping, and reporting (U.S. Environmental Protection Agency, 2011).

Production

Industry statistics for anhydrous ammonia and derivative products were developed by the U.S. Census Bureau. A summary of the production of principal inorganic fertilizers by quarter was reported in the series MQ325B. In 2010, production of anhydrous ammonia (82.2% nitrogen) increased about 8% to 8.29 Mt of contained nitrogen compared with the value of 7.70 Mt in 2009 (table 1). Of the total production, 86% was for use as a fertilizer; the remaining 14% 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 declining order, urea, ammonium nitrate, ammonium phosphates [diammonium phosphate (DAP) and monoammonium phosphate (MAP)], nitric acid, and ammonium sulfate were the major downstream products derived from domestic and imported ammonia in the United States. Their combined production was 8.60 Mt of contained nitrogen, with urea and ammonium nitrate each accounting for 27% of the total, and ammonium phosphates and nitric acid accounting for 22% and 18%, respectively, of the production (table 3).

Ammonia producers in the United States operated at about 76% of their design capacity in 2010; 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 2010. Of the total available U.S. ammonia production capacity, more than 59% was concentrated in the States of Louisiana (35%), Oklahoma (19%), and Texas (5%), where there are large reserves of feedstock natural gas. CF Industries Holdings, Inc., Koch Nitrogen Co., LLC, PCS Nitrogen, Inc., and Agrium Inc., in descending order, accounted for 78% of total U.S. ammonia production capacity (table 4).

On April 5, CF Industries concluded its merger with Terra Industries Inc. at a total cost of about \$4.7 billion. The combined operations of the two companies will contribute slightly more than one-half of the urea ammonium nitrate solution (UAN) and 38% of the ammonia production capacity in the United States (Fertilizer Week, 2010a).

LSB Industries, Inc.'s, Pryor, OK, facility began limited production in the first quarter of 2010 but did not reach sustained anhydrous ammonia production until the fourth

quarter of 2010. The plant was shut down because of a fire in June. The Pryor facility was expected to produce approximately 295,000 metric tons per year (t/yr) of UAN and about 54,000 to 82,000 t/yr of excess anhydrous ammonia available to sell when fully operational (Green Markets, 2010e).

In September, Southeast Idaho Energy LLC received a second permit renewal to construct its proposed \$1.5 billion nitrogen facility near American Falls, ID. The nitrogen plant, using advanced clean-coal gasification technology, would produce 453 metric tons per day (t/d) of anhydrous ammonia, 1,630 t/d of granular urea, and 1,450 t/d of UAN. Construction of the plant was anticipated to begin in 2011 (Green Markets, 2010d).

Researchers at the University of Minnesota's Renewable Energy Center at Morris designed a \$3.75 million carbon-free system that uses power from a wind turbine to produce anhydrous ammonia. The test plant would produce fertilizer for use on university farmland. Production of anhydrous ammonia using wind power would not be able to compete in the current market; however, if prices for anhydrous ammonia doubled, this process may be economically viable (Green Markets, 2010c).

SynGest, Inc. received a \$2.5 million grant from the Iowa Power Fund to help build a planned \$130 million corn-based anhydrous ammonia plant near Menlo, IA. The plant was expected to use about 118,000 t/yr of corn cobs to produce 45,000 t/yr of ammonia. SynGest needed to raise another \$3.5 million for the construction engineering and design (SynGest, Inc., 2010).

Environment

Hypoxia has become a controversial environmental concern for the fertilizer industry and an issue that spawned significant research efforts to determine its cause. Hypoxia happens where water near the bottom of an affected area in a large body of water, such as the Gulf of Mexico, contains less than 2 parts per million of 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, the Black Sea, the East China Sea, the Gulf of Mexico, and the Kattegat (Diaz and Rosenberg, 2008).

U.S. Department of Agriculture (USDA) National Resources Conservation Sources (NRCS) launched the Mississippi River Basin Healthy Watersheds Initiative (MRBI) to address agriculture-related nitrogen, phosphorus, and sediment loading in the Mississippi-Atchafalaya River Basin. The request for proposals closed in May for \$50 million in financial assistance to projects in priority watersheds in Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin. The goal of the MRBI was to help farmers and landowners implement conservation practices that would avoid, control, and trap nutrient runoff. NRCS would provide producers with financial and technical assistance and a system of practices that would control soil erosion, improve soil quality, and provide wildlife habitat, while managing runoff and

drainage water for improved water quality (Mississippi River Gulf of Mexico Watershed Nutrient Task Force, 2011, p. 22).

The Missouri Department of Natural Resources Soil and Water Conservation coordinated development of the USDA's MRBI in the State of Missouri, which resulted in 12 projects being awarded more than \$6 million in 2010. Missouri's MRBI projects involve voluntary implementation of conservation practices to avoid, control, and trap nitrogen and phosphorus runoff, maintain agricultural productivity, adopt system approaches and management strategies to reduce nitrogen and phosphorus runoff, and establish small and large watershed monitoring to document reductions in nitrogen and phosphorus runoff (Mississippi River Gulf of Mexico Watershed Nutrient Task Force, 2011, p. 23).

Consumption

In 2010, apparent consumption of ammonia was 13.8 Mt of contained nitrogen, about 12% higher than that in 2009. 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 2010 crop year (ending June 30, 2010) is listed in table 5. Consumption in fertilizers was estimated to be 10.7 Mt of contained nitrogen, which was slightly higher than that of 2009. Anhydrous ammonia and nitrogen solutions, mostly UAN solutions containing 29.8% to 29.9% nitrogen, were the principal nitrogen fertilizer products, each representing 28% of fertilizer consumption. Urea (45.9% nitrogen) constituted 21% of fertilizer consumption during the 2010 crop year. Ammonium nitrate (33.9% nitrogen) and ammonium sulfate each constituted 2% of 2010 nitrogen fertilizer consumption. The leading nitrogen-consuming States in the 2010 crop year were California, Iowa, Illinois, Kansas, and Nebraska.

Stocks

Stocks of ammonia at yearend 2010 were 165,000 metric tons (t), a slight decrease from comparable stocks at yearend 2009, according to data published by the U.S. Census Bureau (table 6).

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 the Gulf Central ammonia pipeline. The 3,200-km ammonia pipeline originated in the Louisiana Delta area, 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 million metric tons per year (Mt/yr) of ammonia, with a storage capacity of more than 1 Mt. In 2010, about 1.4 Mt of ammonia was shipped through the Gulf Central ammonia pipeline (NuStar Energy L.P., 2011, p. 13).

Magellan Midstream Partners, L.P. owned a common carrier ammonia pipeline system. The 1,750-km pipeline system, which transported and distributed ammonia from production

facilities in Texas and Oklahoma to various distribution plants in the Midwest, had a delivery capacity of about 820,000 t/yr. In 2010, 419,000 t of ammonia was shipped through Magellan's pipeline compared with 583,000 t in 2009 (Magellan Midstream Partners, L.P., 2011, p. 35). 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

Midyear and yearend prices for nitrogen materials are listed in table 7. The average gulf coast ammonia price began 2010 at \$275 per short ton (\$303 per metric ton), and in March reached the high for the year of \$420 per short ton (\$463 per metric ton), where it remained until yearend, a 29% increase in price from the average high for 2009.

The average granular urea price fluctuated throughout 2010, beginning the year at \$316 per short ton (\$348 per metric ton). The average price reached a high of \$386 per short ton (\$425 per metric ton) in mid-November. At yearend, the average urea price was \$375 per short ton (\$413 per metric ton).

The average ammonium nitrate price, which began 2010 at \$273 per short ton (\$301 per metric ton), increased throughout the year. The average price rose to \$375 per short ton (\$413 per metric ton) by early December and then decreased slightly to \$368 per short ton (\$406 per metric ton) by yearend.

Typically, ammonium sulfate prices do not follow the same trend as other nitrogen products, which correlate to natural gas prices, mainly because a substantial portion of the material 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 began 2010 at about \$198 per short ton (\$218 per metric ton) and fluctuated, reaching a low of \$170 per short ton (\$187 per metric ton) in early July. By yearend, the price reached an average of \$280 per short ton (\$309 per metric ton).

In 2010, the annual average prices paid for fertilizers increased slightly. Fertilizer prices began to increase because the annual average cost of natural gas, the primary feedstock for nitrogen fertilizers, increased by 13% in 2010 compared with the annual average in 2009 (U.S. Department of Agriculture, Economic Research Service, 2011a).

Foreign Trade

Ammonia exports were 115% higher than those in 2009 (table 8). Canada and Chile were the leading destinations for U.S. exports of ammonia; together accounting for 85% of the total.

Ammonia imports were about 23% higher than those in 2009 and dwarfed the quantity of exports. The average value of ammonia imports increased to \$392 per metric ton from \$285 per metric ton in 2009 (table 9). Trinidad and Tobago (66%) continued to be the leading import source. Canada (15%) and Ukraine (7%) were the remaining significant import sources.

Tables 10 and 11 list trade data for other nitrogen materials and include information on principal destination or source countries. Exports of nitrogen materials decreased in 2010,

with the exception of anhydrous ammonia and MAP. Import quantities of nitrogen materials were higher than imports in 2009 for most nitrogen compounds. The exceptions were calcium nitrate, potassium nitrate and sodium nitrate mixtures, and sodium nitrate.

World Review

Anhydrous ammonia and other nitrogen materials were produced in more than 70 countries. Global ammonia production in 2010, estimated to be 131 Mt, was about 3% higher than that of 2009 (table 12). China, with 31% of total production, was the leading world producer of ammonia. Asia contributed 48% of total world ammonia production, and the Commonwealth of Independent States (CIS), Estonia, and Lithuania produced 13% of the global total. North America represented 10% of the total; Middle East, 8%; Western Europe, 7%; Central America and South America together, 6%; and Africa, Eastern Europe, and Oceania together contributed the remaining 8%.

In 2010, world ammonia exports, estimated to be 14.8 Mt of contained nitrogen, were higher than those in 2009. Canada, Indonesia, Russia, Saudi Arabia, Trinidad and Tobago, and Ukraine accounted for about 66% of the world export total. North America (primarily the United States) imported 39% of global ammonia import trade, followed by Asia (36%) and Western Europe (10%) (International Fertilizer Industry Association, 2011).

Argentina.—Tierra Del Fuego Power & Chemical Co., Ltd. (a joint venture between Jindulicheng Molybdenum Group, Co., Ltd., Shaanxi Coal and Chemical Industry Group, Co., Ltd., and Shaanxi Xinyida Investment Ltd.) contracted with KBR Inc. to develop a greenfield ammonia plant in Tierra Del Fuego, at the southern tip of the country. The ammonia plant was projected to produce 495,000 t/yr and was expected to be completed in 2013 (Nitrogen + Syngas, 2010a).

Australia.—Orica Ltd. planned an ammonia plant expansion and new ammonium nitrate plant at Kooragang Island. The expansion would add about 65,000 t/yr of ammonia and 320,000 t/yr of ammonium nitrate, costing AUD110 million and AUD600 to AUD750 million, respectively. The ammonium nitrate plant was expected to be completed by 2014 or 2015 (Nitrogen + Syngas, 2010c).

Perdaman Chemicals and Fertilisers Pty. Ltd. secured Federal environmental approval to allow construction of a \$3.3 billion urea manufacturing facility in Collie, about 200 km south of Perth, Western Australia. The plant would be the first to use gasification technologies to produce 1.6 Mt/yr of ammonia and 2 Mt/yr of urea from subbituminous coal. Construction was expected to begin in 2012 with completion by 2014. Output would be aimed for Asia, North America, and South America (Nitrogen + Syngas, 2010b).

Bangladesh.—Bangladesh's cabinet approved construction of a 578,000-t/yr urea plant at Fenchuganj, 280 km northeast of Dhaka. The China National Complete Plant Import and Export Corp. Ltd. was awarded the contract to construct the plant. No timetable for construction was announced (Nitrogen + Syngas, 2010d).

Brazil.—Petróleo Brasileiro S.A. (Petrobras) planned to develop a 760,000-t/yr ammonia and a 1.2-Mt/yr urea plant at

Tres Lagoas in Mato Grosso do Sul State. Petrobras awarded a contract to KBR to provide licensing, basic and extended engineering, and technical consulting services to develop the ammonia plant (Fertilizer Week, 2010e, f). Petrobras also awarded Stamicarbon B.V. (a subsidiary of Marie Tecnimont S.p.A.) a contract to provide the license, process design, and related services for the urea plant. The new plant would be the second Stamicarbon urea plant in Brazil. Natural gas for the plant would come from Bolivia through the Brazil-Bolivia gas pipeline. The plant was expected to be completed by 2014 (Nitrogen + Syngas, 2010e).

China.—Huaqiang Chemical Group Co. planned to invest \$585 million to build five new projects in Dangyang County, Hubei Province, including a 400,000-t/yr ammonia unit and a 600,000-t/yr urea unit. No timetable for construction was announced (Fertilizer Week, 2010d).

Sinochem Group reached an agreement with the provincial government of Ningxia Province to build a nitrogen fertilizer production complex. Sinochem would invest \$2.34 billion in the complex, which would include 2.0 Mt/yr of ammonia production capacity and 3.2 Mt/yr of urea production capacity. The complex would be based on coal gasification. No timetable for construction was announced (Nitrogen + Syngas, 2010g).

China XLX Fertiliser Ltd. announced plans to spend \$450 million to build a fourth urea plant close to its existing plants at Xinxiang City in Henan Province. The new plant was expected to have a production capacity of 800,000 t/yr of urea and was scheduled for completion in 2013 (Nitrogen + Syngas, 2010f).

Stamicarbon announced that it signed a license agreement with Mongolia Bodashidi Co., Ltd. for a 945,000-t/yr urea plant. The plant would be built in the Industrial Zone of Nalinriver, Wushe, Inner Mongolia. The plant was expected to be completed by 2013 (Nitrogen + Syngas, 2011a).

In December, the Chinese Government released its 2011 tariff rates for many products, including urea, to discourage exports during periods of high domestic demand. The surcharge for urea would be 110% during the high seasons, which were from January through June and November through December (Fertilizer Week, 2010b).

Cuba.—CuVenPeq S.A. established a joint venture with the Cuban Government and Venezuela's Pequiven S.A. to build a 726,000-t/yr granulated urea plant at Calicito, Cienfuegos. Toyo Engineering Corp. was awarded the contract for license and development of the basic design of the urea facility, with Haldor Topsoe A/S technology slated for the associated 610,000-t/yr ammonia plant. Production was scheduled to begin in 2014 (Nitrogen + Syngas, 2010h).

Egypt.—El-Delta Co. for Fertilizers and Chemical Industries issued an invitation to bid for the engineering, procurement, and construction contract for its new 1,200-t/d ammonia plant at its Talkha fertilizer complex in Dakahliyy. The plant was expected to take 36 months to complete at a cost of \$300 million (Fertilizer Week, 2010c).

Gabon.—Olam International Ltd. formed a joint venture with the Government of Gabon to build an ammonia-urea complex with a total investment of \$1.3 billion. The plant capacity was expected to be 736,000 t/yr of ammonia and 1.27 million t/yr

of urea, with completion expected by 2015 (Nitrogen + Syngas, 2011b).

India.—Zuari Industries Ltd. signed a natural gas agreement with the Gas Association of India Ltd. for its ammonia-urea unit in Gao. The 413,000-t/yr plant was to be converted from naphtha feedstock to natural gas beginning in January 2013 (Nitrogen + Syngas, 2010j).

India's National Fertilizers Ltd. awarded \$465 million to Larsen & Tourbro Ltd. to convert two ammonia plants from heavy fuel feedstock to run on natural gas. The plants, at Panipat in Haryana State and at Bathinda in Punjab State, each with an ammonia production capacity of 300,000 t/yr, were expected to be operational by January 2013 (Nitrogen + Syngas, 2010i).

The Bengal government allotted land to Matrix Fertilisers & Chemicals Ltd. to establish a natural gas-based urea plant. The first phase would consist of a 2,200-t/d ammonia plant and a 3,850-t/d (1.3 Mt/yr) urea plant, which was expected to be completed by 2012. The second phase would increase the urea capacity to 3.0 Mt/yr. KBR was awarded the contract to provide licensing and engineering services for the plant, which would use coal-bed methane as feedstock for ammonia synthesis. The Matrix plant would market its urea in east India (Green Markets, 2010a; Telegraph, The, 2010).

Russia.—JSC Salavatnefteorgsynthes was converting its urea plant at Slavat in western Russia to produce granular urea. The 460,000-t/yr granulation unit was expected to handle output from two urea trains with production capacities of 260,000 t/yr and 370,000 t/yr. Toyo Engineering would provide the granulation technology license and basic design work. The cost of the conversion was estimated to be \$38 million, and conversion was scheduled to begin in 2011 (Nitrogen + Syngas, 2010k).

JSC Ammonia awarded China National Chemical Engineering Corp. and Japan's Mitsubishi Heavy Industries Inc., Ltd. and Sojitz Corp. a \$1 billion contract to build a large-scale urea, ammonia, and methanol plant in the Russian Republic of Tatarstan at Mendeleevsk about 1,000 km east of Moscow. Production capacities were expected to be about 676,500 t/yr of ammonia or 460,000 t/yr of ammonia and 220,000 t/yr of methanol in the case of coproduction. Technology would be supplied by Haldor Topsoe, Saipem S.p.A., and Uhde GmbH Fertilizer Technology. The plant was expected to begin production in 2015 (Nitrogen + Syngas, 2011c).

Turkmenistan.—Kawasaki Plant Systems Ltd. entered into an agreement with M.W. Kellogg Ltd., a unit of KBR, to provide licensing and basic engineering design for the Mary Project's 400,000-t/yr ammonia and 635,000-t/yr urea plants. The plants were scheduled to be completed by 2013 (Green Markets, 2010b; Nitrogen + Syngas, 2010l).

Uzbekistan.—JSC NIIK was awarded a contract to modernize and reequip KSC Maxam-Chirchiq's urea plant at Chirchiq in Uzbekistan. The project was expected to expand the urea production capacity to 270,000 t/yr. Completion of the project was scheduled for December 2011 (Nitrogen + Syngas, 2010m).

Vietnam.—Ha Bac Nitrogen Fertilizers and Chemicals Co. planned to upgrade and expand its HA Bac Nitrogen Fertilizers' plant. The project would raise the production capacity of the coal gasification-based plant from 180,000 t/yr to 500,000 t/yr

of urea. The urea would be used for the Vietnamese domestic market. The expansion was expected to take 42 months at a cost of \$373 million (Nitrogen + Syngas, 2010n).

Zimbabwe.—TA Holdings Ltd. planned to spend \$40 million during a 4-year period to refurbish Sable Chemicals Industries Ltd.'s ammonia plant that was closed in 2009. Sable originally had planned to import ammonia from South Africa for its nitrogen fertilizer plant in Kwekwe but this option was deemed unreliable owing to supply inconsistencies related to logistic problems and the amount of ammonia required (Herald, The, 2010).

Outlook

According to the USDA, U.S. corn growers intended to plant 37.3 million hectares (Mha) of corn for all purposes in the 2011 crop year, an increase of 5% from that in 2010 and an increase of 7% from that in 2009 (U.S. Department of Agriculture, National Agricultural Statistical Service, 2011, p. 1). Expectations of corn acreage utilization increased in many States because of higher selling prices and expectations of better net returns from corn compared to other commodities.

According to long-term projections from the USDA, projected plantings for the eight major field crops (barley, corn, oats, rice, sorghum, soybeans, upland cotton, and wheat) in the United States were expected to increase to 101 Mha during the projection period (2011–20) from about 99 Mha in 2010. Increased cropland availability (resulting from the reduction in the allowable acreage enrolled in the Conservation Reserve Program), demand, and sustained high commodity prices were expected to keep projected U.S. cropland use high. Corn, soybeans, and wheat were expected to account for about 89% of acreage utilization for the eight major field crops during the projection period. During the 10-year period, the crop mix was expected to keep corn acreage high. Soybean planting likely would rise during the projection period as growth in domestic and foreign demand keeps prices high and returns favorable for producers. Wheat plantings probably would decline as a result of weak demand and significant quantities of stocks. Continued high levels of domestic corn-based ethanol and gains in exports were projected to keep corn demand high. Most U.S. ethanol production used corn as a feedstock, with nearly one-third of total corn use expected to go to ethanol production through 2020. Projected gains were largely in line with moderate expected increases in overall gasoline usage in the United States, which represent more than 10% of the annual gasoline consumption. Relatively high prices for crude oil would be favorable for ethanol production, which, when combined with Government programs, would provide economic incentives for ethanol producers.

Feed and residual use of corn is projected to bottom out in the initial years of the period owing to reduced meat production and increased feeding of distillers grains (a coproduct of dry mill ethanol production). Feed use is expected to rise through the rest of the period, as meat production increases and growth in the availability of distillers grains slows with the decrease in corn-based ethanol expansion. Increases in food and industrial uses of corn (other than for ethanol production) are projected to rise during the next decade. Consumer dietary concerns and

other changes in tastes and preferences limit increases in the combined use of corn for dextrose, glucose, and high-fructose corn syrup to about one-half the rate of population gain. Other food uses of corn also are projected to rise more slowly than the increase in population. U.S. corn exports rise in response to stronger global demand for feed grains to support growth in meat production; the U.S. share of global corn trade remains above 50%. Larger corn plantings increase the demand for nitrogen fertilizers (U.S. Department of Agriculture, Economic Research Service, 2011b, p. 60–61).

In 2010, natural gas prices increased 13% after the low prices of 2009, which was a 7-year low resulting from a weakened economy, a reduced heating demand, as well as higher than usual production and storage levels. Natural gas prices in the United States typically are higher than those in the rest of the world, but lower natural gas prices make U.S. ammonia production more competitive with offshore imports. Depending on its price, natural gas can account for approximately 75% to 90% of the U.S. cash cost of producing ammonia, and this means that the ammonia capacity at older, higher cost U.S. plants is still at risk for closure. The Middle East, North Africa, Russia, Trinidad and Tobago, and Venezuela have ample supplies of lower-cost natural gas, which is a cost advantage to producing and exporting ammonia. U.S. ammonia production was comparatively high, primarily owing to shale gas developments that have increased domestic supply (Potash Corp. of Saskatchewan, 2011, p. 35). The U.S. Department of Energy projected that the Henry Hub natural gas spot price in the United States would average \$4.26 million British thermal units (Btus) in 2011, an \$0.11 decrease from the 2010 average, and \$4.54 per million Btus in 2012 (U.S. Department of Energy, Energy Information Administration, 2011, p. 6).

In the winter of 2001, natural gas prices began to spike and continued to increase through the third quarter of 2008, and as a result, U.S. ammonia production capacity declined by 4.1 Mt/yr, or 24% of the 2001 capacity. In 2010, natural gas prices increased by about 10% from those of 2009, which were still relatively low owing to weak industrial demand and competition from shale gas. Still relatively low compared with the 2008 prices, natural gas prices in 2010 made domestic nitrogen production more competitive with imports from major nitrogen-exporting regions. The future of U.S. ammonia production depends on the variability in natural gas prices. The interest that U.S. firms have in constructing new plants outside the United States, particularly in Trinidad and Tobago where natural gas prices are lower, indicates that in the future, much of the U.S. supply of ammonia is expected to be met by foreign production.

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TABLE 1
SALIENT AMMONIA STATISTICS^{1,2}

(Thousand metric tons of contained nitrogen unless otherwise specified)

	2006	2007	2008	2009	2010
United States:					
Production	8,190	8,540	7,870	7,700	8,290 ^p
Exports	193	145	192	16	35
Imports for consumption	5,920	6,530	6,020	4,530	5,540
Consumption, apparent ³	14,000	15,000	13,500 ^r	12,300	13,800 ^p
Stocks, December 31, producers	201	157	302	167	165
Average annual price, free on board gulf coast ⁴ dollars per short ton	302	307	590	251	396
Net import reliance as a percentage of apparent consumption ⁵	41	43	41	38	40 ^p
Natural gas price, wellhead, average price ⁶ dollars per thousand cubic feet	6.39	6.25	7.97 ^r	3.67 ^r	4.16 ^e
World:					
Production ^e	125,000 ^r	131,000	130,000	127,000 ^r	131,000
Trade ⁷	15,900	15,800	15,500 ^r	14,400 ^r	14,800 ^e

^eEstimated. ^pPreliminary. ^rRevised.

¹Data are rounded to no more than three significant digits.

²Synthetic anhydrous ammonia, excluding coke oven byproduct; data are for calendar year and are from the U.S. Census Bureau unless otherwise noted.

³Calculated from production plus imports minus exports and industry stock changes.

⁴Source: Green Markets.

⁵Defined as imports minus exports; adjusted for industry stock changes.

⁶Source: Monthly Energy Review, U.S. Department of Energy.

⁷Source: 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)

	2008	2009	2010 ^P
Production:			
Fertilizer:			
January–June	3,520	3,040	3,550
July–December	3,210	3,430	3,580
Total	6,730	6,470	7,130
Nonfertilizer:			
January–June	542	603	577
July–December	594	632	585
Total	1,140	1,240	1,160
Grand total	7,870	7,700	8,290
Exports:			
January–June	53	9	28
July–December	139	7	7
Total	192	16	35
Imports for consumption:			
January–June	3,290	2,180	2,630
July–December	2,720	2,340	2,910
Total	6,020	4,530	5,540
Stocks, end of period:			
January–June	193	201	149
July–December	302	167	165
Apparent consumption: ²			
January–June	7,260 ^r	5,920 ^r	6,750
July–December	6,280 ^r	6,430 ^r	7,050
Total	13,500 ^r	12,300	13,800

^PPreliminary. ^rRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Calculated from production plus imports minus exports and industry stock changes.

Source: U.S. Census Bureau.

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

(Thousand metric tons)

	2009						2010 ^P					
	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	2,490	1,140	2,600	1,190	5,080	2,330	2,680	1,230	2,450	1,120	5,120	2,350
Ammonium nitrate	2,920	991	3,380	1,140	6,300	2,140	3,410	1,160	3,380	1,150	6,790	2,300
Ammonium phosphates ³	5,090	815	6,310	1,010	11,400	1,820	5,790	904	6,340	987	12,100	1,890
Nitric acid	2,560	562	3,370	741	5,930	1,300	3,490	767	3,450	758	6,930	1,530
Ammonium sulfate ⁴	1,160	246	1,110	235	2,270	481	1,300	274	1,190	253	2,490	527

^PPreliminary.

¹Data 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: U.S. Census Bureau, Current Industrial Reports MQ325B.

TABLE 4
DOMESTIC PRODUCERS OF ANHYDROUS AMMONIA IN 2010¹

(Thousand metric tons per year of ammonia)

Company	Location	Capacity ²
Agrium Inc.	Borger, TX	490
Do.	Kennewick, WA ³	180
CF Industries Holdings, Inc.	Donaldsonville, LA	2,490
Do.	Port Neal, IA	336
Do.	Verdigris, OK	953
Do.	Woodward, OK	399
Do.	Yazoo City, MS	454
Coffeyville Resources Nitrogen Fertilizers, LLC	Coffeyville, KS	375
Dakota Gasification Co.	Beulah, ND	363
Dyno Nobel Inc.	Cheyenne, WY	174
Do.	St. Helens, OR	101
Eastman Chemical Co.	Beaumont, TX ³	231
Green Valley Chemical Corp.	Creston, IA	32
Honeywell International Inc.	Hopewell, VA	530
Koch Nitrogen Co.	Beatrice, NE	265
Do.	Dodge City, KS	280
Do.	Enid, OK	930
Do.	Fort Dodge, IA	350
Do.	Sterlington, LA ³	1,110
LSB Industries, Inc.	Cherokee, AL	159
Do.	Pryor, OK ³	210
Mosaic Co., The	Faustina (Donaldsonville), LA	508
PCS Nitrogen, Inc.	Augusta, GA	688
Do.	Geismar, LA ³	483
Do.	Lima, OH	542
Do.	Memphis, TN ³	372
Rentech Energy Midwest Corp.	East Dubuque, IL	278
Total		13,300

Do. Ditto.

¹Data 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.

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

(Thousand metric tons of nitrogen)

Fertilizer material ³	2009 ^f	2010 ^e
Single-nutrient:		
Anhydrous ammonia	2,980	3,040
Nitrogen solutions ⁴	2,910	2,970
Urea	2,180	2,220
Ammonium nitrate	233	238
Ammonium sulfate	229	234
Aqua ammonia	83	85
Other ⁵	375	383
Total	8,990	9,170
Multiple-nutrient ⁶	1,530	1,560
Grand total	10,500	10,700

^eEstimated. ^fRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Fertilizer years ending June 30.

³Ranked in relative order of importance by product type.

⁴Principally urea-ammonium nitrate solutions, 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: Slater, J.V., and Kirby, B.J., 2011, Commercial Fertilizers 2009: Columbia, MO, Association of American Plant Food Control Officials Inc. Fertilizer/Ag Lime Control Service, University of Missouri, 42 p.

TABLE 6
U.S. PRODUCER STOCKS OF FIXED NITROGEN
COMPOUNDS AT END OF PERIOD

(Thousand metric tons of contained nitrogen)

Material ¹	2009	2010 ^P
Ammonia:		
January–June	201	149
July–December	167	165
Nitrogen solutions:²		
January–June	153	93
July–December	95	111
Urea:		
January–June	W	37
July–December	W	W
Ammonium phosphates:³		
January–June	17 ⁴	53
July–December	44	W
Ammonium nitrate:		
January–June	48	24
July–December	32	36
Ammonium sulfate:		
January–June	20	44
July–December	26	16
Yearend total ⁵	364	328

^PPreliminary. W Withheld to avoid disclosing company proprietary data.

¹Ranked in relative order of importance.

²Urea-ammonium nitrate and ammoniacal solutions.

³Diammonium and monoammonium phosphates.

⁴Diammonium phosphates data withheld.

⁵Calendar year ending December 31.

Source: U.S. Census Bureau, Current Industrial Reports MQ325B.

TABLE 7
PRICE QUOTATIONS FOR MAJOR NITROGEN COMPOUNDS AT END OF PERIOD

(Dollars per short ton)

Compound	2009		2010	
	June	December	June	December
Ammonium nitrate, free on board (f.o.b.) corn belt ¹	265–270	265–270	305–325	350–383
Ammonium sulfate, f.o.b. corn belt ¹	225–245	185–210	230–250	270–290
Anhydrous ammonia:				
F.o.b. corn belt ¹	300–345	340–390	380–455	640–685
F.o.b. gulf coast ²	255	275	420	420
Diammonium phosphate, f.o.b. central Florida	250–255	320	395–400	540–550
Urea:				
F.o.b. corn belt, ¹ prilled and granular	270–285	350–360	280–310	415–440
F.o.b. gulf coast, granular ²	240–245	307–315	240–253	370–380

¹Illinois, Indiana, Iowa, Missouri, Nebraska, and Ohio.

²Barge, New Orleans, LA.

Source: Green Markets.

TABLE 8
U.S. EXPORTS OF ANHYDROUS AMMONIA, BY COUNTRY¹

(Thousand metric tons of ammonia and thousand dollars)

Country	2009		2010	
	Gross weight	Value ²	Gross weight	Value ²
Belgium	1	526	2	565
Canada	15	7,190	15	7,510
Chile	--	--	21	7,910
Haiti	1	207	1	274
Israel	1	288	1	404
Other	2	861	3	1,450
Total	20	9,070	43	18,100

-- Zero.

¹Data 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 9
U.S. IMPORTS OF ANHYDROUS AMMONIA, BY COUNTRY¹

(Thousand metric tons of ammonia and thousand dollars)

Country	2009		2010	
	Gross weight	Value ²	Gross weight	Value ²
Australia	80	22,200	--	--
Canada	822	357,000	1,010	451,000
Egypt	96	29,400	90	40,100
Latvia	--	--	76	33,600
Russia	438	133,000	281	105,000
Trinidad and Tobago	3,720	936,000	4,450	1,670,000
Ukraine	67	20,400	479	196,000
Venezuela	158	36,900	88	32,300
Other	126	36,000	265	111,000
Total	5,510	1,570,000	6,740	2,640,000

-- Zero.

¹Data 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	2009		2010		Principal destinations in 2010
	Gross weight	Nitrogen content	Gross weight	Nitrogen content	
Ammonium nitrate ²	364	123	355	120	Canada, 49%; Mexico, 30%; France, 10%; Australia, 10%.
Ammonium sulfate ²	963	204	938	199	Brazil, 44%; Dominican Republic, 10%; Peru 13%.
Anhydrous ammonia	20	16	43	35	Canada, 47%; Chile, 35%.
Diammonium phosphate	5,530	996	4,090	736	India, 62%; Mexico, 5%.
Monoammonium phosphate	2,110	232	2,330	256	Canada, 28%; Brazil, 25%; Australia, 14%; Argentina, 11%.
Urea	289	133	152	70	Canada, 45%; Mexico, 19%; Chile, 16%; Columbia, 12%.
Total	9,280	1,700	7,910	1,420	

¹Data 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	2009			2010			Principal sources in 2010
	Gross weight	Nitrogen content	Value ²	Gross weight	Nitrogen content	Value ²	
Ammonium nitrate ³	451	153	98,900	576	195	151,000	Canada, 61%; Georgia, 14%; Netherlands, 12%.
Ammonium nitrate and limestone mixtures	51	14	11,100	103	28	26,200	Ukraine, 40%; Austria, 27%; Netherlands, 24%.
Ammonium sulfate ³	324	69	67,300	357	76	66,100	Canada, 99%.
Anhydrous ammonia ⁴	5,510	4,530	1,570,000	6,740	5,540	2,640,000	Trinidad and Tobago, 66%; Canada, 15%.
Calcium nitrate	123	21	14,600	34	6	4,530	Norway, 82%.
Diammonium phosphate	22	4	9,710	190	34	101,000	Morocco, 41%; Russia, 37%; Lithuania, 12%.
Monoammonium phosphate	57	6	34,500	263	29	146,000	Russia, 38%; Canada, 30%; Morocco, 13%; China, 10%.
Nitrogen solutions	1,170	349	257,000	2,210	660	504,000	Russia, 20%; Trinidad and Tobago, 18%; Canada, 10%.
Potassium nitrate	74	10	48,500	77	11	45,700	Chile, 84%.
Potassium nitrate and sodium nitrate mixtures	1	(5)	(5)	(5)	(5)	250	Canada, 94%.
Sodium nitrate	84	14	20,600	73	12	22,800	Chile, 87%; Germany, 10%.
Urea	4,730	2,170	1,440,000	6,630	3,040	2,220,000	Canada, 26%; China, 11%.
Total	12,600	7,330	3,570,000	17,300	9,640	5,930,000	

¹Data 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: ESTIMATED WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons, contained nitrogen)

Country	2006	2007	2008	2009	2010
Afghanistan	20	20	20	20	20
Albania	10	10	10	10	10
Algeria	470	524	500	614	822
Argentina	727 ³	726	726	570 ^r	600
Australia	1,200	1,200	1,200	1,200	1,200
Austria	400 ^r	400 ^r	400 ^r	300 ^r	350
Bahrain	370 ³	344 ³	350	350	350
Bangladesh ⁴	1,250	1,300	1,300	1,300	1,300
Belarus	815	830	805 ³	750	800
Belgium	850	850	850	850	850
Bosnia and Herzegovina	1	1	1	1	1
Brazil	950	950	950	950	950
Bulgaria	309	310	310	310	310
Burma	30	30	30	30	30
Canada	4,100	4,498 ³	4,781 ³	4,000	4,000
China ³	40,660	42,480	41,140	42,290	40,870
Croatia	319 ³	320	320	320	300
Cuba	42 ³	47 ³	42	27 ^r	27
Czech Republic	250	225	200	200	200
Denmark	2	2	2	2	2
Egypt	1,800	1,750	1,750	2,000	3,000
Estonia	170	170	170	170	170
Finland	62	62	62	62	60
France	616 ³	800	800	800	800
Georgia	140	150	150	150	150
Germany ³	2,718	2,746	2,819	2,363	2,677
Greece	130	130	130	125	120
Hungary	275	300	300	300	300
India ⁵	10,900	11,000	11,100	11,200	11,500
Indonesia	4,300	4,400	4,500	4,600	4,800
Iran	1,020	2,000	2,000	2,000	2,500
Iraq	10	10	10	10	550
Italy	480 ³	460	460	460	460
Japan ³	1,091	1,114	1,244 ^r	1,021 ^r	1,000
Korea, North	100	100	100	100	100
Korea, Republic of	90	--	--	--	--
Kuwait	495	485	485	470 ^r	480
Libya ³	518	523	417	488 ^r	580
Lithuania	453 ³	936 ³	950	950	950
Malaysia	950	960	950	950	950
Mexico ³	487	714 ^r	826 ^r	895 ^r	826
Netherlands	1,800	1,800	1,800	1,800	1,800
New Zealand	120	125	125	125	125
Norway	350	350	350	350	350
Oman	1,000	1,000	1,000	1,000	1,000
Pakistan	2,200	2,250	2,300	2,300	2,400
Peru	5	5	5	5	5
Poland ³	2,007	1,995	1,995	1,697 ^r	1,800
Portugal	244	244	244	244	244
Qatar	1,500 ^r	1,500 ^r	1,600 ^r	1,700 ^r	1,700
Romania	1,300	1,300	1,300	1,100 ^r	1,100

See footnotes at end of table.

TABLE 12—Continued
 AMMONIA: ESTIMATED WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons, contained nitrogen)

Country	2006	2007	2008	2009	2010
Russia	10,500 ³	10,500	10,425 ³	10,441 ³	10,400
Saudi Arabia	2,000	2,600	2,600	2,600	2,600
Serbia	80	85	47 ^r	53 ^r	55
Slovakia	241 ³	260	260	260	260
South Africa	480	480	480	430	450
Spain	400	400	400	400	400
Switzerland	32	32	32	32	32
Syria	120	120	120	210	260
Taiwan	12	12	12	12	12
Tajikistan	35	25	25	20	20
Trinidad and Tobago	5,111 ³	5,129 ³	5,130	4,946 ^{r,3}	5,000
Turkey	92 ³	-- ³	50	100	100
Turkmenistan	250	270	270	270	270
Ukraine	4,200	4,200	4,000 ^r	2,500 ^r	3,400
United Arab Emirates	380	380	380	380	400
United Kingdom	750	1,050	1,100	1,100	1,100
United States ^{3,6}	8,190	8,540	7,870	7,700	8,290 ^p
Uzbekistan	940	1,000	1,000	1,000	1,000
Venezuela	1,160	1,160	1,160	1,160	1,160
Vietnam	230	300	300	300	300
Zimbabwe	10	35	25	25 ^r	25
Total	125,000 ^r	131,000	130,000	127,000 ^r	131,000

^pPreliminary. ^rRevised. -- Zero.

¹World totals, U.S. data, and estimated data have been rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through June 24, 2011.

³Reported figure.

⁴May include nitrogen content of urea.

⁵Data are for years beginning April 1 of that stated.

⁶Synthetic anhydrous ammonia; excludes coke oven byproduct ammonia.