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The Impact of EU Anti-dumping Duties on Urea Ammonium Nitrate Solution

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Abstract

The European Union (EU) promulgated final anti-dumping duties on urea ammonium nitrate solution (UAN) from Russia, Trinidad and Tobago, and the United States on October 8, 2019, following a preliminary determination that spring. Although only in force for a short time, there are notable shifts in EU imports of UAN throughout 2019 and into 2020. Imports from both the United States and Russia have dropped precipitously, while those from Trinidad and Tobago have actually increased since the imposition of the additional duties. This working paper explores those changes in the context of overall nitrogen fertilizer trade and production. Potential future directions for the commodity in the EU are also explored in terms of a shifting global value chain and changes in domestic manufacturing.

U.S. international Trade Commission

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Introduction

Urea ammonium nitrate solution (UAN) has become an important product for the U.S. fertilizer industry. Multiple domestic producers manufacture UAN on the million ton per year scale. While there is substantial demand by domestic farmers, exports encompass a substantial portion of U.S. production. Total U.S. exports have continually increased year-over-year as global demand has risen, growing from a value of $11 million in 2008 to $202 million in 2018.[1] These exports serve a variety of markets, primarily in North and South America and Europe. However, U.S. exports decreased by over a third in 2019 compared to 2018.

One market in particular accounted for the substantial drop in UAN exports from the United States—the European Union (EU). Previously, the EU accounted for over half of total U.S. exports, with a 2018 value of $118 million. But that has fallen by 75 percent in 2019 to only $30 million. This substantial shift reverses a decade-long trend where an ascendant U.S. industry has expanded its market share based on the ready availability of natural resources and production capacity. The downturn does not correlate with shifting demand in the EU agricultural sector, but instead the timeline of an investigation and the imposition of anti-dumping duties by EU authorities on imported UAN, including from the United States.

Summary of European Union Anti-dumping Investigation

Proceedings on UAN solution imported into the EU began in the second half of 2018.[2] Fertilizers Europe (a trade association) filed a complaint against the United States, Russia, and Trinidad and Tobago in June on behalf of EU producers composing a majority of domestic manufacturing.[3] The complaint stated that imports were increasing and cutting into the market share of domestic producers. It also alleged that these imports were being dumped at unfair prices by the exporting firms, leading to lower prices for EU manufacturers, thus distorting the market. In the case of Russia, the complainants alleged additional distortions on the cost of natural gas used to manufacture the UAN. The European Commission (EC) announced their receipt of this complaint and the initiation of an investigation in August 2018, specifically covering the period of January 2017 to June 2018.

A preliminary determination was released by the EC in March 2019.[4] This release stated several facts of the case as determined by the EC for the period under investigation. They compared the imports during the September to December timeframes for both 2017 and 2018, finding thirty-four percent greater

[1] USITC DataWeb for HTS subheading 3102.80 (accessed August 19, 2020).
[2] European Commission, "Notice of Initiation of an Anti-dumping Proceeding Concerning Imports of Mixtures of Urea and Ammonium Nitrate Originating in Russia, Trinidad and Tobago and the United States of America," August 13, 2018.
[3] Two European Union manufacturers accounting for circa thirty percent of production were noted by the European Commission as opposing this investigation.
[4] European Commission, "Commission Implementing Regulation (EU) 2019/455 of 20 March 2019 Making Imports of Mixtures of Urea and Ammonium Nitrate Originating in Russia, Trinidad and Tobago and the United States of America Subject to Registration," March 21, 2019.

volume in 2018.[5] The EC calculated that about ten percent of UAN consumption in the EU was from imports. All three subject countries were calculated as having substantial dumping and injury margins on their exports to the EU. The EC determined that there was sufficient evidence of dumped goods, necessitating local customs authorities begin to register subject imports.

Table 1 EU duty rates on imported UAN

Country	Normal duty rate (%)	Anti-dumping rate (€/t)
United States	6.5	29.48
Russia†		42.47
Trinidad and Tobago		22.24

Note: The final rate for imports from the subject countries is the relevant anti-dumping rate added to the normal duty rate. † Except for Joint Stock Companies Azot and Nevinnomyssky Azot, which are assessed €27.77/t.

The investigation concluded in October 2019 with an affirmative decision.[6] The EC instituted anti-dumping duty rates on imports from all three subject countries (Table 1). In addition, the implementing regulation made several other determinations on the state of the European UAN market. The allegation of a distorted natural gas market in Russia was confirmed and factored into the anti-dumping rate. It estimated the total capacity utilization rate within the EU was circa 46 percent, implying that decreased imports would not substantially harm EU consumers. Even so, alternative import sources that could make up for any shortfalls were hypothesized as including Algeria and Belarus. The ability of third countries to make-up a shortfall in subject imports will depend on their access to the necessary raw materials and capital for producing this fertilizer.

Urea Ammonium Nitrate Solution Properties and Manufacturing

UAN is a liquid nitrogen fertilizer composed of the two independent fertilizers urea and ammonium nitrate.[7] UAN is a relatively new fertilizer, only coming into widespread usage over the past two decades.[8] It is favorable for some users because of its nitrogen content, ranging from 28 to 32 percent, and for its ease of handling. While less nitrogen dense than ammonia, another liquid fertilizer, it is substantially less volatile;[9] it can be easily sprayed onto crops or included in irrigation water instead of

[5] The total quantity of imports was reported as increasing from 578 to 772 kilotons (kt) in that period of which: Russia increased from 226 to 270 kt, Trinidad and Tobago increased from 150 to 168 kt, and the United States increased from 201 to 333 kt.

[6] European Commission, "Commission Implementing Regulation (EU) 2019/1688 of 8 October 2019 Imposing a Definitive Anti-dumping Duty and Definitively Collecting the Provisional Duty Imposed on Imports of Mixtures of Urea and Ammonium Nitrate Originating in Russia, Trinidad and Tobago and the United States of America," October 9, 2019.

[7] Because it is a liquid preparation, it is marketed as being more easily mixed with other plant nutrients than solid nitrogen fertilizers. Mosaic, "Urea Ammonium Nitrate" (accessed June 18, 2020); CF Industries, "Urea Ammonium Nitrate (UAN)" (accessed June 9, 2020).

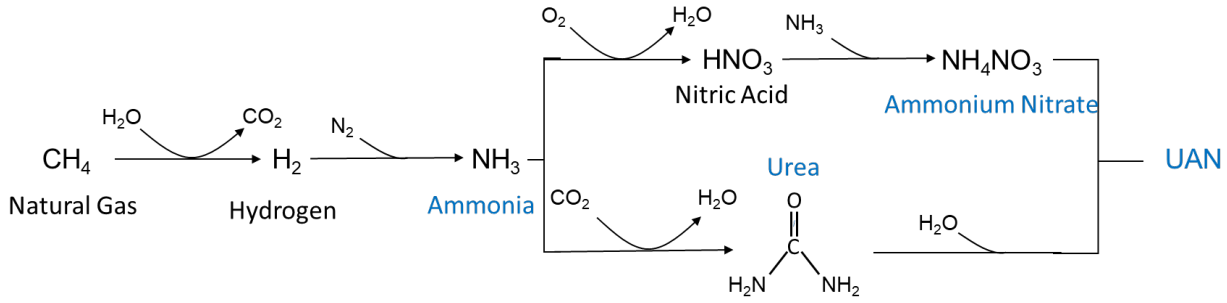
[8] Some of this shift correlates with the decreased demand for solid ammonium nitrate in the United States and elsewhere following terrorist attacks that utilized it in explosive materials. However, UAN has been identified as a potential precursor for explosive production as well. The National Academies of Sciences, Engineering, and Medicine, "Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Explosive Precursor Chemicals," 2018, 4.

[9] Ammonia is a gas at room temperature and injected in a liquified state about twenty centimeters below ground. Successful Farming Staff, "How to Apply Springtime Anhydrous Ammonia," March 25, 2019.

being injected under the soil surface. The UAN can also be combined with other agricultural chemicals, such as certain pesticides and other fertilizers, which are applied together in the aqueous phase.[10] UAN has become the most popular nitrogen fertilizer in the United States, overtaking liquid ammonia over a decade ago and seeing consistently higher use than urea.

The production of UAN is dependent on the upstream feedstocks that are used to synthesize the two nitrogen fertilizer components within it. The process begins with the splitting of natural gas (CH_4) into hydrogen (H_2) and carbon dioxide (CO_2) through steam reforming and the water-gas shift reactions (Figure 1).[11] The cost of natural gas makes-up a substantial portion of the cost to manufacture UAN, estimated by the European Commission to be about one fifth of the total cost. All three countries subject to EU duties—Russia, Trinidad and Tobago, and the United States—have unique advantages for natural gas availability and the resulting manufacturing of UAN. The United States benefits from the decade-long shale gas boom that has driven down the cost of domestic natural gas. Trinidad and Tobago is the largest natural gas producer in the Caribbean, with substantial offshore reserves.[12] Russia is the world's second largest natural gas producer and has multiple built and planned pipelines that deliver to the EU and China.[13]

Figure 1 Chemical manufacturing pathway for producing UAN



Source: USITC staff.
Note: Stoichiometry is omitted for clarity. Blue-highlighted chemicals are fertilizers.

The hydrogen produced from natural gas is used to pull nitrogen from the air and form the fertilizer components. Hydrogen is reacted with atmospheric nitrogen (N_2) to yield ammonia (NH_3) through the Haber-Bosch process. Ammonia is both the basic starting point for further fertilizer production and a fertilizer in its own right, being the second most commonly used nitrogen fertilizer in the United States. Ammonium nitrate is produced in a two-step process from ammonia. The first involves the oxidation of ammonia to nitric acid (HNO_3) through the Ostwald process. While an important industrial chemical in its own right, nitric acid is not a nitrogen fertilizer. The addition of more ammonia completes an acid-base reaction to yield the ammonium nitrate salt (NH_4NO_3). Urea synthesis is accomplished in a parallel process that also starts with ammonia. Carbon dioxide is reacted with two equivalents of ammonia to yield urea.

[10] Agrico, "Urea Ammonium Nitrate Solution" (accessed June 9, 2020).
[11] About 160 to 190 kilograms of natural gas is required to produce one ton of UAN.
[12] U.S. Energy Information Administration, "Trinidad and Tobago," January 2016.
[13] Shiryaevskaya and Khrennikova, "Why the World Worries about Russia's Natural Gas Pipeline," June 13, 2019; Chappell, "Russia Begins Sending Natural Gas to China as Putin and Xi Open New Pipeline," December 2, 2019.

The final stage of UAN production involves mixing the two components. Both ammonium nitrate and urea are produced as a solid material, usually in the form of prills.[14] UAN is manufactured by mixing those two components with water in the desired ratios. For example, UAN-32, which contains 32 percent nitrogen by weight, is a mixture of about 45 percent ammonium nitrate, 35 percent urea, and 20 percent water. UAN can be synthesized without going through the intermediate step of synthesizing distinct and dry ammonium nitrate and urea. For example, CF Industries combines urea with nitric acid and ammonia to create UAN directly in solution.[15] While many manufacturers are integrated producers of UAN, some combine externally purchased urea for mixing with ammonium nitrate produced on-site.[16] Because it is a liquid solution, UAN can be transported by rail, truck, ship, and pipeline, depending on the local distribution network.[17] A corrosion inhibitor is usually added to protect the transport vessels from attack by the nitrate component of the mixture. While generally less regulated and regarded as safer than other blends containing ammonium nitrate, there have been instances of industrial accidents when the solution is allowed to dry, necessitating controls wherever it is transloaded.[18]

Short-term Impacts of Anti-Dumping Duties

The EU anti-dumping duties on UAN imports from the three subject countries have been in effect for less than a year at the time of this publication. That does not leave much time for broad changes in the market for a product with capital-intensive manufacturing. It is also difficult to disentangle the effects of one cause in a market dependent on extrinsic factors like the weather. Even so, it is not unreasonable to expect to see some shifts in trade or production in the short-term. UAN is a commodity product, and demand for it should be elastic given the number of sources for it within the EU, the subject countries, and third countries. The following sections analyze whether or not and where such shifts might be occurring throughout the UAN production and delivery system.

Fertilizer Imports

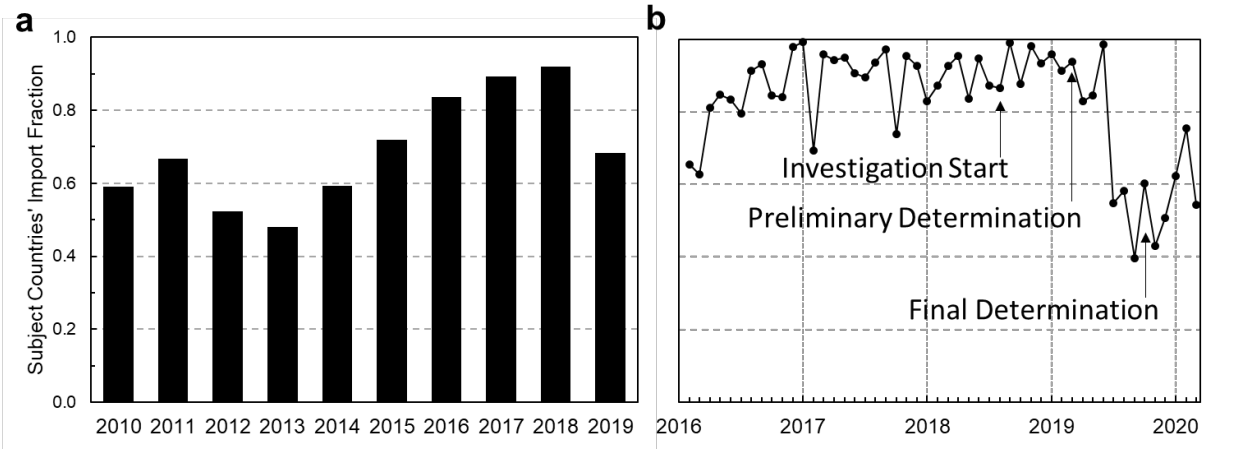
UAN

The most immediate area that the EU duties would have an effect are on EU imports of UAN itself. Trade data from the EU-28 countries shows that the preceding decade experienced substantial increases in imports from the three subject countries (Figure 2a).[19] From an average market share of circa

[14] A prill is a small, spheroid particle of solid material. Fertilizer grade ammonium nitrate is differentiated from explosives grade material through the density of these prills, with explosives requiring lower densities to better mix with fuels.
[15] CF Industries, "Urea Ammonium Nitrate (UAN)" (accessed June 9, 2020).
[16] Gubler et al, "Ammonium Nitrate," October 1, 2019, 12.
[17] The National Academies of Sciences, Engineering, and Medicine, "Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Explosive Precursor Chemicals," 2018, 171–172.
[18] U.K. Health and Safety Executive, "Explosion in a Urea Ammonium Nitrate (UAN) Fertilizer Transfer Pump" (accessed June 9, 2019).
[19] IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).

fifty percent in 2010–2014, the subject imports increased to almost ninety percent of total imports by 2018. That was followed by a substantial loss of market share in 2019, returning to levels seen in the earlier part of the decade. Breaking down the trade data by month shows a precipitous drop midway in 2018 (Figure 2b). This decline from June to July correlates with the preliminary determination and registration required by the EC in March 2019, allowing for the typical several months difference between when fertilizer is ordered and when it is delivered. Unlike previous dips in the preceding years, this was sustained throughout the rest of 2019 and into 2020.

Figure 2 EU Imports of UAN from subject countries



Source: IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).
Note: Fraction of EU-28 UAN imports from subject countries by year (a) and by month (b). Quantities reported for fertilizers are in units of metric kilotons (kt) of equivalent nitrogen. This allows the comparison to be drawn between fertilizers with different nitrogen content per ton. For example, ammonium nitrate has a nitrogen content of 35 percent and urea has a nitrogen content of 47 percent, so one ton of each would not have the same fertilizing potential. A kiloton is equal to one thousand metric tons, and one metric ton is equal to 2,204.62 pounds. (See table A.1).

As one would expect, the overall decline in EU imports of UAN was driven by declines in imports from the key subject countries. The United States and Russia had the greatest market share and greatest year over year increase in UAN exports over the decade before the antidumping duties were implemented (Figure 3a). U.S. exports were negligible in 2010, but rose to a plurality of EU imports by 2018.The EU was the largest export market for U.S. product in 2018, comprising 60 percent of U.S. exports of UAN.[20] In contrast, U.S. exports to the EU only comprised 23 percent of overall U.S. exports in 2019. The United States suffered the largest overall reduction, with 73 percent lower exports by quantity (a decline of $108 million by value) than in 2018 (Figure 3b).

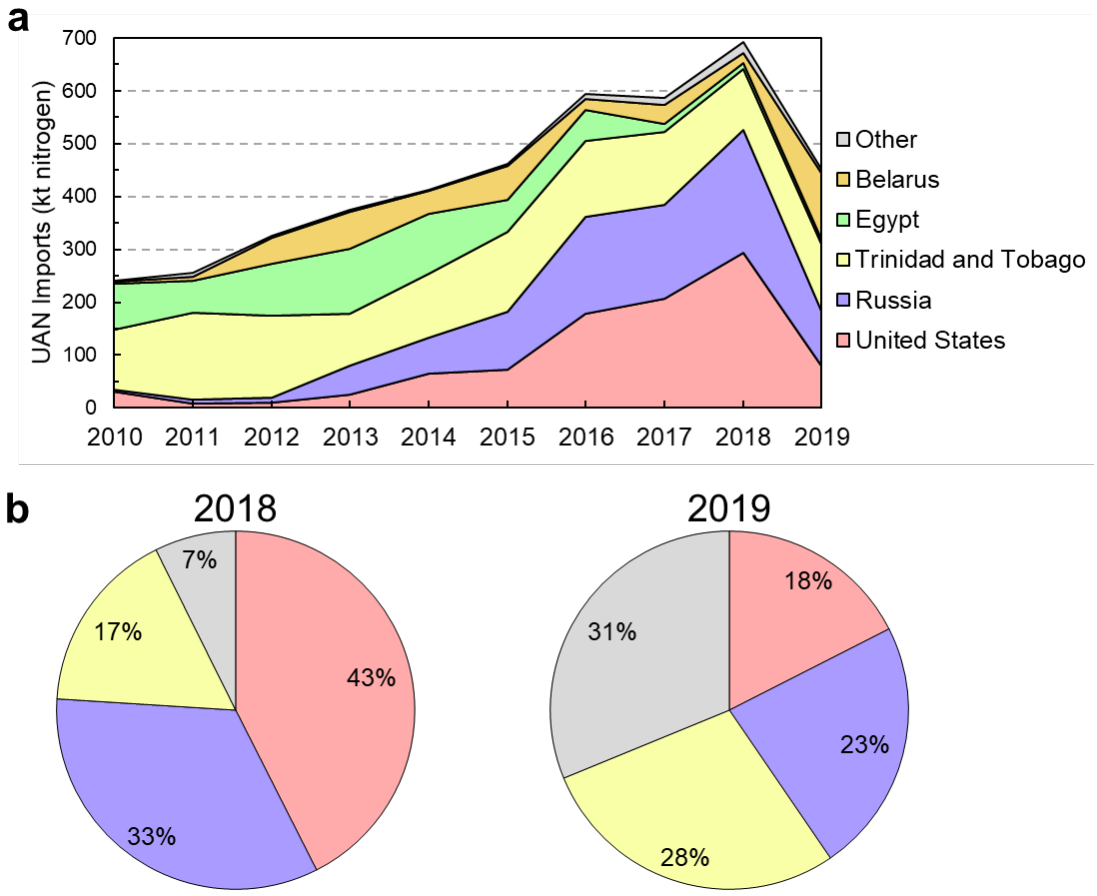
Russian exports exhibited a negative turn as well. Exports of UAN from Russia to the EU dropped 63 percent compared to 2018, although they did not fall to the same levels as the United States.[21] Overall, EU imports of UAN declined along with the market share of these subject countries, falling by 35 percent from all sources in 2019. The only subject country to avoid such a reduction was Trinidad and Tobago, which actually exported more UAN to the EU in 2019 and captured a greater share of the remaining market. Trinidad and Tobago had seen a general decline in exports in the latter half of the decade

[20] Most of the UAN from the United States enters the European market in France and Belgium. IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).
[21] Most of the UAN from Russia enters the European market in Estonia. IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).

compared to the first, when they were the majority exporter to the EU.[22] It is unclear why this is the case. The average price per ton of UAN from Trinidad and Tobago increased from $585–627 in 2019 compared to 2018, while UAN from the United States and Russia both decreased in price from $486–441 and $509–421 per ton, respectively.[23]

The increase in shipments to the EU from the United States and Russia in the preceding decade came at the expense of other previously substantial exporters, namely Egypt and Belarus. By 2016, both of those nations made up a limited part of the EU's UAN market. Only Belarus, re-bounded in 2019, with exports to the EU of UAN increasing by 514 percent over 2018.[24] However, that increase was insufficient to offset the decline in exports from the United States and Russia.

Figure 3 Total European Union imports of UAN



Source: IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).
Note: Total EU-28 UAN imports (in units of kilotons [kt] of nitrogen content) per year (a) and market shares of the individual subject countries (b). Colors are consistent across plots. (See table A.2 and table A.3).

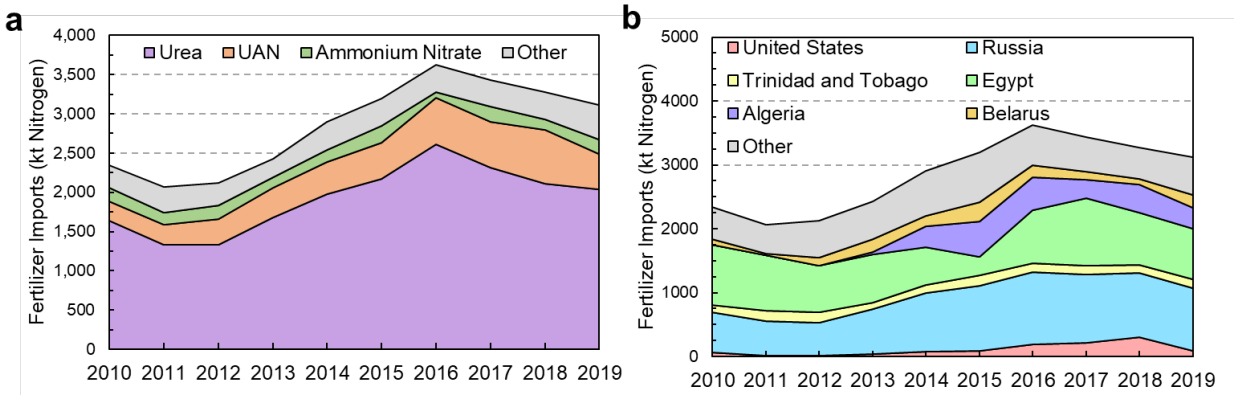
[22] IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).
[23] IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed October 14, 2019).
[24] European Commission, "Commission Implementing Regulation (EU) 2019/1688 of 8 October 2019 Imposing a Definitive Anti-dumping Duty and Definitively Collecting the Provisional Duty Imposed on Imports of Mixtures of Urea and Ammonium Nitrate Originating in Russia, Trinidad and Tobago and the United States of America," October 9, 2019.

The sharp decline in UAN imports in 2019 after the EC's preliminary determination provides a reasonable degree of evidence that the anti-dumping investigation had a measurable effect. With the exception of Trinidad and Tobago, it seems to have reduced the market share of subject imports by the EU before the close of 2019.

Components of UAN

UAN is only the second most common nitrogen fertilizer imported by the EU, implying it's import deficits may engender some change in the trade of other commodities. For example, urea's import market exceeds that of UAN by a factor of five (Figure 4a).[25] There were not substantial shifts in urea exports from individual exporting countries or changes in import trends set by the previous three years. The other component of UAN, ammonium nitrate, also has not substantially shifted in the past decade.[26] That is unlikely to change, given the relatively low demand for ammonium nitrate itself due to EU and country-specific regulations.[27] The quantity of total nitrogen imports from each major supplier also reflected previous import trends, except for the United States, whose overall market share has fallen to negligible levels due to the reliance on UAN exports (Figure 4b).

Figure 4 Total European Union imports of nitrogen fertilizers



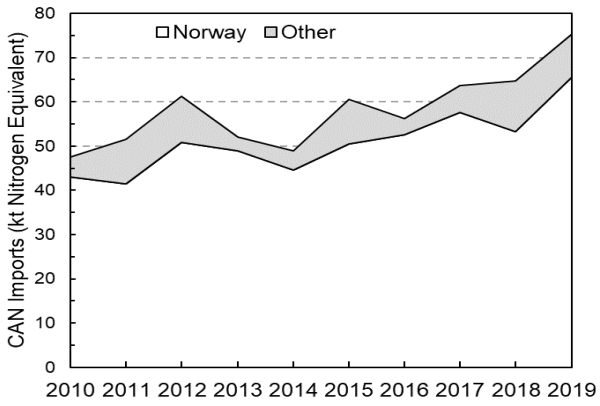
Source: IHS Markit, Global Trade Atlas Database for HTS heading 3102 (accessed May 21, 2019).
Note: Total imports of nitrogen fertilizers by EU-28 nations by type (a) and by country (b). (See table A.4 and table A.5).

The only exception to generally declining imports in both trend and source was for calcium ammonium nitrate (CAN).[28] This material is uniquely popular in the EU due to legal restrictions on unadulterated ammonium nitrate, given the latter's potential for use in explosives. The EU and Norway lead world production and consumption of this fertilizer.[29] The largest external supplier by far is Norway, whose exports to the EU over the past decade have been generally increasing (Figure 5). CAN is still at a level

[25] IHS Markit, Global Trade Atlas Database for HTS heading 3102.10 (accessed May 21, 2019).
[26] IHS Markit, Global Trade Atlas Database for HTS heading 3102.30 (accessed May 21, 2019).
[27] For example, in 2014, the EU enacted Regulation 98/2013 governing the commerce of improvised explosive device precursors, including ammonium nitrate. This regulation requires EU members to either ban or more stringently regulate the identified commodities, making ammonium nitrate's use as fertilizer more difficult. The National Academies of Sciences, Engineering, and Medicine, "Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Explosive Precursor Chemicals," 2018, 78–81.
[28] IHS Markit, Global Trade Atlas Database for HTS heading 3102.60 (accessed May 21, 2019).
[29] Gubler et al, "Ammonium Nitrate," October 1, 2019, 6.

orders of magnitude below replacing UAN, and its imports follow previous trends, so one can conclude that its increased imports are not due to the new anti-dumping duties. All other nitrogen fertilizers were consistent in exports, imports, and trade balance over the period.

Figure 5 European Union imports of calcium ammonium nitrate by source



Source: IHS Markit, Global Trade Atlas Database for HTS heading 3102.60 (accessed May 21, 2019). (See table A.6)

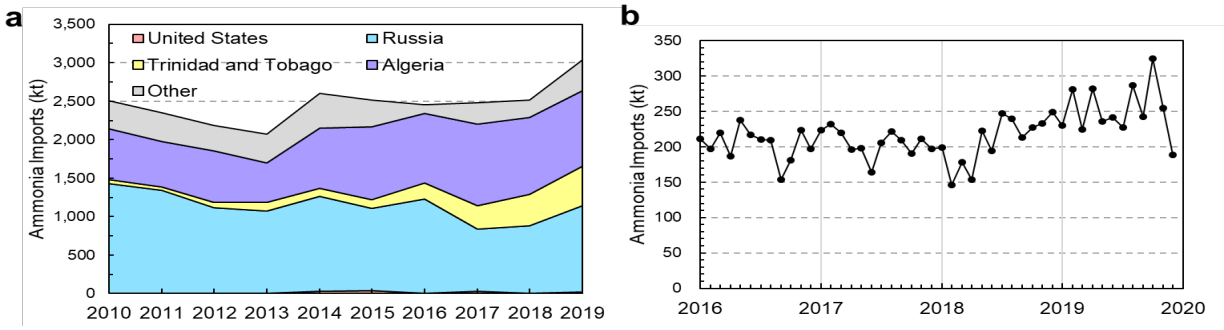
Ammonia

The ammonia manufactured as an intermediary on the way to UAN is a widely produced and traded commodity.[30] About four fifths of global ammonia production is dedicated to either use as fertilizer or as an input for manufacturing fertilizer.[31] Imports into the EU are substantial, and the EU as a whole is one of the largest import markets for ammonia; however, trade had been relatively flat since 2014.[32] That trend was interrupted by a 20 percent uptick in 2019, driven primarily by increased imports from Russia and Trinidad and Tobago (Figure 6a).[33] However, the monthly data does not explicitly correlate with any activities during the anti-dumping investigation (Figure 6b) beyond a general increase in import quantity.

Ammonia is the general exception to the trend of otherwise stable nitrogen fertilizer imports. With a nitrogen content of 82 percent, the 425 kt increase in ammonia-based nitrogen imports during 2019 would have been enough to cover the 159 kt deficit of other fertilizer imports. However, production of other chemicals accounts for a substantial fraction of ammonia consumption in the EU, preventing the conclusive determination that the increased imports were directly used to counter the decreased imports of UAN.[34]

[30] IHS Markit, Global Trade Atlas Database for HTS heading 2814.10 (accessed May 22, 2019).
[31] Suresh et al, "Ammonia," July 2017, 5.
[32] Suresh et al, "Ammonia," July 2017, 15.
[33] Russia increased by 28 percent, reversing a downward trend observed since 2010. Trinidad and Tobago has been almost linearly increasing exports year over year since 2015. Algerian imports have remained constant. Trade with the United States is negligible. IHS Markit, Global Trade Atlas Database for HTS heading 2814.10 (accessed May 22, 2019).
[34] Suresh et al, "Ammonia," July 2017, 56.

Figure 6 European Union imports of anhydrous ammonia



Source: IHS Markit, Global Trade Atlas Database for HTS heading 2814.10 (accessed May 22, 2019).
Note: Imports of ammonia by source (a) any by month (b). (See table A.7 and table A.8).

Production and Exports

Fertilizers

Absent substantial increases in EU imports of UAN or other substitutable products following the antidumping order, one might expect to see EU production of UAN ramp up to meet unfilled demand.[35] The EC noted in their investigation that there is slack in the domestic production capacity of UAN. However, available data shows that UAN production in the EU was constant between 2018 and 2019, meaning the decrease in imports was not a substantial enough market signal to spur greater domestic production before the end of the year.[36] It therefore seems reasonable to conclude that there was lower overall demand for UAN during the period, independent of the new duties, and that purchasers reduced consumption of the subject countries' imports because they were now relatively more expensive. This is supported by lower overall UAN prices during this period that track with the decrease in subject country imports.[37]

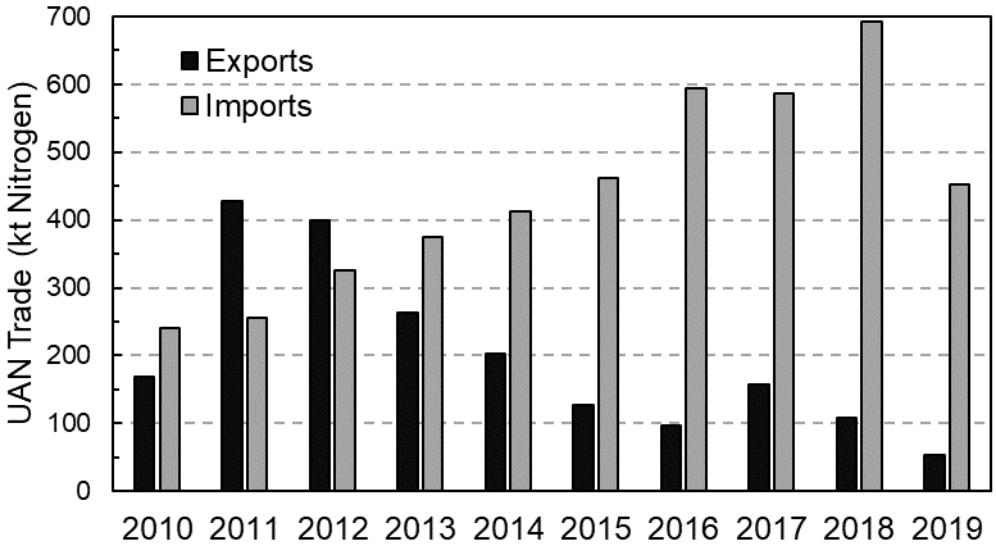
The lack of increase in UAN production within the EU is reflected in the manufacturing of its individual chemical components. Ammonium nitrate saw minimal shifts in both production capacity and utilization between 2019 and 2018.[38] Only Western EU production of urea increased—by about 100 kt nitrogen equivalent in 2019—although this was mostly tied to demand by non-fertilizer chemical industries, such as polymer manufacturing. [39]

The EU trade balance of UAN was also mostly unaffected by the anti-dumping investigation. EU exports of UAN continued their downward trajectory, which have been a fraction of imports since the export peak in 2011–2012 (Figure 7). While exports did decrease by about 55 kt in 2018 compared to 2019, this quantity is dwarfed by the overall decrease in imports of circa 240 kt during the same period. As that

[35] It takes approximately four years to construct a new fertilizer plant, so changes in capacity utilization would be the only noticeable shift in this timeframe. Frost, "Global Nitrogen Outlook: Top 4 Market Themes to Watch in 2020," February 10, 2020.
[36] Suresh et al, "Urea," April 15, 2020, 64.
[37] Meehan, "INSIGHT: Global UAN Market Unfazed by EU Anti-Dumping Duties," November 11, 2019.
[38] Gubler et al, "Ammonium Nitrate," October 1, 2019, 12, 55, 68–71.
[39] Suresh et al, "Urea," April 15, 2020, 63–64.

decrease is in line with data since 2017, it is unlikely that exports were purposefully re-directed to the domestic market as a result of the anti-dumping duties.

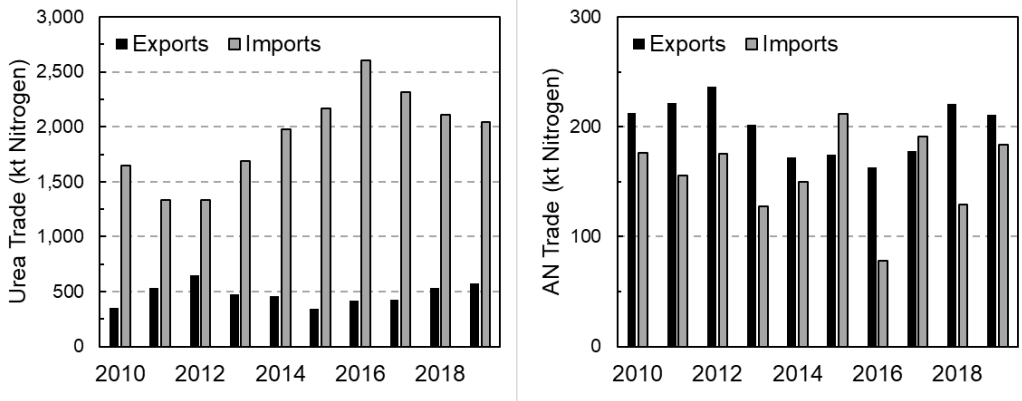
Figure 7 European Union imports and exports of UAN



Source: IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed May 21, 2019).
Note: Units are in kilotons (kt) of nitrogen content. (See table A.9).

It is conceivable that exports of urea and ammonium nitrate could be re-directed from export to domestic UAN manufacturing, or imports of these inputs could be increased to help bolster domestic capacity; they need only be mixed to yield UAN. However, both commodities experienced negligible changes in export volume or trade balance following the anti-dumping duties (Figure 8).

Figure 8 European Union trade balance of urea and ammonium nitrate (AN)



Source: IHS Markit, Global Trade Atlas Database for HTS heading 3102 (accessed May 21, 2019). (See table A.10).

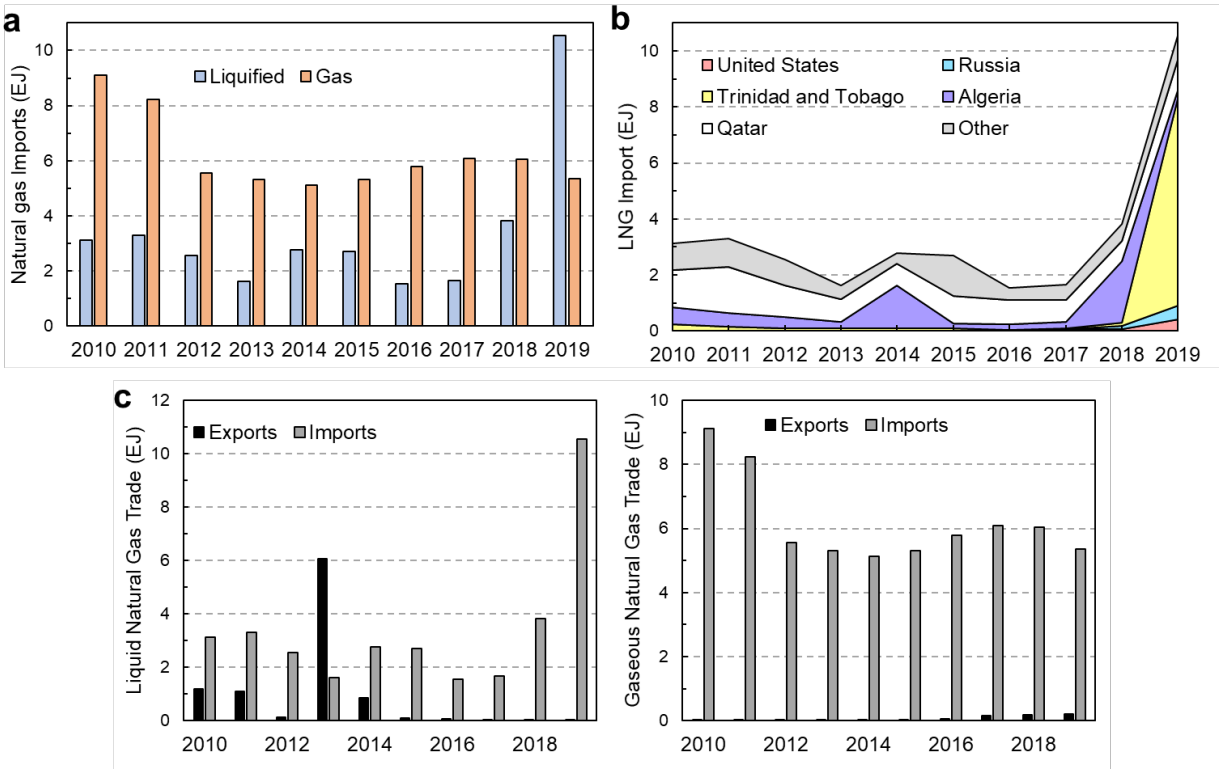
Natural Gas and Hydrogen

Any increase in fertilizer manufacturing will be reflected in the production, imports, or consumption of its chemical inputs.[40] UAN is ultimately manufactured from natural gas that is either produced domestically or imported and used to generate hydrogen.[41] However, the quantity of natural gas used to manufacturer fertilizer reflects a very small part of its overall market in the EU: only about three percent of the natural gas consumed in Europe is dedicated to producing ammonia, the precursor for every other fertilizer.[42] Thus, while there are substantial shifts in liquefied natural gas imports by the EU in 2019, they cannot be assumed the result of a major re-arrangement in the European fertilizer value chain (figure 9).[43]

The hydrogen produced by natural gas feeds substantially fewer industries, making shifts more likely to be attributable to changes in the fertilizer market.[44] About a 45 percent of all hydrogen consumed in western and central Europe is dedicated to ammonia production.[45] However, hydrogen is mostly generated and consumed on-site due to the danger in storing and transporting it, meaning shifts in fertilizer demand or production are unlikely to be reflected in hydrogen trade shifts.[46] Demand for hydrogen in the EU has slackened recently due to the comparatively cheaper feedstocks in other regions with more ready access to natural gas, which encourages capital investment in other regions.[47] Thus, to-date, there do not appear to be major shifts in this part of the value chain in response to the anti-dumping duties.

[40] The EU is and has been a major importer of natural gas. However, production in the western EU has fallen consistently over the past ten years, along with the stocks of proven reserves. The majority of production current occurs in the Netherlands and the United Kingdom. Glauser and Smith, "Petrochemical Feedstocks," February 2020, 112. Offshore, "Northwest Europe Gas Output Set for Steep Decline," December 13, 2019.
[41] Nitrogen, the other input, can be pulled from the atmosphere anywhere and is not traded for this purpose. In contrast, natural gas is a commodity petroleum feedstock for both chemical synthesis and, more widely, for power and heat generation that is globally traded in vast quantities. Glauser and Smith, "Petrochemical Feedstocks," February 2020, 113.
[42] Percentage calculated by using the quantity of ammonia produced to calculate the mass of natural gas required to produce the hydrogen necessary for that volume. That mass of natural gas was then divided by overall European consumption to yield the quoted percentage. Suresh et al, "Hydrogen," May 2018, 10; Glauser and Smith, "Petrochemical Feedstocks," February 2020, 113, 134.
[43] Overseas natural gas is transported as a liquid due to the much greater density and thus quantity of material that can be shipped in the same volume. The infrastructure for moving that material include a liquefaction plant at the departure terminal that convers it from the gas to the liquid phase and the reverse at the landing terminal.
[44] Natural gas is also the source the carbon dioxide used in urea production, but that is a ubiquitous chemical and its trade will have negligible relation to changes in fertilizer production and consumption.
[45] Suresh et al, "Hydrogen," May 2018, 10.
[46] Hydrogen's danger arises from its flammability and ability to auto-ignite if there is a leak in a pressurized vessel. There are only two areas in Europe where there are substantial pipeline networks for delivering it, in the Benelux region and eastern Germany. Neither of these are amenable for drastically different operations nor trade with partners external to the EU. Suresh et al, "Hydrogen," May 2018, 117–119.
[47] Suresh et al, "Hydrogen," May 2018, 138.

Figure 9 European Union imports of natural gas



Source: IHS Markit, Global Trade Atlas Database for HTS headings 2711.11 (liquified natural gas) and 2711.21 (gaseous natural gas) (accessed May 22, 2019).
Note: Imports of natural gas by type (a) and liquified natural gas (LNG) imports by source (b), along with the overall EU trade balance of natural gas (c). Natural gas is usually traded in terms of the heat energy it can provide. The EU tracks this in terms of joules (J), where one BTU contains 1,055.06 J. The accompanying figures are in terms of exajoules (EJ), where an EJ is one quintillion joules (1018). Other natural gas units used in the United States include the Ccf (100 cubic feet), equivalent to 100,000 BTU; Mcf (1,000 cubic feet); MMBTU (one million BTU); and therm (100,000 BTU). (See table A.11, table A.12, and table A.13).

Long-term Outlook

Tracking the impact of the anti-dumping duties into the future will be difficult due to complicating variables and events. For example, changing EU agriculture policies and global events like the COVID-19 pandemic will have long-lasting effects on fertilizer demand that will be difficult to disentangle from these new duties.[48] It is still possible to evaluate the state of the market in context of potential production capacity and trade to outline different possible options available to the EU and its fertilizer consumers. The following sections detail different shifts that may occur over the longer term due to the imposition of the anti-dumping duties on UAN in domestic production, foreign production feeding the EU, and changes in trade and the value chain.[49]

[48] The EU is reportedly changing its agriculture subsidies policies, which would likely affect fertilizer demand. Gubler et al, "Ammonium Nitrate," October 1, 2019, 12, 61.
[49] All analysis is done assuming that overall nitrogen demand in the EU will remain constant, which may not be reflected in future behavior, but provides one boundary limitation; it is unlikely that demand will increase for nitrogen overall, making all other scenarios encompass less extreme shifts due to lower demand.

Internal Production

A lack of production shifts in 2019 does not preclude the option of European producers to ramp-up production in the future. That will depend on the availability of capacity in both of the constituent components—urea and ammonium nitrate. There is already slack in operating capacity among EU ammonium nitrate producers, to the tune of approximately twenty percent.[50] Since growth in ammonia nitrate production has been driven by demand for UAN over the past decade, any additional use of that capacity would naturally indicate greater UAN manufacturing.[51] However, there is only room for some limited additional urea capacity utilization in some central EU nations and none at all in western Europe.[52] Those facts indicate that production would most likely have to take away from pure urea manufacturing to feed additional UAN, in the absence of additional capacity coming online.

The decision to invest in new capacity will be gated by the realities of raw material availability, specifically natural gas. Most ammonia capacity and fertilizer manufacturing growth has occurred outside of the EU as a result of natural gas availability since 2016.[53] As an overwhelmingly net importer of natural gas, firms in the EU will only be able to invest in new fertilizer capacity if they are able to either import more natural gas or if some is re-directed from other uses. The former will be discussed in the following section, while the latter is potentially possible due to changing political priorities in the EU. The European Green Deal would reduce fossil fuel consumption in the goal to reach net zero emissions and, therefore, free-up more natural gas from the power sector for use in fertilizer manufacturing.[54] However, energy trends in Germany, which has dedicated substantial resources to installing renewable energy, indicate that decarbonization will begin with retiring coal and nuclear infrastructure first, leaving substantial demand for natural gas outside of the fertilizer sector for the foreseeable future.[55]

The EU has limited options going forward. Overcoming UAN import shortfalls with domestic capacity does not seem likely given raw material constraints. A shift in internal production seems more likely to meet demand, increasing ammonium nitrate manufacturing and shifting some urea to producing UAN.

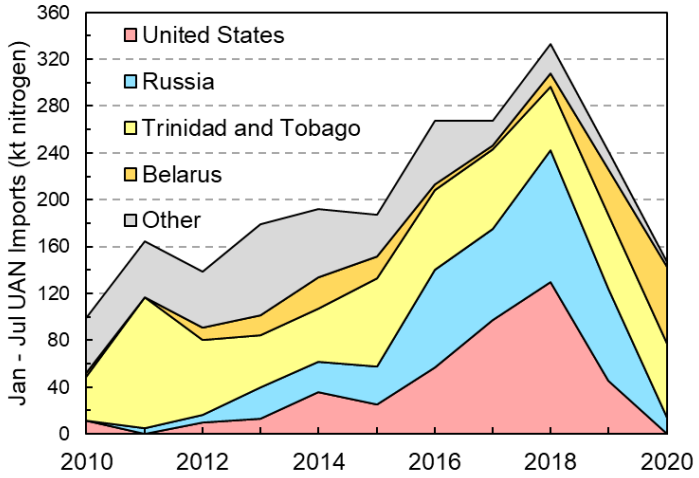
Trade

The available data does provide some information on how import trends may develop in the future. Already in the first seven months of 2020, there is a notable decline in UAN imports by the EU, both overall and from the subject countries (Figure 10). The United States has seen a total collapse in demand, falling to less than 0.012 percent of 2018's peak imports. Imports from Russia have similarly massively declined, by over 87 percent compared to 2018. Only Trinidad and Tobago has remained unscathed, and its UAN imports have even increased over the past two years, despite higher prices than

[50] Gubler et al, "Ammonium Nitrate," October 1, 2019, 12, 55, 71.
[51] Gubler et al, "Ammonium Nitrate," October 1, 2019, 12, 20.
[52] Suresh et al, "Urea," April 15, 2020, 62, 69.
[53] Suresh et al, "Ammonia," July 2017, 9.
[54] For additional information on this policy package, see: European Commission, "A European Green Deal" (accessed June 11, 2020).
[55] Nuclear energy does not emit carbon, but it has been slated for phaseout in multiple countries due to the perceived risk after the Fukushima Daiichi meltdown in 2011. If retiring that infrastructure takes precedence over other decarbonization goals for a particular country, renewables will have to fill that gap before natural gas is brought offline. Appunn et al, "Germany's Energy Consumption and Power Mix in Charts," March 31, 2020.

Russia thus far in 2020.[56] However, as the United States and Russia were the formerly largest sources of UAN for the EU, this means the overall projections for UAN imports in 2020 are 39 percent lower than in 2019, if the first seven months of imports are instructive.[57]

Figure 10 European Union imports of UAN during the first seven months of the year



Source: IHS Markit, Global Trade Atlas Database for HTS heading 2814.80 (accessed October 14, 2019). (See table A.14).

Shifting trade is one solution to the current shortfall from the subject countries. The bloc could further alter its trade balance by decreasing exports of UAN. However, the observed reduction in imports from 2018–19 already exceeds the total UAN exports from the EU in 2018 by a factor of two, making such action of limited utility (Figure 4). There is also the possibility of increased natural gas imports that could feed domestic production through the new pipeline from Russia, though the fate of that gas remains to be seen until after the project is complete.[58] Additional LNG imports are also possible, provided there is adequate port infrastructure to handle it.

It is likely that imports of UAN will continue be sourced from other nations, as they already have in 2019 from Belarus. In the first seven months of 2020, Belarus became the single largest supplier of UAN to the EU (figure 10). However, their existing capacity is not infinite. There is only one ammonia producer in Belarus, which is already producing near capacity.[59] While that quantity could be enough to feed the entire EU import market for UAN, the majority of that fertilizer is consumed internally by Belarus. Without substantial investment in new capacity, it doesn't not seem likely that Belarusian exports will substantially increase over the coming years, leaving room for other third-party countries.

[56] Cost per ton UAN thus far in 2020 are: $788 for the United States, $372 for Russia, and $511 for Trinidad and Tobago. IHS Markit, Global Trade Atlas Database for HTS heading 3102.80 (accessed October 14, 2019).
[57] The first three months average 23 percent of the year's total UAN imports, based on historic data. With imports through march totaling 16.8 kt, the projected yearly total of 74.7 kt is well below 2019's 452 kt. IHS Markit, Global Trade Atlas Database for HTS heading 2814.80 (accessed May 21, 2019).
[58] Trellevik, "Russian Gas Increasingly Important to Europe," January 7, 2020.
[59] The ammonia from that plant is split between urea and ammonium nitrate in an approximately 60:40 ratio. Suresh et al, "Ammonia," July 2017, 65, 71; Gubler et al, "Ammonium Nitrate," October 1, 2019, 72, 75, 78; Suresh et al, "Urea," April 15, 2020, 72, 75.

The north African nations of Algeria and Egypt have tremendous fertilizer manufacturing capacity, though only about one percent is dedicated to UAN production.[60] Algeria is a historic exporter to the EU of fertilizers in general. The country has a substantial capacity for ammonia, the majority of which is exported.[61] However, only about fifty percent of that was used in 2019, leaving tremendous room for growth using the existing capital. Ammonium nitrate is similar, possessing substantial capacity that is only partially used.[62] In contrast, Algeria has a large urea capacity and utilization rate for urea production, approaching six times greater than ammonium nitrate, with substantial exports.[63] Egyptian exports are driven by the country's substantial fertilizer industry. The total ammonia capacity of Egypt is about double Algeria, though with limited exports of it in that form.[64] It has the largest capacity and production of ammonium nitrate in the region, exceeding Algeria by almost double, although most of that ammonium nitrate is used internally instead of for export.[65] Egypt is also the largest urea producer in the region, allowing most of the product to be exported.[66]

Both Algeria and Egypt seem to be in similar situations as the EU for increasing UAN manufacturing. There is room to grow ammonium nitrate production, but limited possibilities for urea expansion. It seems likely that some internal re-configuration would be possible to supply a portion of the necessary UAN without having to invest in new overall capacity. The two countries are the largest natural gas producers in Africa, which puts them in a more abundant situation than the EU in terms of raw material availability and flexibility.[67] It seems likely that both countries will play a larger role in UAN exports to the EU that, in conjunction with Belarus, would be able to either make-up the shortfall or replace the subject countries entirely, if the demand signal from EU consumers were strong enough.

The United Kingdom

Another factor to consider for the future of UAN trade is the position of the United Kingdom (UK) following its exit from the EU.[68] In both 2018 and 2019, the majority of UAN imported by the UK was from other EU nations (Figure 11). The same shift away from subject nations was seen as well, though with a lesser impact due to the already low levels of Russian and U.S. imports. Overall imports fell in 2019 as well, though substantially less than the EU as a whole.[69] The trade balance in the UK is more extreme than the EU at-large, with exports totaling less than one percent of the value of imports in both 2018 and 2019. It appears that the EU anti-dumping duties on UAN, which were enacted before Brexit, are still in effect, meaning the 2019 shifts are likely to persist unless new trade agreements are penned in the coming years.[70]

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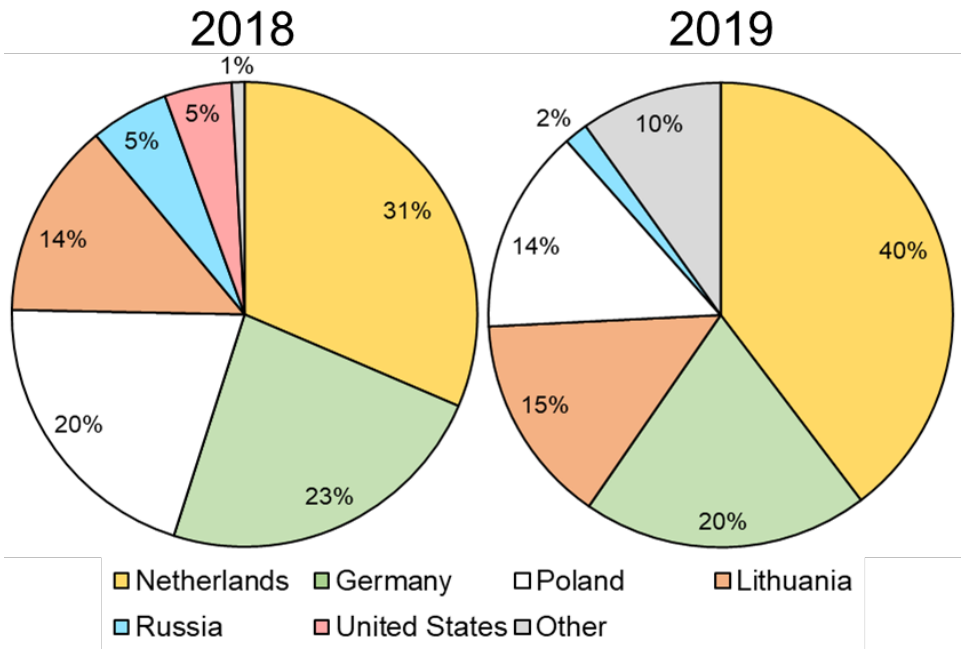
[60] Suresh et al, "Urea," April 15, 2020, 91.
[61] Suresh et al, "Ammonia," July 2017, 84, 88, 90.
[62] Gubler et al, "Ammonium Nitrate," October 1, 2019, 99, 103.
[63] Suresh et al, "Urea," April 15, 2020, 88–89, 91.
[64] Suresh et al, "Ammonia," July 2017, 84, 86, 88, 90.
[65] Gubler et al, "Ammonium Nitrate," October 1, 2019, 99, 103 107.
[66] Suresh et al, "Urea," April 15, 2020, 88–89, 91–92.
[67] Glauser and Smith, "Petrochemical Feedstocks," February 2020, 198.
[68] The data presented in the preceding sections included the UK as it remained in the Union throughout the entirety of 2019, and its inclusion in Figure 10 is marginal due to low levels of extra-EU UAN entering the UK.
[69] Ten percent for the UK versus 33 percent for the EU.
[70] The UK has also indicated that it will review EU anti-dumping activity after exiting the Union, not necessarily keeping all current ones in place at their current duty rates. UK Government, "Guidance: Imports of Urea and Ammonium Nitrate Solutions from Russia, USA and Trinidad and Tobago (Anti-Dumping Duty 2361)," October 10,

Figure 11 United Kingdom UAN import sources



Source: IHS Markit, Global Trade Atlas Database for HTS heading 2814.80 (accessed May 21, 2019).

To help understand the UK position in the post-Brexit era vis-à-vis UAN, one can characterize the existing domestic demand and industry. The United Kingdom currently has no domestic producers of urea, necessitating its domestic consumption be fed entirely by imports.[71] There are two sites producing ammonium nitrate in the UK, with combined capacity to meet overall domestic demand when combined with a third ammonia producer.[72] The UK is the second largest producer of natural gas in Western Europe, though that is only able to meet about half of its domestic needs.[73] Production of natural gas has also fallen over the past decade, and is projected to continue decreasing over the next five years.[74] Thus, it seems unlikely that any new urea capacity or expanded ammonium nitrate capacity will be built there.

Conclusions

The EU's anti-dumping duties on UAN have already had notable effects on trade. Imports of UAN from the United States and Russia have fallen substantially compared to previous highs in 2018. In contrast, imports from Trinidad and Tobago have somewhat increased since the anti-dumping order was issued, and that country now the largest non-domestic source of UAN for the EU. There was also an increase in

2019. Hurst, "Anti-dumping Agreements – UK Prepares to Impose its own Duties on Foreign Exporters," May 21, 2020.

[71] Suresh et al, "Urea," April 15, 2020, 63.

[72] Gubler et al, "Ammonium Nitrate," October 1, 2019, 53, 61; CF Industries, "Ince Nitrogen Complex" (accessed June 18, 2020); CF Industries, "Billingham Nitrogen Complex" (accessed June 18, 2020); Suresh et al, "Ammonia," July 2017, 50; Yara, "About Yara UK" (accessed June 18, 2020).

[73] Glauser and Smith, "Petrochemical Feedstocks," February 2020, 112–113.

[74] Offshore, "Northwest Europe Gas Output Set for Steep Decline," December 13, 2019.

imports from Belarus, but these shifts were not enough to counter the lost volume from Russia and the United States, and the total EU import market for UAN has declined as a result of the new duties. These trends appear to be continuing into 2020 based on the trade data for the first few months of the year, implying these will be long-term effects.

Future trade may also be affected by shifts in other third country production. Additional UAN could be imported from North African and Middle East nations if their manufacturing capacity was shifted to it. It will be important to watch the behavior of countries like Egypt and Algeria, which both have the potential capacity for and history of producing UAN for export to the EU.

While the trade in UAN has been affected, the effect on other commodities are not yet clear. Imports of other fertilizers like urea have held steady since the anti-dumping determination. In contrast, there was a notable increase in EU imports of ammonia, especially from Trinidad and Tobago, and liquified natural gas in 2019. This may indicate either a partial shift to a different liquid fertilizer (ammonia) or plans to increase domestic production with imported feedstocks.

Monitoring the trajectory of these commodities and domestic output going forward will be required to obtain a definitive picture of the market trajectory. This situation will continue developing, and the most direct evidence of a continued effect will be continued shifts in UAN trade and EU production, making both sectors important areas to watch in the future.

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Appendix A
Data Tables for Figures

Table A.1 EU Imports of UAN from subject countries

Year	Fraction
2010	0.59
2011	0.67
2012	0.52
2013	0.48
2014	0.59
2015	0.72
2016	0.84
2017	0.89
2018	0.92
2019	0.68

Note: See figure 2a.

Table A.2 EU Imports of UAN from subject countries

Date	Fraction
2016-1	0.65
2016-2	0.63
2016-3	0.81
2016-4	0.85
2016-5	0.83
2016-6	0.80
2016-7	0.91
2016-8	0.93
2016-9	0.84
2016-10	0.84
2016-11	0.98
2016-12	0.99
2017-1	0.69
2017-2	0.96
2017-3	0.94
2017-4	0.95
2017-5	0.91
2017-6	0.89
2017-7	0.93
2017-8	0.97
2017-9	0.74
2017-10	0.95
2017-11	0.93
2017-12	0.83
2018-1	0.87
2018-2	0.93
2018-3	0.95
2018-4	0.84
2018-5	0.95
2018-6	0.87
2018-7	0.86
2018-8	0.99
2018-9	0.88
2018-10	0.98
2018-11	0.93
2018-12	0.96

Date	Fraction
2019-1	0.91
2019-2	0.94
2019-3	0.83
2019-4	0.85
2019-5	0.98
2019-6	0.55
2019-7	0.58
2019-8	0.40
2019-9	0.60
2019-10	0.43
2019-11	0.51
2019-12	0.62
2020-1	0.75
2020-2	0.54
2020-3	0.57

Note: See figure 2b.

Table A.3 Total European Union imports of UAN, million dollars

Year	EU UAN Imports					
	United States	Russia	Trinidad and Tobago	Belarus	Egypt	Other
2010	17	3	64	1	56	2
2011	5	6	134	7	60	6
2012	8	8	140	39	99	4
2013	20	43	87	45	113	4
2014	44	46	96	29	96	2
2015	46	65	104	38	43	3
2016	79	84	76	9	31	7
2017	87	85	71	10	11	8
2018	138	112	67	8	7	12
2019	35	42	80	62	6	5

Note: See figure 3a.

Table A.4 Total European Union imports of nitrogen fertilizers

Year	EU Imports (kt Nitrogen Equivalent)		
	Urea	UAN	Ammonium Nitrate
2010	1,643	241	177
2011	1,334	255	156
2012	1,330	326	176
2013	1,684	375	127
2014	1,975	413	150
2015	2,169	462	212
2016	2,608	595	78
2017	2,316	586	191
2018	2,109	691	129
2019	2,040	452	183

Note: See figure 4a.

Table A.5 Total European Union imports of nitrogen fertilizers

Year	Fertilizer Imports (kt Nitrogen Equivalent)						
	US	Russia	T&T	Egypt	Algeria	Belarus	Other
2010	58	637	114	942	3	86	506
2011	17	537	164	862	0	32	457
2012	19	514	157	734	2	118	581
2013	35	708	101	756	31	205	592
2014	78	916	127	595	318	167	700
2015	86	1,025	159	288	559	293	788
2016	189	1,129	148	821	522	187	633
2017	217	1,066	140	1,057	295	121	538
2018	302	1,010	117	826	439	91	491
2019	93	979	132	792	329	199	593

Note: See figure 4b.

Table A.6 European Union imports of calcium ammonium nitrate by source

Year	EU Imports of CAN (kt Nitrogen)	
	Norway	Other
2010	43	5
2011	41	10
2012	51	10
2013	49	3
2014	45	4
2015	51	10
2016	53	4
2017	58	6
2018	53	11
2019	66	10

Note: See figure 5.

Table A.7 European Union imports of anhydrous ammonia

Year	Ammonia Imports (kilotons)				
	US	Russia	T&T	Algeria	Other
2010	1	1,426	54	658	372
2011	1	1,337	43	596	371
2012	0	1,113	72	670	329
2013	0	1,074	112	509	373
2014	29	1,235	107	782	452
2015	35	1,073	110	947	354
2016	4	1,227	207	903	116
2017	26	808	313	1,058	272
2018	3	880	411	994	224
2019	18	1,124	516	981	402

Note: See figure 6a.

Table A.8 European Union imports of anhydrous ammonia

Year	Ammonia Imports (kilotons)
2016.00	211
2016.08	197
2016.17	220
2016.25	186

Year	Ammonia Imports (kilotons)
2016.33	238
2016.42	217
2016.50	210
2016.58	209
2016.67	154
2016.75	181
2016.83	223
2016.92	197
2017.00	224
2017.08	232
2017.17	219
2017.25	196
2017.33	198
2017.42	164
2017.50	205
2017.58	221
2017.67	209
2017.75	191
2017.83	212
2017.92	197
2018.00	199
2018.08	146
2018.17	178
2018.25	153
2018.33	222
2018.42	194
2018.50	247
2018.58	239
2018.67	213
2018.75	228
2018.83	233
2018.92	249
2019.00	230
2019.08	281
2019.17	225
2019.25	282
2019.33	236
2019.42	242
2019.50	227
2019.58	286
2019.67	242
2019.75	325
2019.83	255

Note: See figure 6b.

Table A.9 European Union imports and exports of UAN

Year	EU Trade (kt Nitrogen)	
	Exports	Imports
2010	168	241
2011	428	255
2012	399	326
2013	263	375
2014	202	413
2015	127	462
2016	97	595
2017	157	586
2018	107	691
2019	53	452

Note: See figure 7.

Table A.10 European Union trade balance of urea and ammonium nitrate (AN)

Year	Urea Trade (kt Nitrogen)		Ammonium Nitrate Trade (kt Nitrogen)	
	Exports	Imports	Exports	Imports
2010	1,643	348	177	213
2011	1,334	531	156	221
2012	1,330	653	176	236
2013	1,684	477	127	202
2014	1,975	460	150	172
2015	2,169	343	212	175
2016	2,608	420	78	163
2017	2,316	423	191	178
2018	2,109	530	129	221
2019	2,040	579	183	211

Note: See figure 8.

Table A.11 European Union imports of natural gas

Year	Natural Gas Imports (EJ)	
	Liquified	Gaseous
2010	3.1	9.1
2011	3.3	8.2
2012	2.6	5.6
2013	1.6	5.3
2014	2.8	5.1
2015	2.7	5.3
2016	1.5	5.8
2017	1.7	6.1
2018	3.8	6.0
2019	10.6	5.4

Note: See figure 9a.

Table A.12 European Union imports of natural gas

Year	Liquid Natural Gas Imports (EJ)					
	U.S.	Russia	T&T	Algeria	Qatar	Other
2010	0.0	0.0	0.2	0.6	1.3	1.0
2011	0.0	0.0	0.2	0.5	1.6	1.0
2012	0.0	0.0	0.1	0.4	1.1	0.9
2013	0.0	0.0	0.1	0.2	0.8	0.5
2014	0.0	0.0	0.1	1.5	0.8	0.4
2015	0.0	0.0	0.1	0.2	1.0	1.5
2016	0.0	0.0	0.0	0.2	0.8	0.5
2017	0.1	0.0	0.0	0.2	0.8	0.5
2018	0.1	0.1	0.1	2.2	0.7	0.6
2019	0.4	0.5	7.4	0.3	1.1	0.9

Note: See figure 9b.

Table A.13 European Union imports of natural gas

Year	Liquid Natural Gas Trade (EJ)		Gaseous Natural Gas Trade (EJ)	
	Exports	Imports	Exports	Imports
2010	1.19	3.1	0.03	9.1
2011	1.11	3.3	0.03	8.2
2012	0.12	2.6	0.03	5.6
2013	6.08	1.6	0.03	5.3
2014	0.85	2.8	0.03	5.1
2015	0.11	2.7	0.03	5.3
2016	0.06	1.5	0.06	5.8
2017	0.02	1.7	0.17	6.1
2018	0.05	3.8	0.18	6.0
2019	0.01	10.6	0.21	5.4

Note: See figure 9c.

Table A.14 European Union imports of UAN during the first seven months of the year

Year	EU UAN January through March Imports (kt Nitrogen)				
	United States	Russia	T&T	Belarus	Other
2010	11	0	38	4	47
2011	0	5	112	0	48
2012	10	6	64	10	48
2013	13	27	45	16	78
2014	36	26	46	27	59
2015	26	32	75	18	35
2016	57	84	68	5	54
2017	97	78	68	3	21
2018	130	113	55	11	25
2019	45	78	64	39	16

Note: See figure 10.