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Understanding the Risks and Vulnerabilities Facing the Canadian Agricultural Fertilizer Market

Research Report prepared for CAPI by
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Research Report

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Note from CAPI

The year 2022 has seen fertilizer emerge as a globally strategic commodity, eliciting analysis in the realms of trade, transport, and investment. CAPI now joins the conversation from an agricultural policy perspective to frame the current situation, depict the medium- and long-term implications on Canadian farmers, and suggest policy alternatives.

Policy at the national and international levels have had major impacts on the global fertilizer market. In 2021, China and Russia introduced export controls on fertilizer as elements of trade policy, resulting in price spikes. Business closures and pandemic-related lockdowns severely limited the production and movement of fertilizer. Then in 2022, political responses to the Russia-Ukraine war included rail and seaway disruptions and economic sanctions, decreasing the supply of fertilizer and natural gas, a key input in the production of nitrogen fertilizers. Quite apart from current market and geo-political tensions, the limited supplies and suppliers of phosphate fertilizers are increasingly perceived as a source of vulnerability in a more volatile world.

In this environment, producers and the broader agri-food sector in Canada must have an understanding of the situation, be able to update expectations as the new 2023 crop year approaches, and assess risks. This *Research* Report outlines Canadian fertilizer markets, identifies the key sources of uncertainty, and provides recommendations for a Canadian policy response.

Key Takeaways

- Global factors, including fertilizer export restrictions, production disruptions in Europe and the Russian invasion of Ukraine, are disrupting fertilizer supplies and increasing prices.
- Canada has regional fertilizer markets, and the impact of this global disruption is felt most acutely in Eastern Canada, where imports are an essential source of fertilizer supply, especially for urea.
- The 35 percent duty Canada placed on Russian fertilizer following its invasion of Ukraine has impacted Canadian farmers, making a historically significant source of fertilizer cost prohibitive, but given the global demand, has had little impact on Russia.
- Removing the duty is the most effective policy solution to ensure the fertilizer supply in Canada. Other solutions include investing in infrastructure to facilitate domestic trade and increasing capacity in Eastern Canada, but both are expensive and long-term propositions.

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List of acronyms and initialisms

N	nitrogen
P	phosphorous
K	potassium
NPK	nitrogen, phosphorous, potassium
MAP	monoammonium phosphate
DAP	diammonium phosphate
UAN	urea-ammonium nitrate
NT	nutrient tonnes
PT	product tonnes
nes	not elsewhere specified (HS code titles)

Introduction

Fertilizer has emerged as a strategic resource globally, essential for maintaining existing agricultural crop yields and quality, and for growth in output. However, in a matter of the last year, the global fertilizer situation has changed markedly. This is a function of a host of factors including pandemic interruptions and backup in global logistics, and energy price spikes and disruptions in fertilizer availability. Major producers have curtailed production – notably Europe – and major exporters such as China have curtailed exports, creating the prospect of a global market gap.

The Russian invasion of Ukraine exacerbated logistical problems in the Black Sea; moreover, many countries (including Canada) revoked the Most Favoured Nation status of Russia and Belarus in response, and have sanctioned Russia and Belarus on a range of products that include fertilizers (Canada Border Services Agency, 2022).[1] The war and the rounds of trade sanctions and retaliation also triggered changes in the energy complex which, among other things, increased natural gas prices in western Europe and have dramatically decreased the production of nitrogen fertilizers in the EU.

With the situation developing quickly since the late winter of 2022, it created some concerns regarding 2022 fertilizer supplies in Canada. This is still a matter of active discussion, especially for Spring 2023. However, the broader question now is how the Canadian fertilizer market can return to balance going forward given this complex of factors, and more specifically, the feasibility of the Canadian market needs being effectively supplied.

The purpose of this report is to provide an overview of the Canadian fertilizer market as it has existed, and to overlay the shocks introduced by the current situation to facilitate assessment of the feasibility and potential options for fertilizer supply going forward.

1 Russian-flagged vessels have also been banned from Canadian waters

Approach

This report analyses the potential for Canadian fertilizer market gaps and implications stemming from shocks relating to trade and external factors. To do so, it employs a stylized balance sheet approach drawing from data to estimate supply (production and imports) and demand (consumption and exports). To implement this, certain refinements are made to accommodate data limitations and the nuances of fertilizer market information in Canada. Statistics Canada reports data on shipments, production, and inventories of agricultural fertilizers from the Fertilizer Shipments Survey. Shipments are effectively sales volumes of agricultural fertilizers, fragmented by destination market, with limited regional fragmentation. Production data reports gross manufacturing of all fertilizer products in Canada at the national level. Inventories are reported by product at a regional level.[2]

Because the fertilizer shipments data include exports and domestic sales of imported products, in a balance sheet with independently obtained trade data, production is more precise than shipments. However, for anhydrous ammonia which is both an end-use nitrogen fertilizer and an intermediate product from which other nitrogen fertilizers (urea, urea-ammonium nitrate) are made, production overstates manufacturing of anhydrous ammonia for use directly as a fertilizer. Moreover, imports of anhydrous ammonia are very small. Thus, specifically for anhydrous ammonia, the shipments data are used in lieu of anhydrous ammonia production in the balance sheet model. Because production is not fragmented regionally, regional changes in inventory do not effectively adjust production and are excluded; review of the data show little change in annual inventories of nitrogen fertilizers and potash in any case.

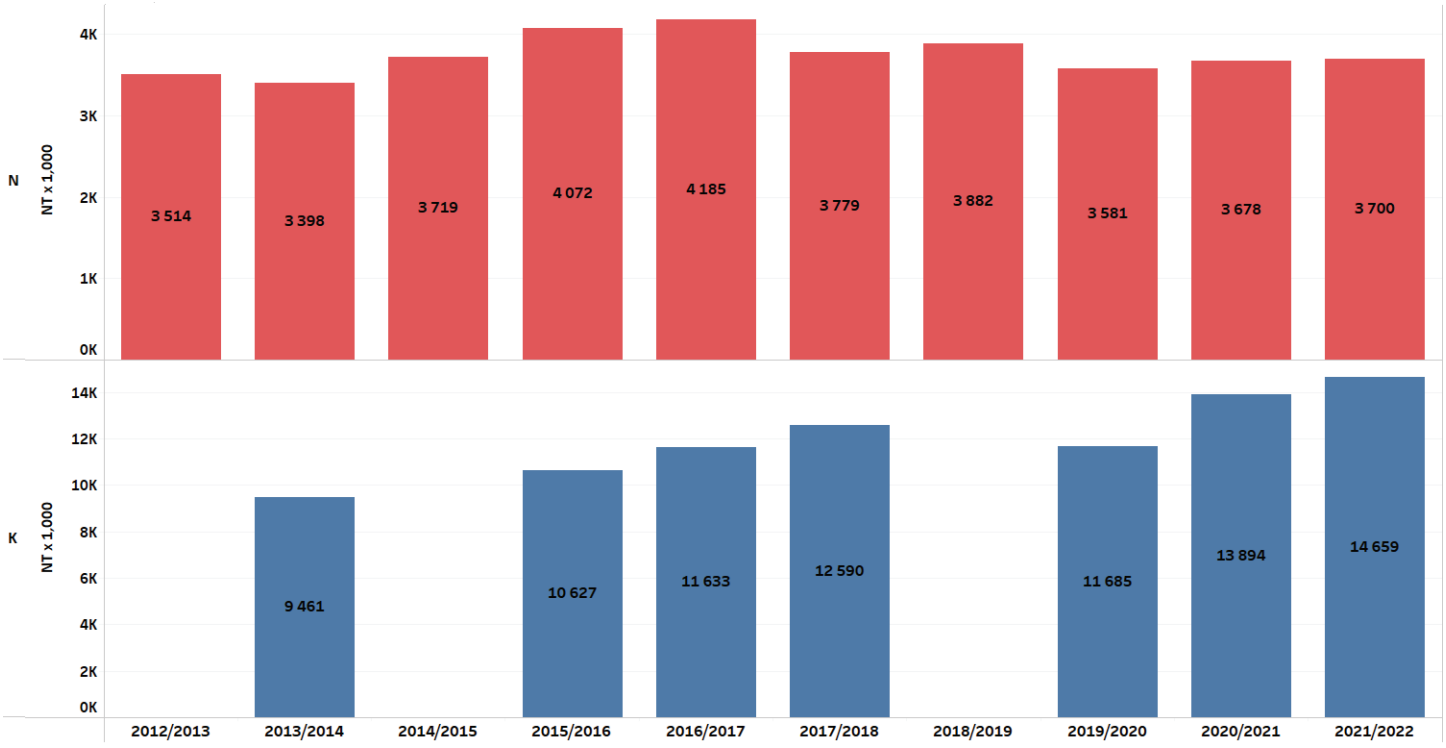
This report relies on data from Statistics Canada and several industry sources and, where possible, the data are reported in both product tonnes (PT) and nutrient tonnes (NT). To do so, the conversion factors in Appendix 2 are used to convert specific fertilizer ingredients from product tonnes to nutrient tonnes. The data deal with primary fertilizer ingredients; and the analysis focuses on the primary agricultural fertilizers in aggregate homogenous form, rather than as fertilizer blends.

2 See Fertilizer Shipments Survey questionnaire https://www.statcan.gc.ca/en/statistical-programs/instrument/5148_Q1_V3

Fertilizer Production

Figure 1 presents production data from Statistics Canada's Fertilizer Shipments Survey at the national level, from July to June of each year. As described above, total nitrogen production contains domestic shipments of anhydrous ammonia in lieu of production. Production is stated in NT volumes to allow adding together of the various fertilizer products. Canada is a producer of nitrogen and potassium fertilizers, but not of phosphorus fertilizers. As can be seen, production of nitrogen fertilizers has ranged around under 3.5 million NT to around 3.7 million NT. Production of potassium fertilizer has been increasing as well, recently just under 15 million NT.

Figure 1. Fertilizer production, Canada.



*K data are strictly from Table 32-10-0037 (production). N data are a combination of shipments data (NH3) and production data (net urea, UAN, AN, and AS). Ammonia (NH3) is taken from shipments to be certain that net ammonia (not gross) is being counted.

**2019-20 onward have smaller N values because a "net urea" variable became available in the production data and is approximately 400,000 NT lower than gross urea each year.

Sources:

(1) Statistics Canada. Table 32-10-0037. (2022). "Canadian fertilizer production, by product type and fertilizer year." [Product tonnes. Not available by province]. Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210003701.

(2) Statistics Canada. Table 32-10-0038. "Fertilizer shipments to Canadian agriculture and export markets, by product type and fertilizer year, cumulative data (x 1,000)." Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210003801.

Data on fertilizer production at the provincial or regional level are not published by Statistics Canada; however, production can be inferred by examining annual reports and websites of fertilizer companies operating manufacturing facilities in Canada. This is summarized in Table 1 below and is found in more detail in Appendix 3.

Table 1. Regional Fertilizer Production capacities (2021).

			N* (net)	K
Eastern Canada	Production	CF Ind.	263,676 NT 512,400 PT	0
	Total production capacity (East):		263,676 NT 512,400 PT	0
Western Canada		Nutrien	1,560,888 NT 3,183,600 PT	8,460,000 NT 14,100,000 PT
		Mosaic	0	4,740,000 NT 7,900,000 PT
		Yara	472,080 NT 1,092,000 PT	0
		CF Ind.	843,360 NT 1,327,200 PT	0
		Koch§	377,462 NT 460,320 PT	0
		Sherritt§	194,242 NT 236,880 PT	0
	Total production capacity (West):		3,711,708 NT 6,812,400 PT	13,200,000 NT 22,000,000 PT

*Based on 84% capacity utilization for net ammonia, urea, UAN, AN, and AS, as reported in companies' annual reports
§Source is the Nutrien Fact Book (cited below)

Sources:
(1) Nutrien. (2022). "Fact Book 2022." [Page 12/14: Canadian potassium/nitrogen production capacities]. Retrieved from https://nutrien-prod-asset.s3.us-east-2.amazonaws.com/s3fs-public/uploads/2022-06/Nutrien%202022%20Fact%20Book.pdf.
(2) Mosaic. (2022). "North America Business." Retrieved from https://mosaicco.com/North-America-Business.
(3) Yara. (2022). "Yara Integrated Report 2021." [Annual report, page 178: 0.7MT ammonia, 0.1MT nitric acid, 1.1MT urea, 0.2MT UAN]. Retrieved from https://www.yara.com/siteassets/investors/057-reports-and-presentations/annual-reports/2021/yara-integrated-report-2021.pdf/.
(4) CF Industries. (2022). "2021 Annual Report." [Page 4: 2021 capacities by N type and facility]. Retrieved from https://www.cfindustries.com/globalassets/cf-industries/media/documents/reports/annual-reports/cfindustriesannualreport2021.pdf.

The data in the table assume nitrogen plants operating at 84 percent capacity, given industry averages reported by CF Industries. Canadian fertilizer production is heavily focused in western Canada; little nitrogen production takes place in eastern Canada. This is consistent with the availability of natural gas resources in Alberta and Saskatchewan, which is a major input in nitrogen fertilizer manufacturing (using the Haber-Bosch process). Potash is mined in large-scale facilities in Saskatchewan. The regional production capacities listed in Table 1 account for the preponderance of national production summarized in Figure 1, and suggest that on a nutrient basis, about 6 percent of nitrogen fertilizer, and no potash, is produced in eastern Canada.

Imports/Exports

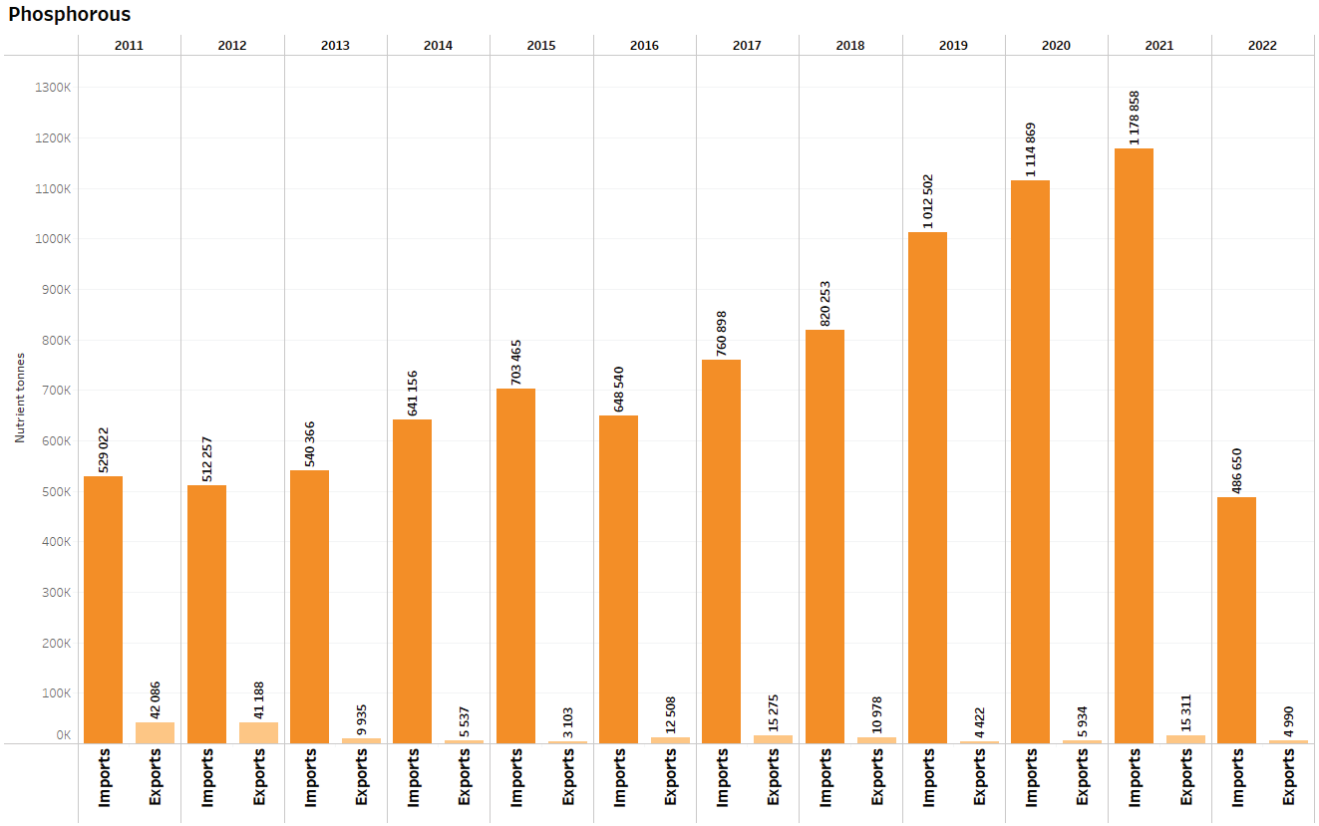
Import and export data were obtained from the Canadian International Merchandise Trade Web Application (CIMT, 2022). The data are collected at the provincial level and are traceable according to trade partner: country, State in the US, or province in Canada. Trade values are reported in kilograms and by HS code, which are then sorted into tonne volumes of actual N, P, and K using the nutrient content values in Appendix 2.

Imports and exports are presented below in Figures 2 through 4 (in nutrient tonnes) as an annual time series for Canada: 2011 to 2022 (2022 data are as at July 2022). For nitrogen fertilizers (red bars), imports have steadily increased to around 1 million tonnes, while exports have gently decreased to a range around about 1.5 million tonnes. This leaves Canada a net exporter, on an NT basis. Canada's phosphorus fertilizer imports are up markedly, more than doubling between 2014-15 and 2021. Increases in imports of phosphorus fertilizers also tend to increase nitrogen imports, as two of the major phosphorus fertilizers (MAP and DAP) also contain nitrogen: 11 percent, and 18 percent, respectively; this nitrogen is credited in the volumes of nitrogen fertilizer imports. Canada is the largest exporter of potash, exporting the equivalent of about 14 million tonnes on an actual K basis. Imports of potash are exceptionally small.

Figure 2. Nitrogen Fertilizer Imports and Exports, Actual Nutrient Basis, Canada.

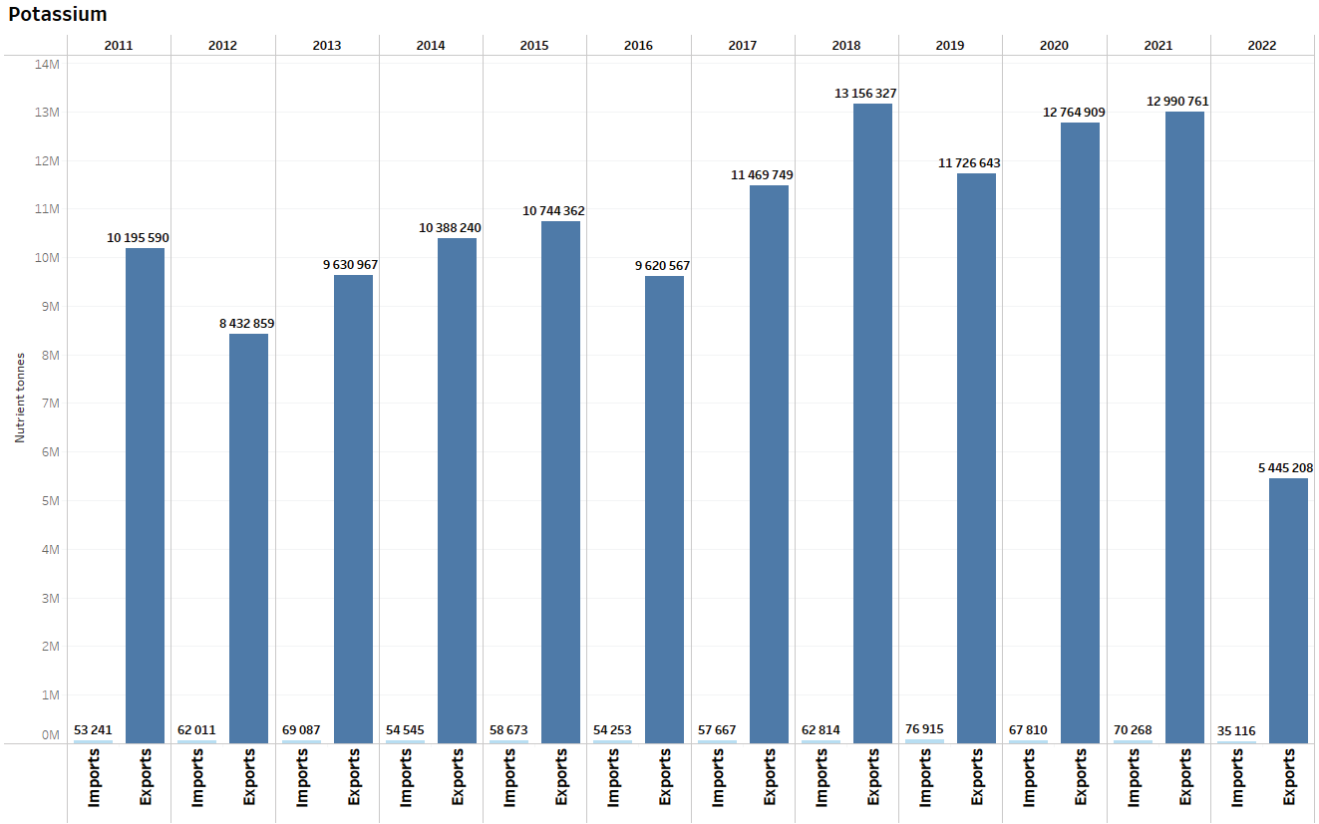
Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Figure 3. Phosphorous Fertilizer Imports and Exports, Actual Nutrient Basis, Canada.



Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Figure 4. Potassium Fertilizer Imports and Exports, Actual Nutrient Basis, Canada.

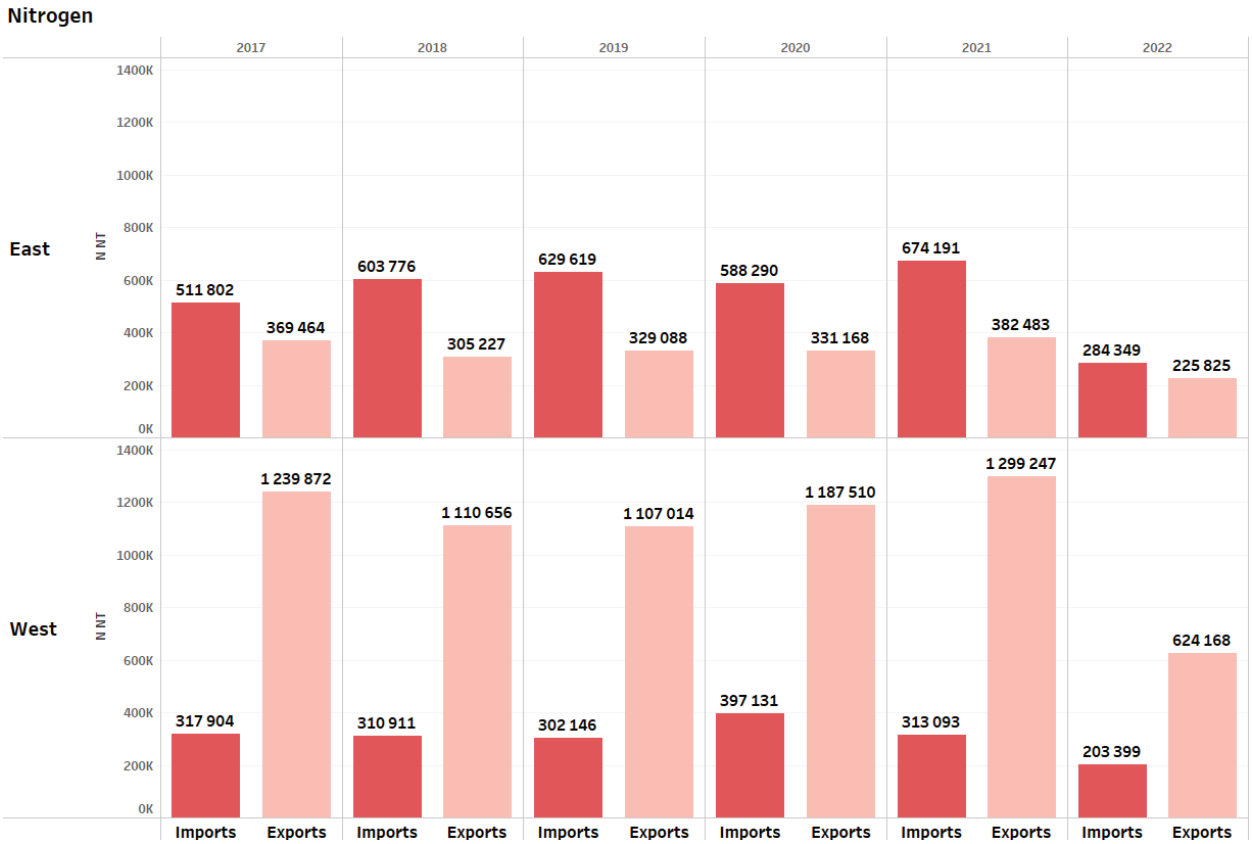


Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Figures 5 through 7 present fertilizer trade fragmented into eastern and western Canada from 2017 through 2022 year to date. "Eastern Canada" comprises Ontario, Quebec, and the Atlantic provinces. "Western Canada" comprises British Columbia, Alberta, Saskatchewan, and Manitoba.

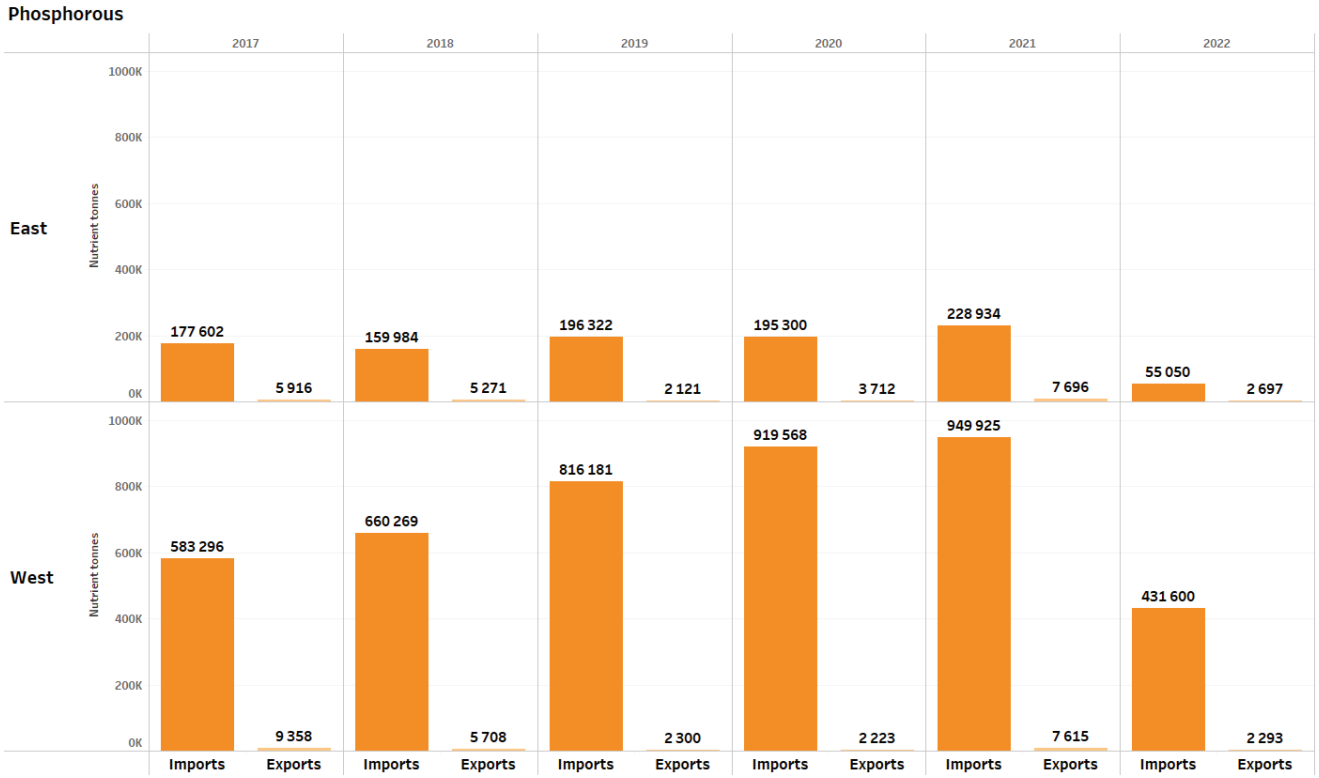
Nitrogen imports have broadly increased in eastern Canada and to a lesser degree in western Canada. Nitrogen exports have remained relatively steady across both regions. Phosphorous imports have increased in the East, and especially in the West, where imports nearly doubled from 2017 to 2021 (391,700 to 793,121 NT). Potash exports – a mainstay in Saskatchewan – have steadily increased in western Canada, with 2022 expected to catch up by the end of the calendar year.

Figure 5. Nitrogen Fertilizer Imports and Exports, Eastern and Western Canada, Actual Nutrient Basis.



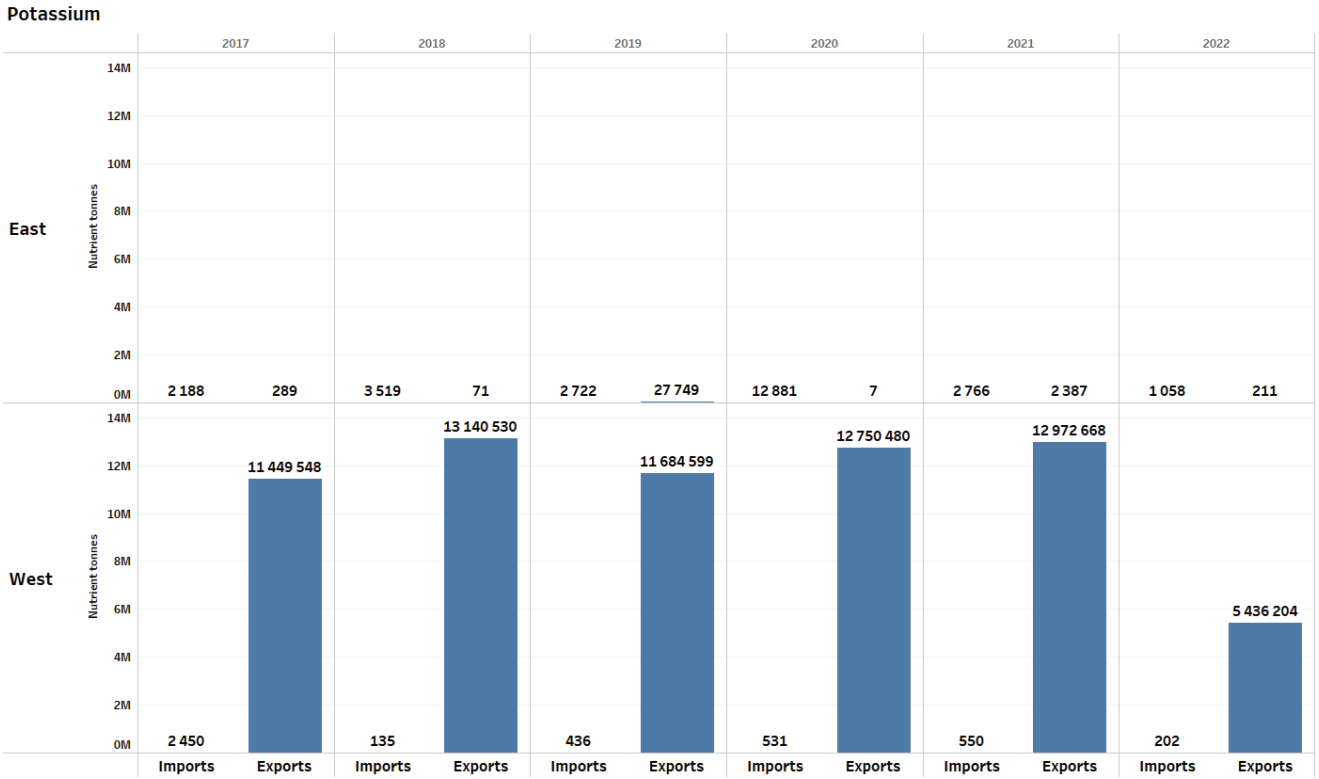
Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous Ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Figure 6. Phosphorous Fertilizer Imports and Exports, Eastern and Western Canada, Actual Nutrient Basis.



Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous Ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Figure 7. Potassium Fertilizer Imports and Exports, Eastern and Western Canada, Actual Nutrient Basis.



Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous Ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Balance Sheet

With data on fertilizer production as well as imports and exports, a type of balance sheet can be used to estimate domestic consumption. This identity, illustrated in Figure 8, is rooted in basic economic theory which states that in market equilibrium, supply (production + imports) equals demand (consumption + exports). This identity ignores changes in inventories, which are assumed to be relatively small.

Figure 8. Balance sheet identity.

AVAILABILITY			=	UTILIZATION		
PRODUCTION	+	IMPORTS	=	CONSUMPTION	+	EXPORTS

This expression implies that fertilizer consumption must be equal to production plus imports less exports. Table 2 below estimates the balance sheet at the national level. Trade and production data are averaged over 2018-19 to 2020-21 to obtain a baseline and to minimize the prospective error associated due to fertilizer annual stocks carried over and changes in stocks.

Table 2 tells us that consumption of nitrogen fertilizers in Canada, on a nutrient basis, is about 3 million nutrient tonnes. Consumption of phosphorus fertilizers are just over 1 million nutrient tonnes, and potassium represents just under 1 million nutrient tonnes.

Table 2. Balance sheet identities for N,P,K (Canada).

	AVAILABILITY			=	UTILIZATION		
	PRODUCTION*	+	IMPORTS‡	=	CONSUMPTION¤	+	EXPORTS‡
N	3,653,000 NT 8,304,300 PT	+	968,156 NT 4,176,202 PT	=	3,075,653 NT § 9,490,937 PT	+	1,545,503 NT 2,989,565 PT
	4,621,156 NT 12,480,502 PT			=	4,621,156 NT 12,480,502 PT		
P	0 NT 0 PT	+	1,102,076 NT 2,271,823 PT	=	1,093,520 NT 2,252,818 PT	+	8,556 NT 19,005 PT
	1,102,076 NT 2,271,823 PT			=	1,102,076 NT 2,271,823 PT		
K	13,413,000 NT 22,354,000 PT	+	71,665 NT 124,116 PT	=	990,561 NT 1,646,491 PT	+	12,494,104 20,831,625 PT
	13,484,665 NT 22,478,116 PT			=	13,446,449 NT 22,478,116 PT		

* Production are the average of 2019/20 through 2021/22; for N, it is the sum of shipments of ammonia (NH3) to Canada, US, and other countries (1.153 M NT) plus production of urea, UAN, AN, and AS (2.5 M NT).
¤ Consumption is the residual after plugging in actual data for imports, exports, and production.
§ Nitrogen is in greatest demand of all three nutrients in terms of NT and PT.
‡ Imports and exports are the averages of 2019 through 2021 calendar years.

Sources:
(1) Statistics Canada. (2022). "Canadian fertilizer production, by product type and fertilizer year." Table 32-10-0037. [Product tonnes. Not available by province]. Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210003701.
(2) Statistics Canada. (2022). Canadian International Merchandise Trade Web Application. Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.
(3) Statistics Canada. Table 32-10-0038. "Fertilizer shipments to Canadian agriculture and export markets, by product type and fertilizer year, cumulative data (x 1,000)." Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210003801.

Table 3 repeats this analysis, but at a regional level. Again, consumption is the residual after plugging in all three other variables. For imports and exports, provincial data are obtained for the 10 provinces and then sorted into East and West.

Fragmenting the national fertilizer market regionally is critical in understanding market dynamics; however, it also introduces inherent complexity and sources of error. Production data is not fragmented provincially or regional in Statistics Canada reporting, so this must be inferred from fertilizer manufacturer annual reports, often reporting facility production capacity rather than production. Transfers of product between Eastern and Western Canada are not accounted for under imports and exports (provided that regional transfers do not cross an international border); this is a potential source of error.

Appendix 3, which presents rail transport volumes of fertilizers in Canada, provides some context for this. Freight volumes of potash represent 85-90 percent of rail volumes moved from west to east, recently ranging around 700,000 product tonnes (or 420,000 potassium nutrient tonnes). The volumes of non-potash fertilizers are relatively small, typically 100,000 tonnes or less. The implication is that interregional movement introduces little error to regional analyses of nitrogen and phosphorus fertilizers, but that important caveats apply to the regional analysis dealing with potassium fertilizers.

Table 3 shows that eastern Canada has an estimated consumption of nitrogen fertilizers of about 545,000 nutrient tonnes, about 202,000 tonnes actual phosphorus and 54,000 tonnes actual potassium. Western Canada has nitrogen consumption of about 2.9 million NT, about 892,000 tonnes of actual phosphorus and about 723,000 tonnes of actual potassium. Potassium consumption is more likely approximately equally shared between eastern and western Canada; the import/export data in Table 3 do not reflect interregional potash shipments from West to East (see Appendix 2 for data on fertilizer shipments by rail, in product tonnes, of potash and non-potash fertilizers). With the caveat regard regional interpretation of potassium consumption observed, it can be anticipated that the estimate of eastern consumption of potassium fertilizers is biased low, with a portion of the estimated western potassium consumption containing the eastern volume.

Table 3. Fertilizer balance sheet, regional

		AVAILABILITY			=	UTILIZATION		
		PRODUCTION¤	+	IMPORTS‡	=	CONSUMPTION*	+	EXPORTS‡
EAST	N	263,676 NT 512,400 PT	+	630,700 NT 1,990,330 PT §	=	546,796 NT 1,848,268 PT §	+	347,580 NT 654,462 PT
		894,376 NT 2,502,730 PT			=	894,376 NT 2,502,730 PT		
	P	0 NT 0 PT	+	206,852 NT 429,885 PT	=	202,342 NT 420,081 PT	+	4,510 NT 9,804 PT
		206,852 NT 429,885 PT			=	206,852 NT 429,885 PT		
	K	0 NT 0 PT	+	65,228 NT 113,111 PT	=	54,196 NT** 94,516 PT	+	11,032 NT 18,595 PT
		65,228 NT 113,111 PT			=	65,228 NT 113,111 PT		
WEST	N	3,448,032 NT 6,300,000 PT	+	337,457 NT 2,149,695 PT §	=	2,587,565 NT 6,114,846 PT §	+	1,197,924 NT 2,334,849 PT
		3,785,489 NT 8,449,695 PT			=	3,785,489 NT 8,449,695 PT		
	P	0 NT 0 PT	+	895,225 NT 1,841,937 PT	=	891,179 NT 1,892,736 PT	+	4,046 NT 9,201 PT
		895,225 NT 1,841,937 PT			=	895,225 NT 1,841,937 PT		
	K	13,200,000 NT 22,000,000 NT	+	6,437 NT 11,005 PT	=	723,365 NT** 1,197,975 PT	+	12,483,072NT 20,813,030 PT
		13,206,437 NT 22,011,005 PT			=	13,206,437 NT 22,011,005 PT		

¤ Production is the sum of capacities from fertilizer companies' annual reports, multiplied by an 84% capacity utilization factor.
* Consumption is an estimate based upon the residual after plugging in actual data for imports, exports, and production.
§ Nitrogen product tonnes of imports (and therefore consumption PT) are overstated because they include MAP and DAP; this overstatement does not apply to nutrient tonnes.
‡ Imports and exports are the averages of 2019 through 2021 calendar years.
** K consumption in the East is understated (and consumption in the West is overstated) because potash shipments from West to East do not appear in the trade data. See Appendix 2. Fertilizer rail shipments, western Canada to eastern Canada.

Sources:

(1) Statistics Canada. (2022). Canadian International Merchandise Trade Web Application. Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

(2) Nutrien. (2022). "Fact Book 2022." [Page 12/14: Canadian potassium/nitrogen production capacities]. Retrieved from https://nutrien-prod-asset.s3.us-east-2.amazonaws.com/s3fs-public/uploads/2022-06/Nutrien%202022%20Fact%20Book.pdf.

(3) Mosaic. (2022). "North America Business." Retrieved from https://mosaicco.com/North-America-Business.

(4) Yara. (2022). "Yara Integrated Report 2021." [Annual report, page 178: 0.7MT ammonia, 0.1MT nitric acid, 1.1MT urea, 0.2MT UAN]. Retrieved from https://www.yara.com/siteassets/investors/057-reports-and-presentations/annual-reports/2021/yara-integrated-report-2021.pdf/.

(5) CF Industries. (2022). "2021 Annual Report." [Page 4: 2021 capacities by N type and facility]. Retrieved from https://www.cfindustries.com/globalassets/cf-industries/media/documents/reports/annual-reports/cfindustriesannualreport2021.pdf.

Canadian Market Observations

The data on the Canadian market illustrate the following. Canada's consumption is entirely import dependent with regard to phosphorus; conversely, Canada is surplus in potassium fertilizer such that exports overwhelm domestic consumption by a very large margin. Nitrogen is an intermediate case in which Canada's production is just over its total consumption, with the market coming into balance with net exports.

However, the regional picture is very different. Eastern Canada has a nitrogen consumption (requirement) of about 547,000 NT and with production capacity of about half that amount. Nitrogen imports (631,000 NT) actually exceed estimated consumption, but in turn supply material nitrogen fertilizer exports (347,000 NT). Western Canada's nitrogen fertilizer production (3.4 million NT) markedly exceeds its estimated consumption (about 2.9 million NT), which in combination with nitrogen imports, it leverages into nitrogen exports.

Regional considerations regarding phosphorus are essentially the same; neither region has any production, and any exports are based on re-exports. The very large production of potash in western Canada can easily serve consumption in both the West and the East and retain extensive export capacity.

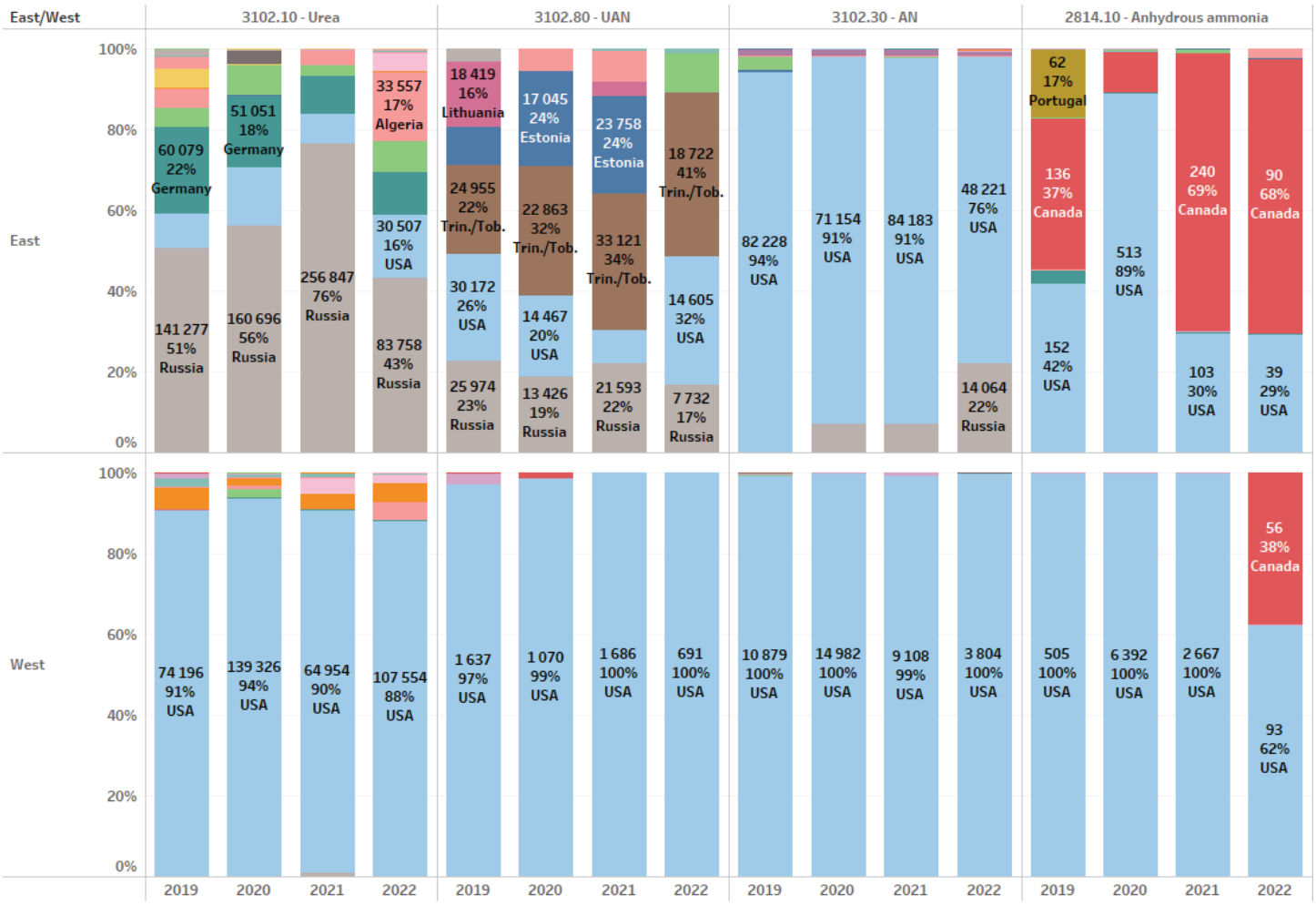
Thus, the strategic issue for Canada, in an environment of disrupted fertilizer market dynamics and shortages in the nitrogen fertilizer complex, is on eastern nitrogen balance and the potential threat posed by loss of import market access.[3]

3 Phosphorus security of supply is also an important issue: Canada is wholly dependent upon imports. But this has existed for some time as more of a structural matter than the current strategic issue that is focused on nitrogen.

Nitrogen Regional Trade Balances

Figures 9 and 10 below present data on regional nitrogen fertilizer imports, by major product type, according to supplying country. The information illustrated presents stark differences between western and eastern Canada. Western Canada relies almost solely on the US for nitrogen fertilizer imports, and what is imported into western Canada is overwhelmingly urea. Eastern Canada imports material volumes of urea, UAN, and AN from a more diverse set of sources, including the US, Russian Federation, Germany, Estonia, and Trinidad and Tobago. It is also clear that very little nitrogen fertilizers are moving between western and eastern Canada.

Figure 9. Regional Import Shares of Nitrogen Fertilizers by Source and Product, NT



Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous Ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Figure 10. Regional Imports of Nitrogen Fertilizers by Product and Source, NT (2019-2022)

			Grand Total	Canada				USA				Russia				Belarus	Ukraine		Germany			
				2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022	2019	2019	2020	2019	2020	2021	2022
East	3102.10 - Urea	N NT	1 094 560	29	37	243	159	23 456	41 244	24 393	30 507	141 277	160 696	256 847	83 758		4 347	0	60 079	51 051	31 949	20 099
		% of total imports (2019 to 2022)	100%	0%	0%	0%	0%	8%	14%	7%	16%	51%	56%	76%	43%		2%	0%	22%	18%	10%	10%
	3102.80 - UAN	N NT	330 230					30 172	14 467	8 229	14 605	25 974	13 426	21 593	7 732	3 696						
		% of total imports (2019 to 2022)	100%					26%	20%	8%	32%	23%	19%	22%	17%	3%						
	3102.30 - AN	N NT	321 471					82 228	71 154	84 183	48 221	7	5 498	6 457	14 064							143
		% of total imports (2019 to 2022)	100%					94%	91%	91%	76%	0%	7%	7%	22%							0%
	2814.10 - Anhydrous ammonia	N NT	1 417	136	59	240	90	152	513	103	39								13	0	0	0
		% of total imports (2019 to 2022)	100%	37%	10%	69%	68%	42%	89%	30%	29%								3%	0%	0%	0%
West	3102.10 - Urea	N NT	424 523	0	0	3	5	74 196	139 326	64 954	107 554	0		710					0	0	0	0
		% of total imports (2019 to 2022)	100%	0%	0%	0%	0%	91%	94%	90%	88%	0%		1%					0%	0%	0%	0%
	3102.80 - UAN	N NT	5 151	4	15			1 637	1 070	1 686	691	0										
		% of total imports (2019 to 2022)	100%	0%	1%			97%	99%	100%	100%	0%										
	3102.30 - AN	N NT	38 925					10 879	14 982	9 108	3 804			7								
		% of total imports (2019 to 2022)	100%					100%	100%	99%	100%			0%								
	2814.10 - Anhydrous ammonia	N NT	9 727				56	505	6 392	2 667	93											
		% of total imports (2019 to 2022)	100%				38%	100%	100%	100%	62%											

Source: Canadian International Merchandise Trade Web Application. [Chapter 31 HS codes + 2814.10 – Anhydrous Ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

Eastern Canada has used Russia as a supplier of imported urea, UAN, and, to a lesser degree, of AN. Its reliance on Russian urea has increased over the last three years, from 51% of total imports in 2019, to 56% and 76% in 2020 and 2021. In the three years prior to 2022, imports of Russian urea into eastern Canada increased from 141 thousand NT to 256 thousand NT. UAN imports from Russia into eastern Canada have also been significant but more variable, ranging from just over 19 thousand NT to just over 37 thousand NT.

Although the 2022 trade data are only up to and including August 2022, some interesting breaks in the trends emerge, especially for urea. For urea imports illustrated in Figure 9, eastern Canada has dramatically reduced the amount imported from Russia, from 256,847 NT in 2021 to only 83,758 NT to the end of August 2022. Figure 11, which plots the monthly imports of urea, shows the trend more clearly: in 2022 there have been no imports of Russian urea since May, unlike 2020 and 2021. To make up this shortfall, Figure 9 shows that the share of urea imports from both Algeria (pink) and the USA (blue) to eastern Canada have increased. In terms of nutrient tonnes, urea imports to western Canada from the USA have nearly doubled, from 64,954 in all of 2021 to 107,554 already to August 31, 2022.

In UAN imports, eastern Canada's reliance on Russia has also decreased in 2022 compared to previous years. Again, this shortfall is absorbed by other countries: Netherlands (light green) and the United States, which have increased from 2021 to 2022 both in terms of NT and share of total imports.

The essential finding is that since the 35 percent duties applicable to Russian product appear to be economically prohibitive – urea is not being imported from Russia, when it was previously – eastern Canada has effectively lost access to what has recently been between 141 thousand and 256 thousand NT of Russian urea, and 19 thousand to 37 thousand NT of Russian UAN due to sanctions and retaliatory actions taken against Russia due to the Russian invasion. Canada must now thoroughly consider alternative sources.

Alternative Nitrogen Sources

The supply gaps for eastern Canada are essentially urea and, to a lesser extent, UAN. Anhydrous ammonia is exported from eastern Canada. Table 4 below provides an overview of the international supply and demand balance for urea for 2018-2020 as a baseline reference (International Fertilizer Association, 2020).

Figure 11. Canadian Imports of Urea from Russia and Elsewhere, Volume (PT) and Value $ (Monthly 2020-2022).

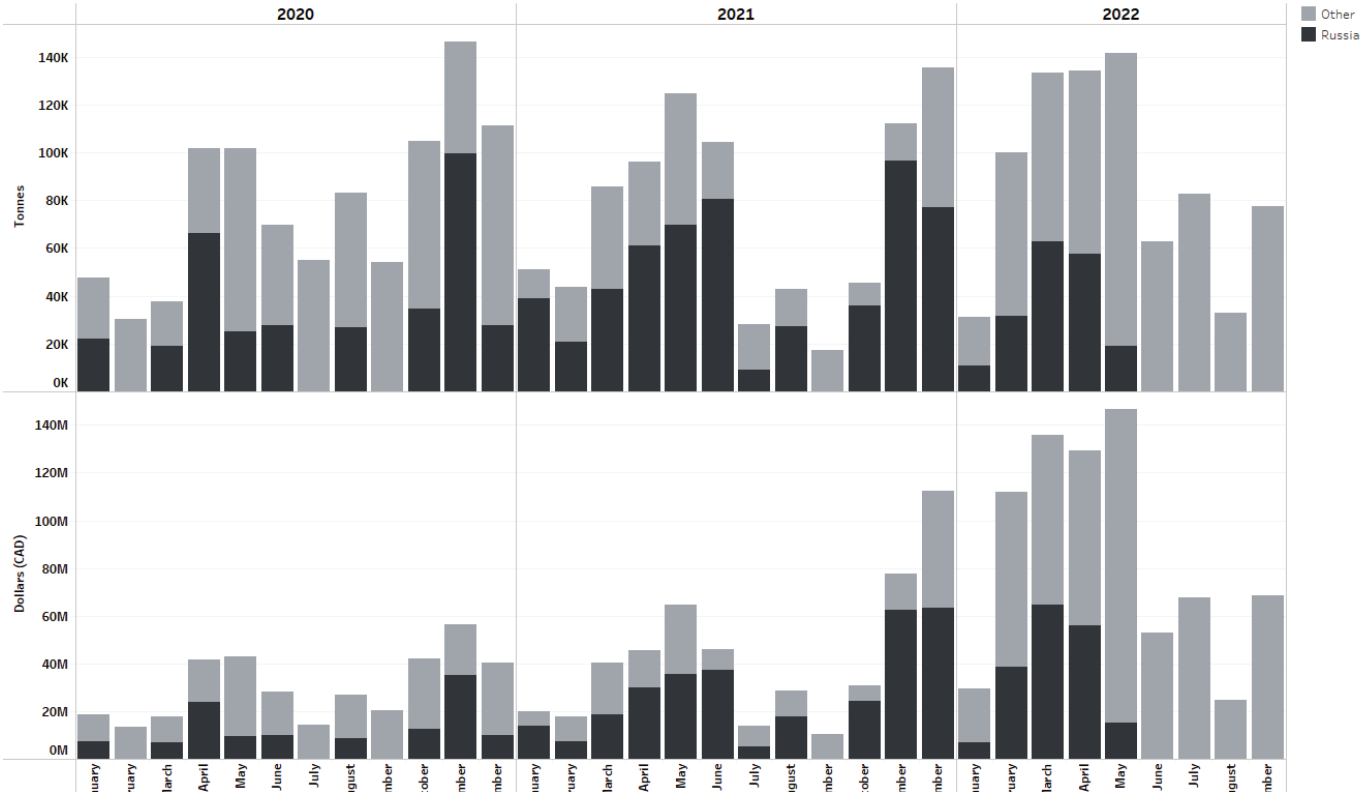


Table 4. World Urea Supply and Demand Summary, 2018-20 (Thousand Nutrient Tonnes).

	Production			Imports			Consumption			Exports		
	2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
Total West Europe	2,713.20	2,703.30	2,740.10	825.5	879.1	856.8	4,306.20	4,136.70	4,080.80	2,418.50	2,312.60	2,197.50
Total EU 28	4,317.50	4,320.70	4,518.70	1,287.30	1,370.80	1,442.60	6,113.10	6,090.40	6,024.60	3,082.70	3,140.40	2,948.70
Total Central Europe	1,321.60	1,300.30	1,481.50	369.6	388	490.6	1,615.40	1,820.40	1,841.00	663.4	908	850.2
Total East Europe & Central Asia	6,261.70	7,021.80	7,628.10	3,829.40	4,145.60	4,689.10	2,849.70	3,211.00	3,275.30	417	334.6	336.4
Total North America	6,623.90	6,859.40	7,162.80	716.9	656.8	770.4	8,947.70	8,691.50	8,918.00	3,040.80	2,488.80	2,525.40
Total Latin America	1,673.40	1,578.10	1,400.80	488.2	504.5	425.5	5,863.60	6,023.00	6,937.60	4,678.50	4,949.30	5,962.30
Total Africa	5,273.30	5,099.30	5,357.70	4,063.40	3,865.20	3,904.70	2,425.30	2,487.00	2,897.40	1,215.30	1,252.70	1,444.50
Total West Asia	11,115.70	10,619.60	10,813.20	9,581.50	8,143.50	8,318.40	2,764.30	3,668.20	3,733.40	1,229.70	1,192.10	1,238.60
Total South Asia	14,255.00	14,713.70	15,198.90	28.9	-	-	18,345.20	20,066.60	20,537.00	4,119.20	5,353.00	5,338.10
Total East Asia	29,611.00	31,185.30	31,512.00	2,364.50	3,845.20	4,474.50	30,593.10	29,843.40	29,700.80	3,346.50	2,503.30	2,663.40
Total Oceania	204.4	211.6	191.4	-	-	4.6	1,300.40	1,327.70	1,559.40	1,096.00	1,116.20	1,372.60
Total Various	-	-	-	-	-	-	42.4	17.1	5.8	42.4	17.1	5.8
Total World	79,053.40	81,292.60	83,486.60	22,267.60	22,427.60	23,934.50	79,053.20	81,292.60	83,486.60	22,267.40	22,427.60	23,934.50

Source: Source: International Fertilizer Association. (2020). "Nitrogen Products: Urea." Retrieved from https://www.ifastat.org/supply/Nitrogen%20Products/Urea.

• During this period, the largest regional urea producers were East Asia (dominated by China), South Asia (including India), and West Asia (including the Middle East).

• The leading exporters were West Asia, Eastern Europe + Central Asia, and Africa.

• The top consumers were East Asia, South Asia, and North America (Canada and the US).

• The largest importers were Latin America, South Asia, the EU, and East Asia.

With 2018-20 as a baseline, the current context can be overlaid to interpret the likely changes in the global urea supply and demand situation.

• Production: Production of N fertilizers in the EU has effectively shut down as of late summer 2022 under an evolving energy crisis and extreme prices of natural gas.

• Exports: Among major exporters, Russia faces a wartime-and-sanctions environment that must surely limit the availability of its exports to traditional customers. China has curtailed N fertilizer exports. The EU lacks production to support its historical levels of export. China has also been a significant export supplier, but now has a ban on exports of rock phosphate (HS 2512) and has invoked export license requirements on a broad swath of fertilizers (HS 2827;3102;3103;3104;3105), effectively limiting exports (Laborde and Mamun, 2022).

• Imports: The table shows that the largest importers are Latin America, and the largest producers, South and East Asia. The growing energy crisis will surely have hampered urea production among the largest producers, who will wish to backfill with increased imports. Urea imports by the EU are likely to increase as it attempts to replace its own lost urea production and to access fertilizer to support yields and recover from a poor 2022 harvest and lost imported grain supplies from Ukraine.

The overall global market situation is thus indicative of widespread scarcity with respect to urea.

Similar global supply and demand tables for UAN are not publicly available. However, based on 2019 capacity data from the International Fertilizer Association, approximately 84 percent of the UAN manufacturing is in North America, Eastern Europe + Central Asia, and the EU. By itself, North America is about 47 percent of global UAN capacity, whereas North America only has about 8 percent of urea manufacturing capacity. The situation for UAN should be similar to urea with regard to Eastern Europe + Central Asia, and the EU, but with the North American market a much larger influence with a more stable energy situation, market scarcity should be mitigated. At the same time, on a NT basis, the urea market is about 10 times the size of UAN market.

Filling nitrogen fertilizer market gaps with inter-regional shipments within Canada would appear not to be a solution. While Western Canada is N surplus, that surplus is largely in the form of anhydrous ammonia, which is not a perfect substitute for urea or UAN; the west has relatively small deficits in both urea and UAN which are filled by product imported from the US. Eastern Canada is also surplus anhydrous ammonia and deficit in urea (in particular) and also UAN. In other words, the surpluses in Western Canada do not address the deficits in Eastern Canada, and in any event the costs of rail movement from west to east in Canada are likely to greatly exceed the cost of vessel movement from international suppliers, making freight cost an economic barrier to movement of nitrogen from west to east.

Conclusions and Policy Options

Looking forward from the current situation, it is clear that globally, nitrogen will be in short supply with major producers cutting back (EU) and major exporters curtailing exports (China). At the same time, strong crop prices are strengthening fertilizer demand, opening up a gap between global demand and supply.

Canada is in a unique situation with regard to accessing nitrogen fertilizers, particularly associated with its treatment of Russian product and the withdrawal of Russia's Most Favored Nation status by Canada and restrictions on Russian navigation in Canadian waters. Canada's allies and agricultural competitors, notably the US, have not levied Russian fertilizer exports in the same way.

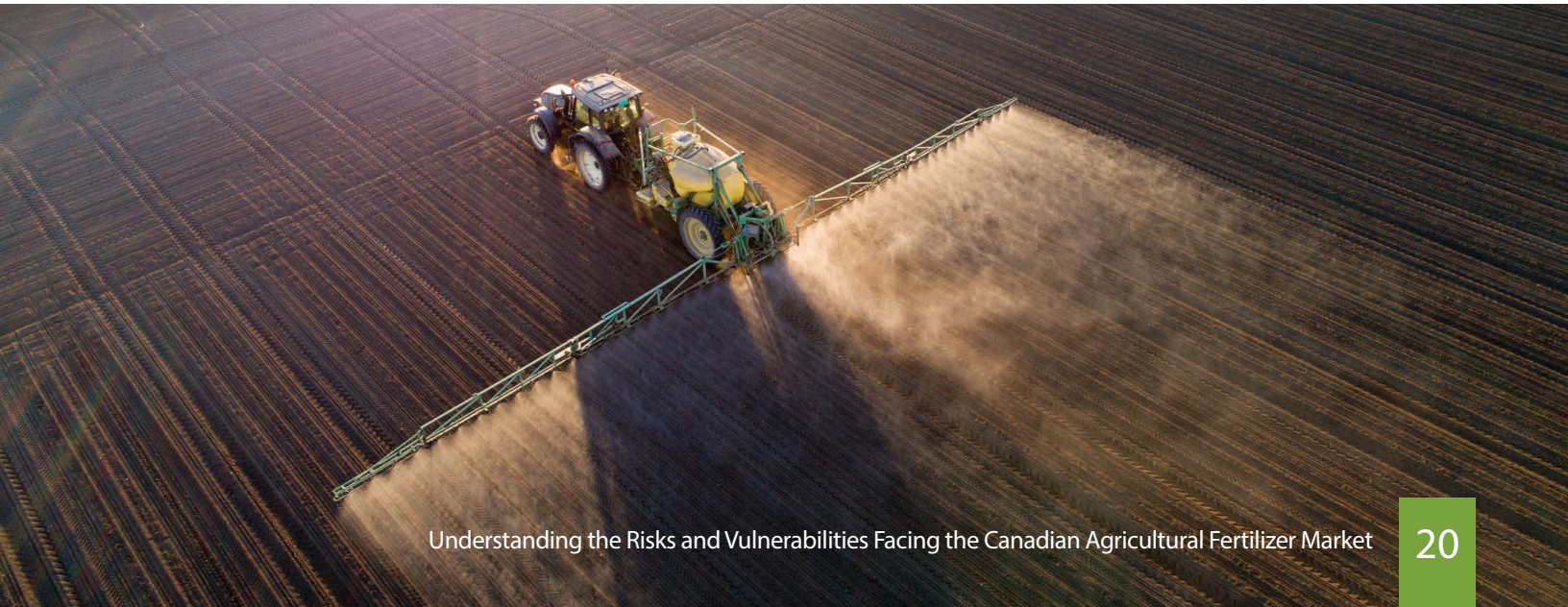
The adversity in Canada is focused on eastern Canada, largely on urea and to a lesser extent on UAN. Anhydrous ammonia, both a fertilizer and an intermediate product used in manufacturing urea and UAN, is much less affected. Both eastern and western Canada are surplus in anhydrous ammonia. Eastern Canada has some UAN production but imports some UAN and all of its urea supplies. Western Canada has material urea manufacturing capacity and some UAN manufacturing, but also imports urea and UAN. There are few alternative international sources of urea and UAN to Russia that Canada can import from, as a result of trade restrictions (e.g., China), lack of exportable surpluses (e.g., EU), logistical challenges as a legacy of the pandemic and labour shortages, and generally expensive energy feedstock. Canada should be in a strong position to compete for available imports with other countries on the basis of the efficiency of Canadian agriculture and strong crop prices; however, it will need to seek out and secure alternate supplies and it can be anticipated that there will be price impacts.

While N fertilizer comes principally in three forms, equivalent on a nutrient basis, there are important constraints affecting producers switching among them relating to equipment, storage facilities, timing and flexibility of use.

Anhydrous ammonia is a gas, requiring pressurized storage facilities and accompanying safety considerations, and is sub-surface injection applied rather than surface broadcast, and is not applied in combination with herbicides. UAN is a liquid, requiring liquid storage and application equipment, is surface broadcast or sub-surface applied, and offers the potential for tank mixes with certain herbicides. Urea is a granular solid product with less specific storage and handling requirements, can be surface broadcast or sub-surface applied, and can be impregnated with certain herbicide products. Each product handing and application setup thus entails its own advantages and disadvantages, and accompanying economic tradeoffs.

While Canadian customers could choose to pay the 35 percent duty and import Russian fertilizers, it is reasonable to assume that the cost impacts will render this option infeasible. Observed urea import trends in 2022 validate this assumption. The most obvious policy measure that could be employed to address the situation is to grant an exemption to the additional duties applied to fertilizer imported by Canada from Russia, or some sort of rebate to duties applied. There are two critical points of context that support this approach. First, with nitrogen fertilizer in such short supply globally, Russia has extensive markets to which it can export, and Canada attaching a 35 percent duty to its fertilizer exports does very little to diminish this as there are many other customers. Rather, the injury effect falls on Canadian fertilizer customers faced with having to source alternate supplies at higher prices and/or reduced availability of product. In implementing this policy option it will be important to consult with industry, as failure to create clarity of policy direction and implementation could create competitive distortions in the immediate term, and amplify the impact of the duty in the course of lifting it.

Secondly, Canada's approach to retaliation through the removal of MFN status differs from other countries, notably the US. Under Canada's approach, all imports from countries to whom Canada has not granted MFN status are levied an additional 35 percent duty in addition to any other duties applied. US takes a different approach, and targets specific products/HS codes for countries it has not granted MFN status to; the US has not placed any additional duties on fertilizers in HS 31, and its MFN tariffs for products in HS 31 are zero. The implication is that, for the same fertilizers imported from Russia, US fertilizer prices will be materially lower. Yet, Canada and the US have free trade in fertilizers, as well as the vast majority of crops and related animal products linked to the use of fertilizers. Canada's cost competitiveness could materially suffer from this. Alternatively, if US markets co-mingle Russian product with US and other origin product, it could introduce some difficulty in assigning origin for the purposes of Canada's duties against Russia. In turn this could be perceived as undermining or circumventing Canada's trade policy.



Other options exist. Canada has an opportunity to further enhance trade relations with allies to adapt to developments in less friendly countries. This can be advanced by creating a policy and infrastructure climate for markets and investment that diversifies the fertilizer supply between domestic and foreign sources. For example, the US has been an important source of nitrogen fertilizer imports by Canada. The US has not been subject to some of the extremes in energy feedstocks experienced elsewhere, and the prospect exists that increased imports of urea and UAN could help to fill the gap in eastern Canada.

In aggregate, Canada is trade surplus in nitrogen fertilizers, owing to exportable surpluses of anhydrous ammonia in both eastern and western Canada. This surplus anhydrous ammonia could be redeployed into domestic manufacturing of urea and UAN to bring the Canadian nitrogen market more into balance based on its own production. This would require investment in facilities or expansion of existing manufacturing facilities, with public support used to facilitate this investment; however, several caveats to this approach are immediately apparent. Firstly, it assumes that hostilities with Russia and risks associated with import access will continue to occur long-term. Secondly, it assumes that each region has or could have the production capacity for the types of N products that are most needed in that region. Currently, the East has only one N production facility and it produces only small amounts of anhydrous ammonia and UAN, and no urea. The West, with its current facilities, has greater expansion capacity and would therefore have to supply the East with its N needs, but shipping across Canada by rail is probably cost-prohibitive especially compared to importing by vessel) and often fails to meet crucial deadlines. Finally, if these investments were efficient and profitable, it is unclear why private incentives would not be sufficient and indeed why these investments might not have already occurred. Fertilizer facility expansions entail very high investment costs and multiple years to develop and bring up to full capacity; shorter-term solutions are required, as farmers will be sourcing inputs for the 2023 crop year.

Another alternative is to facilitate expansion of the use of anhydrous ammonia as a fertilizer in Canada, with Canada's surplus of anhydrous ammonia

redeployed accordingly. However, this would require that a broader range of farm customers previously using urea or UAN as a nitrogen fertilizer get access to storage facilities, application equipment, education and training, et cetera, to make the switch to anhydrous ammonia. It is acknowledged that while this approach leverages available anhydrous ammonia, it leaves important gaps – notably for perennials and other crops that require surface broadcast applications – such as winter wheat.

Canada would be facing a major nitrogen fertilizer crunch on pricing and supply, the result of a range of global factors, regardless of the reverberations from the Russian invasion of Ukraine. However, the invasion and Canada's trade policy response to it creates very clear bottlenecks and gaps. These are important, both as a matter of maintaining Canadian agricultural incomes and as a matter of global food security, in which Canada is a major player. The situation is both very important, and urgent. Understanding that the focus is urea and UAN in eastern Canada which have been heavily supplied by Russian product, the easiest and best source of relief would be to create an exemption to the 35 percent duties associated with the loss of Russia's MFN status in Canada. Policy approaches that retain this duty in place involve public investment for new investments that are probably inefficient and otherwise unnecessary, without truly creating any pressure on Russia, and instead, injuring Canadian fertilizer customers.

References

Canada Border Services Agency. (2022). "Order withdrawing the Most-Favoured-Nation status from Russia and Belarus." Customs Notice 22-02. Ottawa, March 3, 2022. Retrieved from https://www.cbsa-asfc.gc.ca/publications/cn-ad/cn22-02-eng.html.

Canadian International Merchandise Trade (CIMT) Web Application. (2022). [Chapter 31 HS codes and 2814.10 – Anhydrous ammonia.] Retrieved from https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm.

CF Industries. (2022). "2021 Annual Report." [Page 4: 2021 capacities by N type and facility. Page 3: Utilization capacities]. Retrieved from https://www.cfindustries.com/globalassets/cf-industries/media/documents/reports/annual-reports/cfindustriesannualreport2021.pdf.

International Fertilizer Association. (2020). "Nitrogen Products: Urea." [Production & Trade Tables by Region]. Retrieved from https://www.ifastat.org/supply/Nitrogen%20Products/Urea.

Laborde, D. and Mamun, A. (2022). "Food and fertilizer export restrictions during the Ukraine-Russia crisis." International Food Policy Research Institute. Updated 10-03-2022.

Mosaic. (2022). "North America Business." [Website]. Retrieved from https://mosaicco.com/North-America-Business.

Nutrien. (2022). "Fact Book 2022." [Page 12/14: Canadian potassium/nitrogen production capacities]. Retrieved from https://nutrien-prod-asset.s3.us-east-2.amazonaws.com/s3fs-public/uploads/2022-06/Nutrien 2022 Fact Book.pdf.

Statistics Canada. (2022). "Canadian fertilizer production, by product type and fertilizer year." Table 32-10-0037. [Product tonnes. Not available by province]. Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210003701.

Statistics Canada. (2022). Table 32-10-0038. "Fertilizer shipments to Canadian agriculture and export markets, by product type and fertilizer year, cumulative data (x 1,000)." Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210003801.

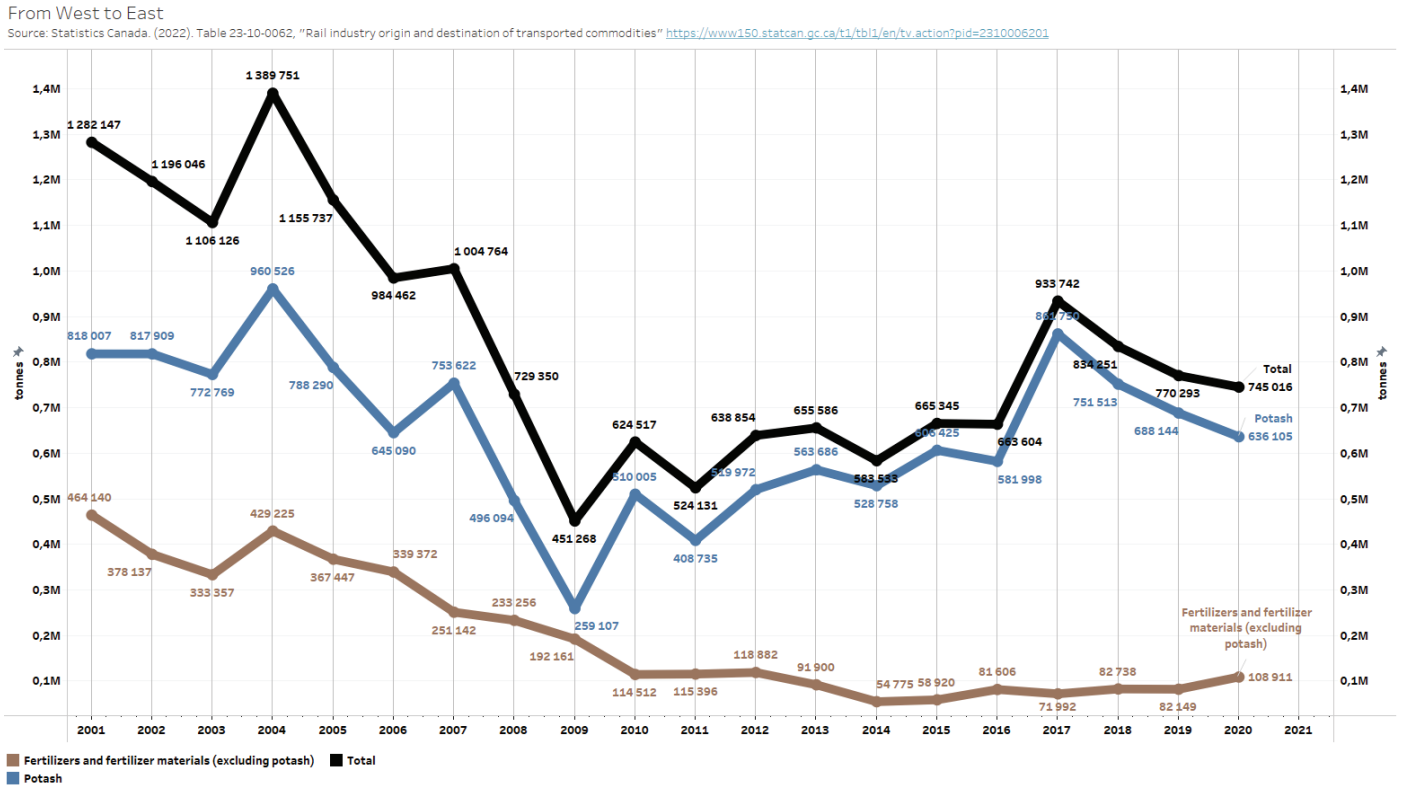
Statistics Canada. (2022). "Rail industry origin and destination of transported commodities." Table 23-10-0062. Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2310006201.

Yara. (2022). "Yara Integrated Report 2021." [Annual report]. Retrieved from https://www.yara.com/siteassets/investors/057-reports-and-presentations/annual-reports/2021/yara-integrated-report-2021.pdf/.

Appendix 1. Fertilizer Ingredient Nutrient Content Factors

HS Code	Product	N	P	K
2814.10	Anhydrous ammonia (NH3) 82-0-0-0	82%		
3102.30, 3102.40	Ammonium nitrate/calcium ammonium nitrate (AN/CAN) 34-0-0-0	34%		
3102.50	Sodium nitrate, in packages weighing more than 10 kg	73%		
3102.21, 3102.29	Ammonium sulphate (AS) 20-0-0-24	20%		
3102.10	Urea 46-0-0	46%		
3102.80	Urea ammonium nitrate (UAN) 28-0-0-0	28%		
3105.30	Diammonium phosphate (DAP) 18-46-0	18%	46%	
3105.40	Monoammonium phosphate (MAP) 11-52-0	11%	52%	
3105.51	Fertilizers, containing nitrates and phosphates, nes, in pack weighing > 10 kg *(mostly MicroEssentials)*	12%	40%	
3105.59	Fertilizers, containing nitrogen and phosphorus, nes, in pack weighing > 10kg *(mostly MicroEssentials)*	12%	40%	
3103.11	Superphosphates fertilizer, cont by weight >= 35% diphosphorus pentaoxide (P2O5)		35%	
3103.19	Superphosphates		45%	
3103.90	Mineral or chemical fertilizers, phosphatic, nes, in packages weighing > 10 kg		20%	
3104.20	Potash / Potassium chloride			60%
3104.30	Potassium sulphate			44%
3104.90	Mineral or chemical fertilizers, potassic, nes, in packages weighing > 10 kg			60%
3104.90	Mineral or chemical fertilizers, potassic, in packages weighing > 10 kg			20%

Appendix 2. Fertilizer rail shipments, western Canada to eastern Canada.



Source: Statistics Canada. (2022). "Rail industry origin and destination of transported commodities." Table 23-10-0062. Retrieved from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2310006201.

Appendix 3. Nitrogen capacities by product type, region, and company.

		Ammonia	Urea	UAN	AN	AS	**Total N**	**84% utiliz.**
E	CF Ind.	217,300 265,000 PT	-	96,600 345,000 PT	-	-	313,900 NT 610,000 PT	**263,676 NT** **512,400 PT**
W	CF Ind.	631,400 770,000 PT	372,600 810,000 PT	-	-	-	1,004,000NT 1,580,000 PT	**843,360 NT** **1,327,200 PT**
E	Nutrien	852,800 1,040,000 PT	729,100 1,585,000 PT	95,200 340,000 PT	39,100 115,000 PT	142,000 710,000 PT	1,858,200NT 3,790,000 PT	**1,560,888NT** **3,183,600 PT**
S	Yara	-¤	506,000 1,100,000 PT	56,000 200,000 PT	-	-	562,000 NT 1,300,000 PT	**472,080 NT** **1,092,000 PT**
T	Koch§	449,360* 548,000 PT	-	-	-	-	449,360 NT* 548,000 PT	**377,462 NT*** **460,320 PT***
	Sherritt§	231,240* 282,000 PT	-	-	-	-	231,240 NT* 282,000 PT	**194,242 NT** **236,880 PT**
Total (Canada)		2,382,100 2,905,000 PT	1,607,700 3,495,000 PT	247,800 885,000 PT	39,100 115,000 PT	142,000 710,000 PT	**4,418,700NT** 8,110,000 PT	**3,711,708 NT** **6,812,400 PT**

¤Nearly all of Yara's ammonia production is used for creating other N fertilizer products.
*Gross ammonia, not net (net ammonia values were not available and therefore these values may be overstated).
§Source is the Nutrien Fact Book (cited below)

Sources:
1. CF Industries. (2022). "2021 Annual Report." [Page 4: 2021 capacities by N type and facility]. Retrieved from https://www.cfindustries.com/globalassets/cf-industries/media/documents/reports/annual-reports/cfindustriesannualreport2021.pdf.
2. Nutrien. (2022). "Fact Book 2022." [Page 12/14: Canadian potassium/nitrogen production capacities]. Retrieved from https://nutrien-prod-asset.s3.us-east-2.amazonaws.com/s3fs-public/uploads/2022-06/Nutrien%202022%20Fact%20Book.pdf.
3. Yara. (2022). "Yara Integrated Report 2021." [Annual report]. Retrieved from https://www.yara.com/siteassets/investors/057-reports-and-presentations/annual-reports/2021/yara-integrated-report-2021.pdf/.