Chemicals for the Non-Chemist

Plant Nutrients and Plant Nutrient Markets

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Vice President Market and Strategic Analysis

Mosaic

Safe Habor

This document contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Such statements include, but are not limited to, statements about our proposed acquisition of the global phosphate and potash operations of Vale S.A. ("Vale") conducted through Vale Fertilizantes S.A. (the "Transaction") and the anticipated benefits and synergies of the proposed Transaction, other proposed or pending future transactions or strategic plans and other statements about future financial and operating results. Such statements are based upon the current beliefs and expectations of The Mosaic Company's management and are subject to significant risks and uncertainties. These risks and uncertainties include but are not limited to risks and uncertainties arising from the possibility that the closing of the proposed Transaction may be delayed or may not occur, including delays or risks arising from any inability of Vale to achieve certain specified regulatory and operational milestones, and the ability to satisfy any of the other closing conditions; our ability to secure financing, or financing on satisfactory terms and in amounts sufficient to fund the cash portion of the purchase price without the need for additional funds from other liquidity sources; difficulties with realization of the benefits of the proposed Transaction, including the risks that the acquired business may not be integrated successfully or that the anticipated synergies or cost or capital expenditure savings from the Transaction may not be fully realized or may take longer to realize than expected, including because of political and economic instability in Brazil or changes in government policy in Brazil; the predictability and volatility of, and customer expectations about, agriculture, fertilizer, raw material, energy and transportation markets that are subject to competitive and other pressures and economic and credit market conditions; the level of inventories in the distribution channels for crop nutrients; the effect of future product innovations or development of new technologies on demand for our products; changes in foreign currency and exchange rates; international trade risks and other risks associated with Mosaic's international operations and those of joint ventures in which Mosaic participates, including the performance of the Wa'ad Al Shamal Phosphate Company (also known as MWSPC) and the entity operating the Miski Mayo mine, the risk that protests against natural resource companies in Peru extend to or impact the Miski Mayo mine, the ability of MWSPC to obtain additional planned funding in acceptable amounts and upon acceptable terms, the timely development and commencement of operations of production facilities in the Kingdom of Saudi Arabia, the future success of current plans for MWSPC and any future changes in those plans; difficulties with realization of the benefits of our long term natural gas based pricing ammonia supply agreement with CF Industries, Inc., including the risk that the cost savings initially anticipated from the agreement may not be fully realized over its term or that the price of natural gas or ammonia during the term are at levels at which the pricing is disadvantageous to Mosaic; customer defaults; the effects of Mosaic's decisions to exit business operations or locations; changes in government policy; changes in environmental and other governmental regulation, including expansion of the types and extent of water resources regulated under federal law, carbon taxes or other greenhouse gas regulation, implementation of numeric water quality standards for the discharge of nutrients into Florida waterways or efforts to reduce the flow of excess nutrients into the Mississippi River basin, the Gulf of Mexico or elsewhere; further developments in judicial or administrative proceedings, or complaints that Mosaic's operations are adversely impacting nearby farms, business operations or properties; difficulties or delays in receiving, increased costs of or challenges to necessary governmental permits or approvals or increased financial assurance requirements; resolution of global tax audit activity; the effectiveness of Mosaic's processes for managing its strategic priorities; adverse weather conditions affecting operations in Central Florida, the Mississippi River basin, the Gulf Coast of the United States or Canada, and including potential hurricanes, excess heat, cold, snow, rainfall or drought; actual costs of various items differing from management's current estimates, including, among others, asset retirement, environmental remediation, reclamation or other environmental regulation, Canadian resources taxes and royalties, or the costs of the MWSPC, its existing or future funding and Mosaic's commitments in support of such funding; reduction of Mosaic's available cash and liquidity, and increased leverage, due to its use of cash and/or available debt capacity to fund financial assurance requirements and strategic investments; brine inflows at Mosaic's Esterhazy, Saskatchewan, potash mine or other potash shaft mines; other accidents and disruptions involving Mosaic's operations, including potential mine fires, floods, explosions, seismic events, sinkholes or releases of hazardous or volatile chemicals; and risks associated with cyber security, including reputational loss, as well as other risks and uncertainties reported from time to time in The Mosaic Company's reports filed with the Securities and Exchange Commission. Actual results may differ from those set forth in the forward-looking statements.

Mosaic

Plant Nutrients and Plant Nutrient Products

Plant Nutrients

- Plant nutrients are plant food
  (and common chemical elements)
- 17 chemical elements are required for plant growth
- N-P-K: the carbohydrates-protein-fat in a plant's diet
- Growing importance of secondary nutrients and micronutrients especially in high yield systems
- Justus von Liebig and the Law of the Minimum

Liebig's Barrel

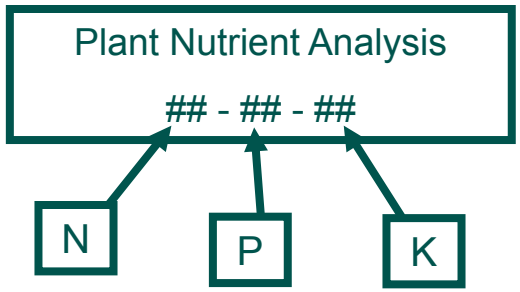


Image: TFI



Plant Nutrient Products

- Plant nutrients are contained in a variety of plant nutrient products
  - Much like nutrients for animals are contained in a variety of feed ingredients
  - Each plant nutrient product is identified by three numbers
    - Referred to as its "analysis" (check it out on your next bag of lawn fertilizer)
    - Percentage of each primary nutrient contained in a unit of the product





Urea
46-0-0



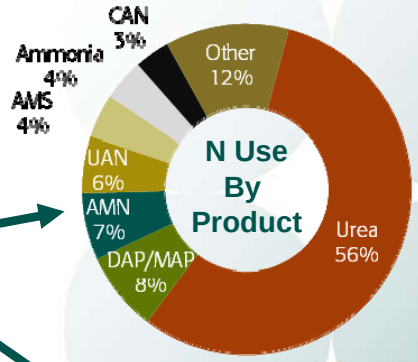
Diammonium Phosphate (DAP)
18-46-0

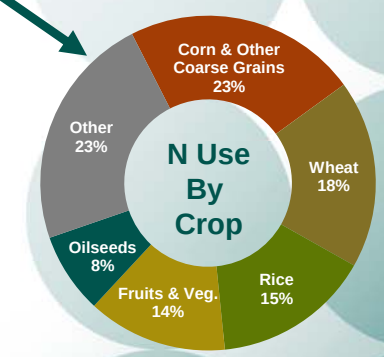


Muriate of Potash (MOP)
0-0-60

Primary Nutrient Overview: Nitrogen (N)

- Production process: highly energy intensive Haber-Bosch process to synthesize ammonia (NH_3) from inert atmospheric N and H
- Key input: hydrocarbon feedstock (~two-thirds produced from natural gas)
- 2017 global use estimates (IFA)
  - Agricultural: ~107 million tonnes N or ~300 million tonnes final N products
  - Industrial/Other: ~41 million tonnes N or ~100 million tonnes final N products
- Leading downstream nitrogen products produced from ammonia
  - Direct application ammonia (82% N – gas at normal temperatures and pressures)
  - Urea (46% N – solid)
  - Urea-ammonium nitrate (UAN) solution (28%-32% N – liquid)
  - Ammonium nitrate (34% N – solid)
  - Ammonium sulphate (21% N – solid)
  - Ammonium phosphate (DAP and MAP) products (10%-18% N – solid)
  - NPK/NP/NPS/NK compounds (% N varies – both solid and liquid)
- Leading producers: China, Russia, India, North America, Mideast

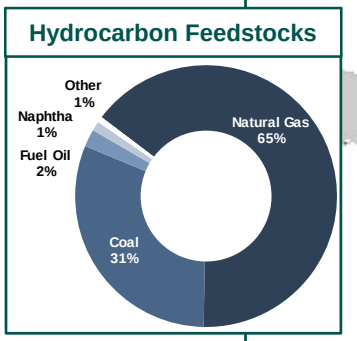




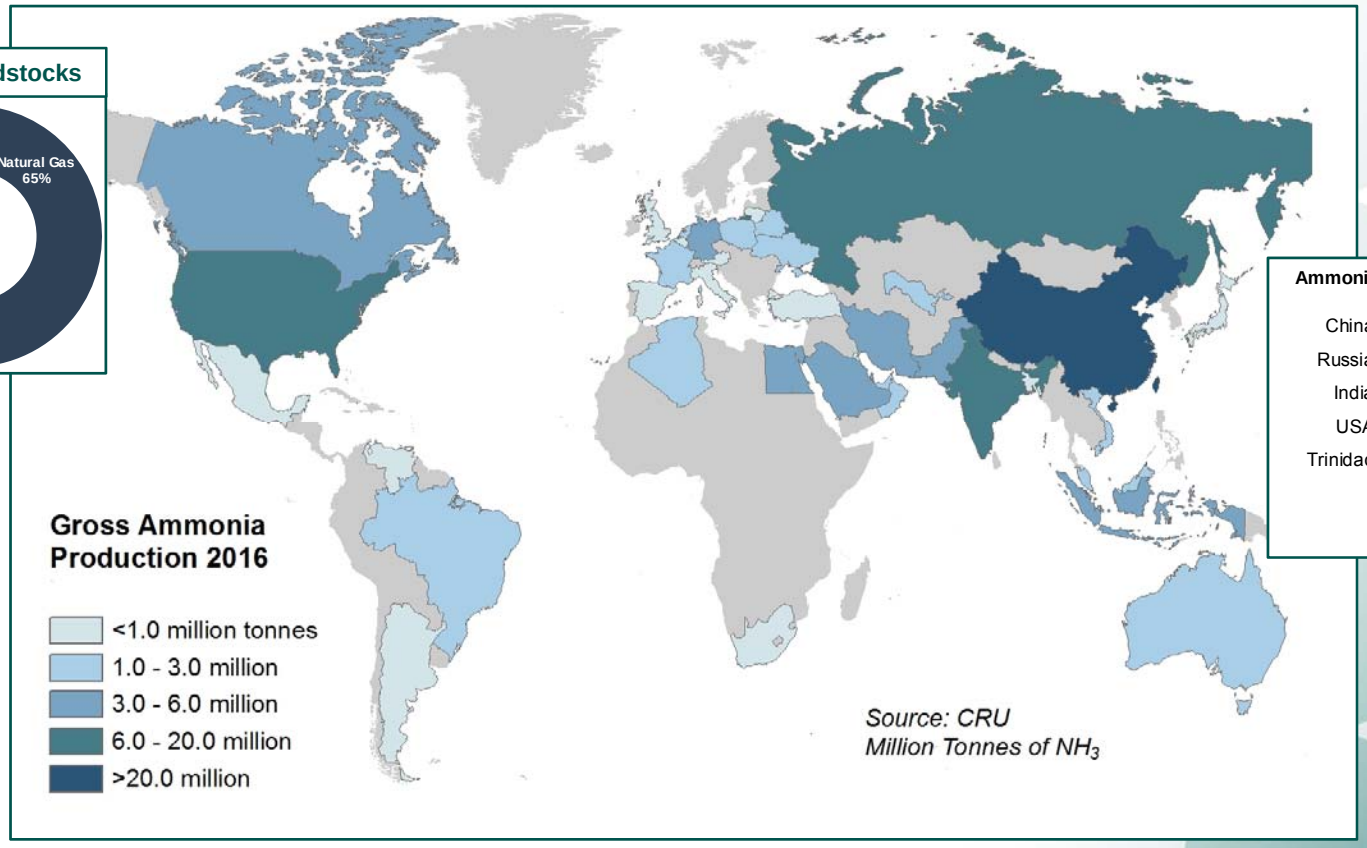
Source: IFA, CRU, Fertecon and Mosaic

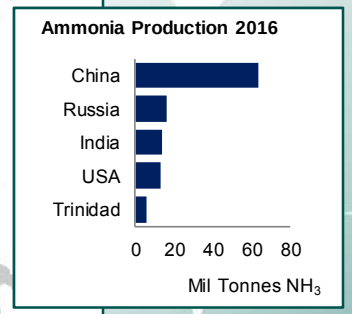
Mosaic

Global Ammonia Production



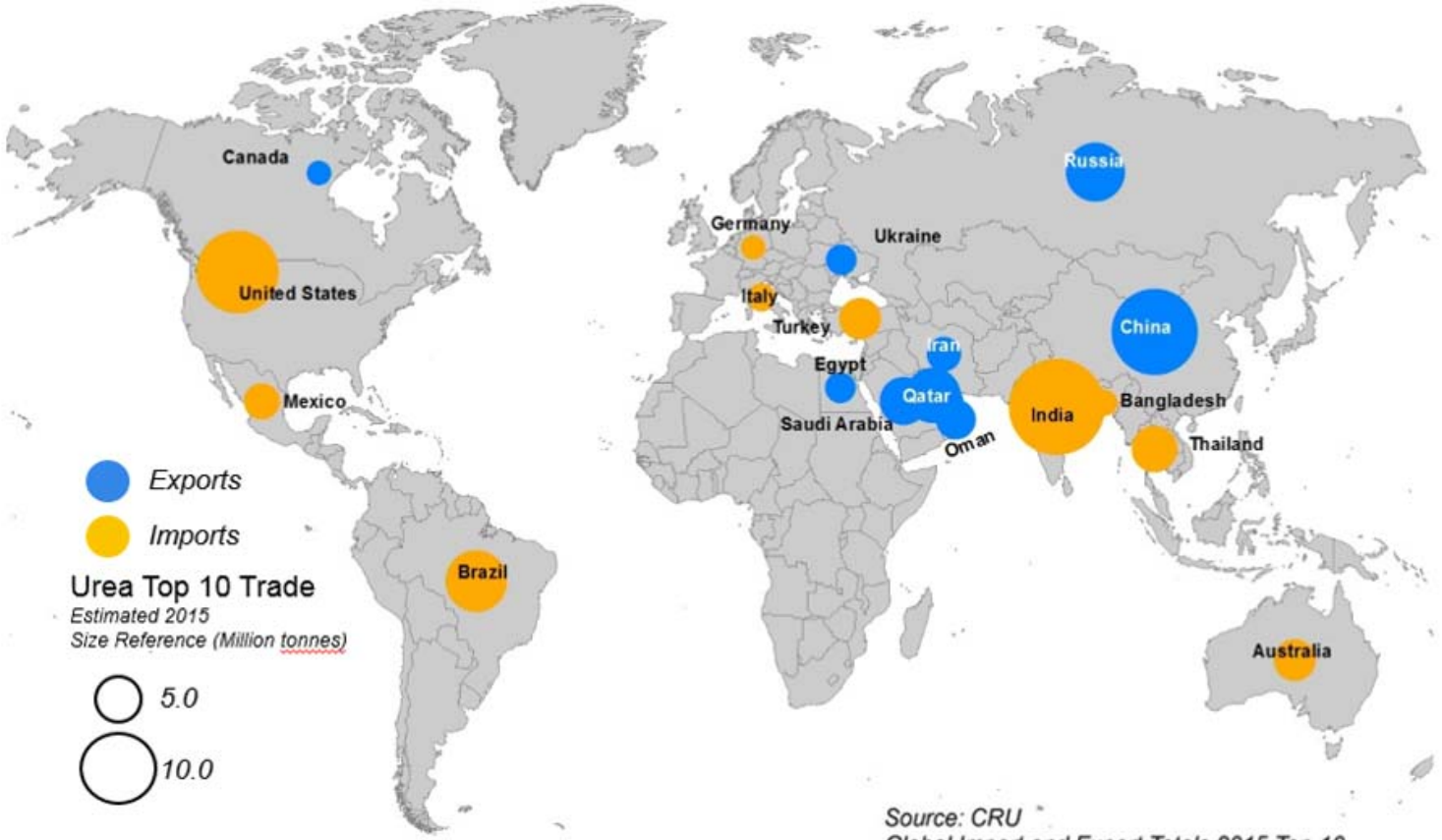
Source: IFA





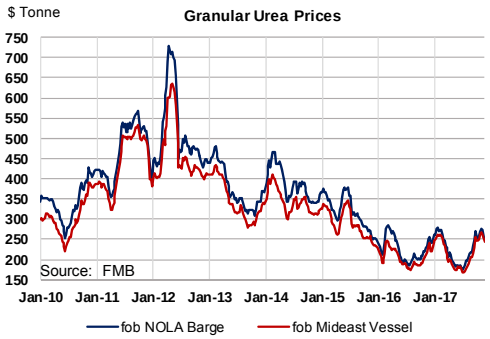
Source: CRU

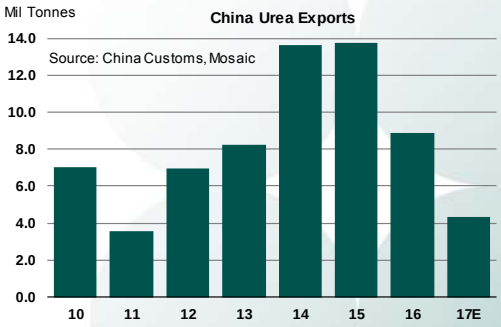
Nitrogen Trade Flows (Urea)

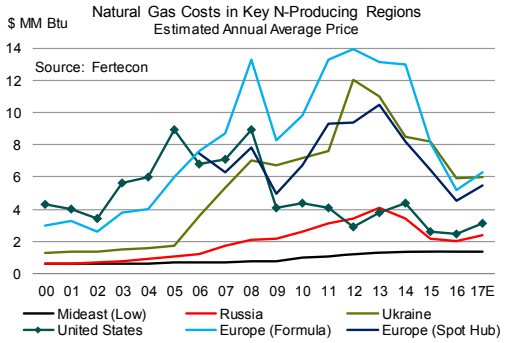


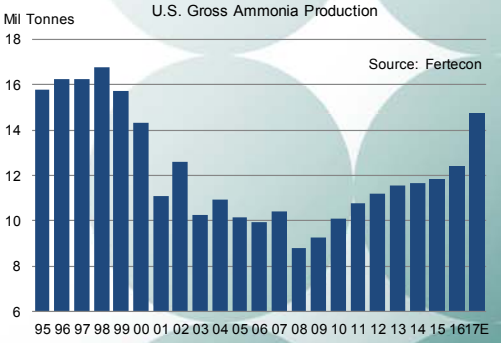
Nitrogen Factors to Watch

- Chinese urea production and exports
  - Coal prices
  - Environmental regulations
- Start-up of new capacity
  - USA
  - Elsewhere
- Indian policies
  - Nitrogen subsidy
  - Make-in-India initiatives to restart idled plants
- Feedstock costs
- Demand drivers
  - Agricultural commodity prices
  - Nitrogen use efficiency (NUE) improvements especially in China and India



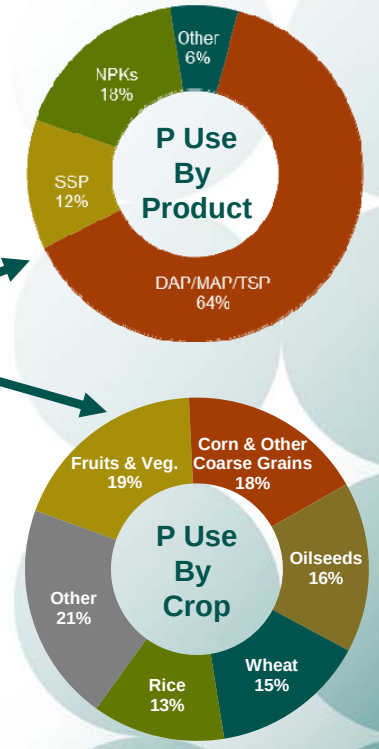






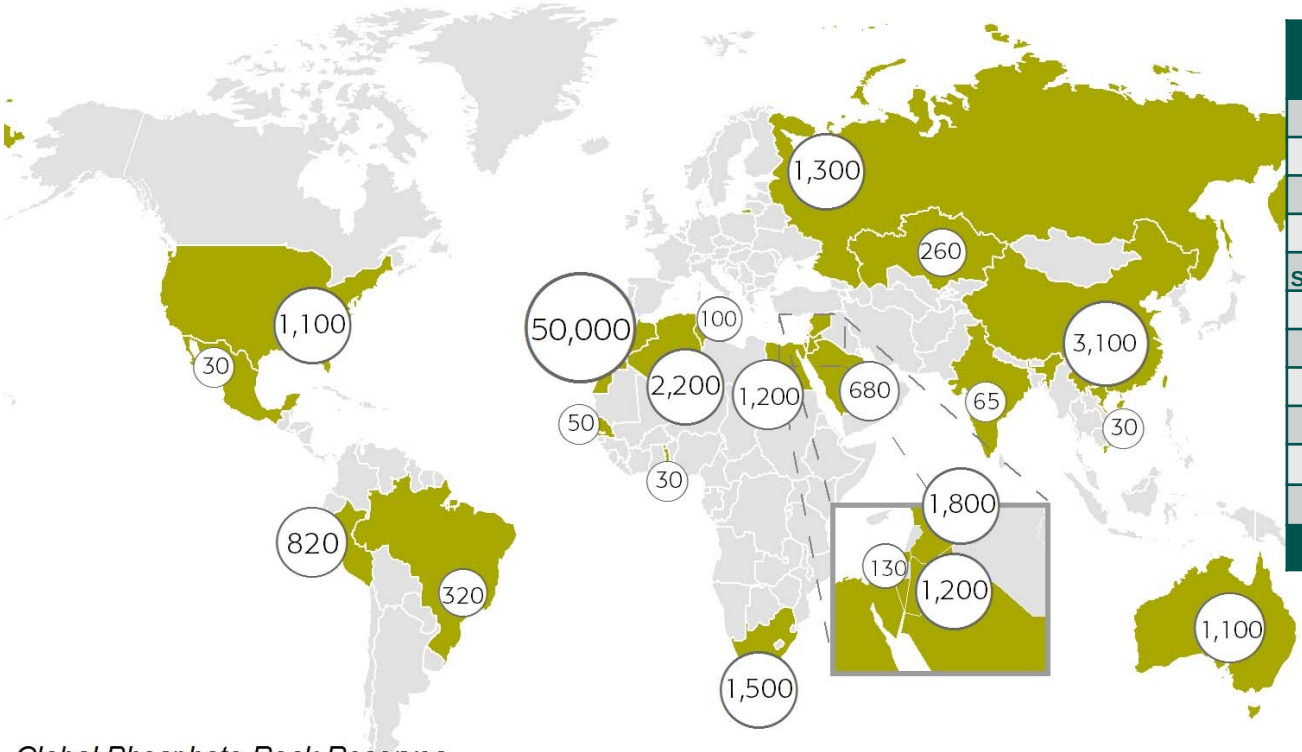
Primary Nutrient Overview: Phosphorus (P)

- Production process - making phosphorus water soluble
- Key inputs: phosphate rock mineral ore, sulphur and ammonia
- Intermediate product used to produce most final products: phosphoric acid
- Integrated vs. non-integrated production (e.g. Morocco vs. India)
- 2017 global use estimates (IFA)
  - Agricultural: ~45 million tonnes P_2O_5 or ~145 million tonnes final P products
  - Feed/Industrial/Other: ~7 million tonnes P_2O_5 or ~ 15 million tonnes final P products
- Main phosphate products
  - Diammonium phosphate (DAP) (46% P_2O_5 – solid)
  - Monoammonium phosphate (MAP) (52% P_2O_5 – solid)
  - Triple superphosphate (TSP) (46% P_2O_5 – solid)
  - Single superphosphate (SSP) (18%-22% P_2O_5 – solid)
  - NPK/NP/NPS/PK compounds (% P_2O_5 varies – both solid and liquid)
- Leading producers: China, USA, Morocco, Russia, Saudi Arabia, Brazil



Source: IFA, CRU, Fertecon and Mosaic

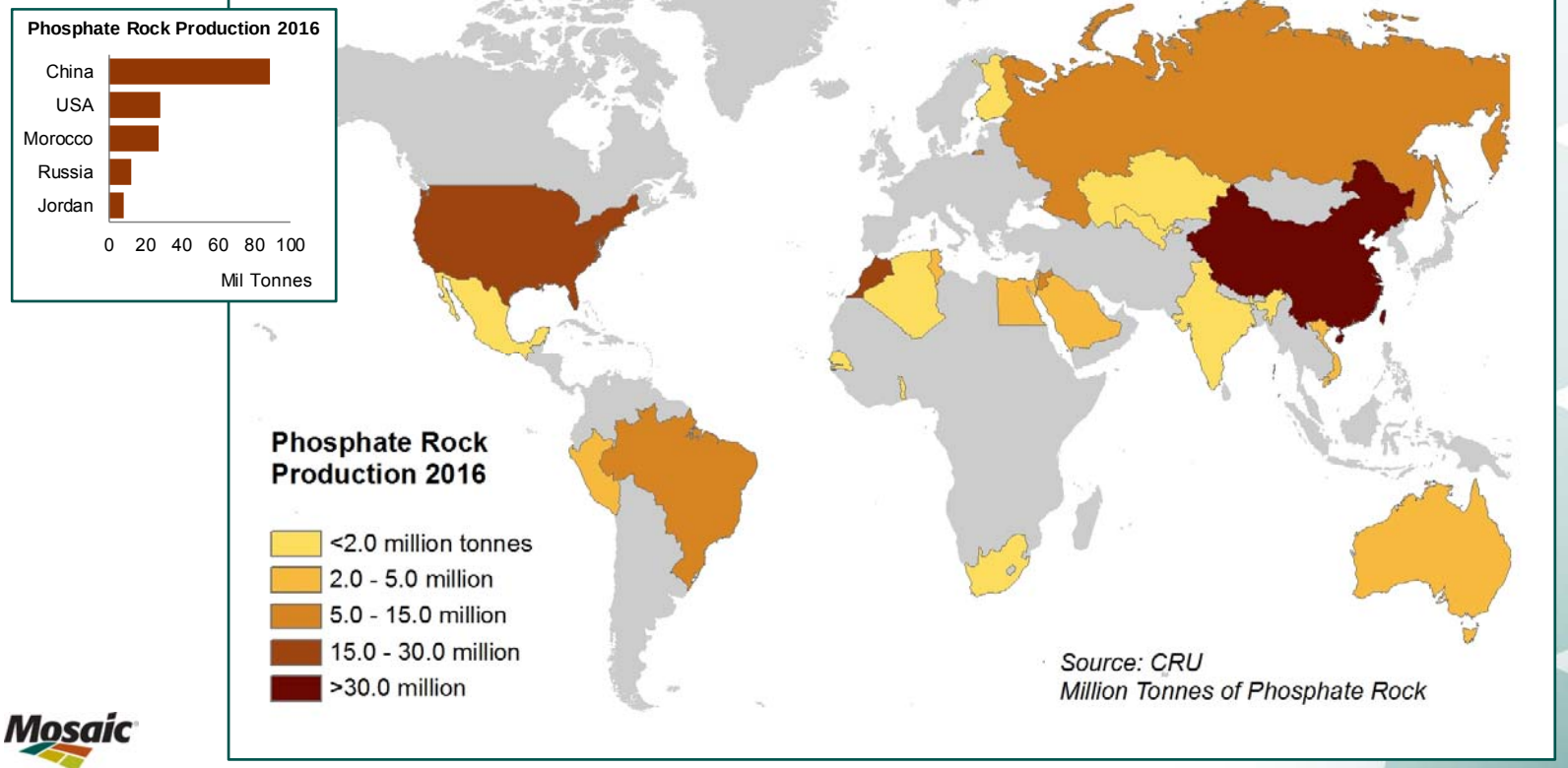
Global Phosphate Rock Reserves



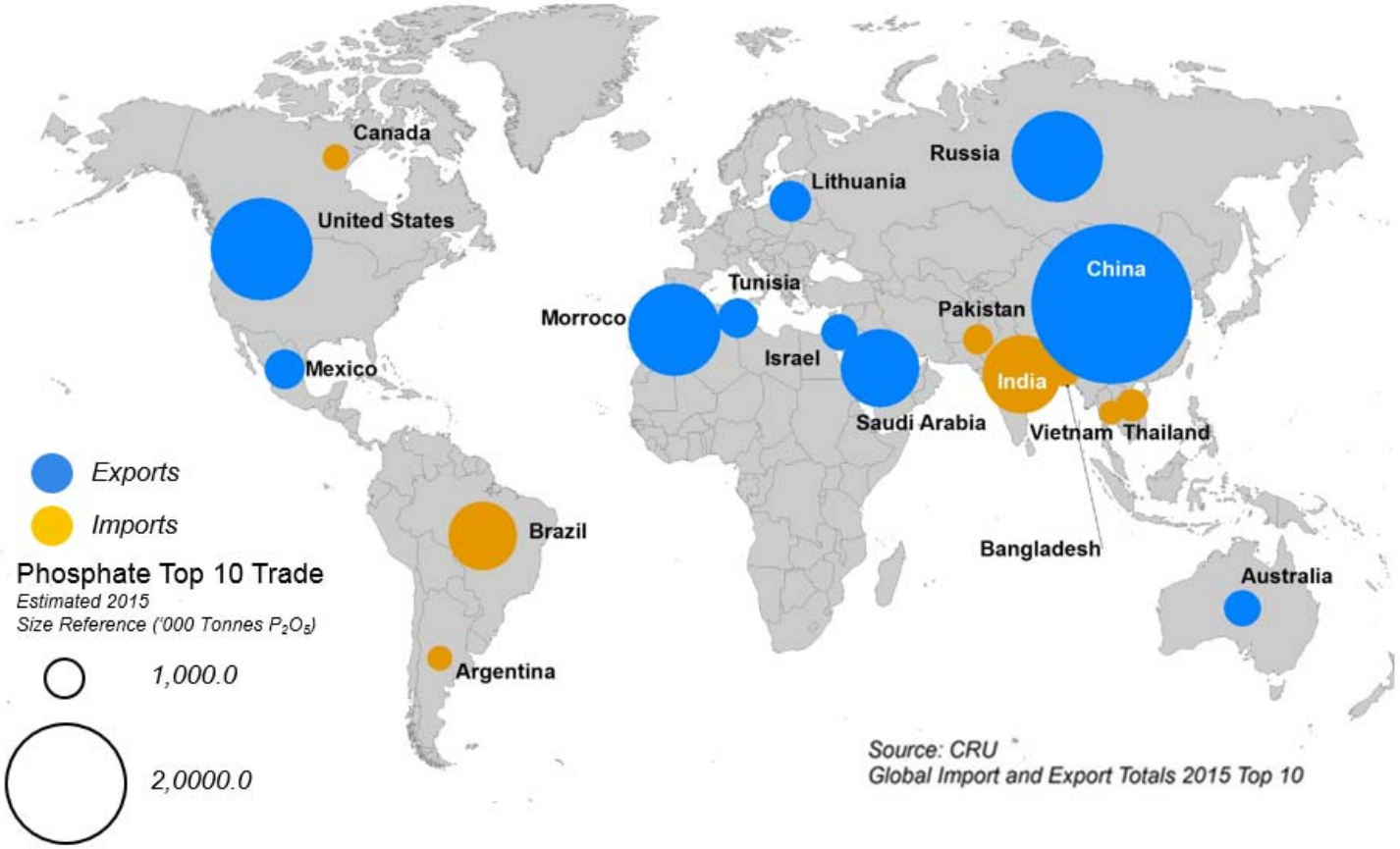
Country	Mil Tonnes	Percent of Total	Cumulative Percent
Morocco	50,000	73.7	73.7
China	3,100	4.6	78.3
Algeria	2,200	3.2	81.5
Syria	1,800	2.7	84.2
South Africa	1,500	2.2	86.4
Russia	1,300	1.9	88.3
Egypt	1,200	1.8	90.1
Jordan	1,200	1.8	91.9
USA	1,100	1.6	93.5
Australia	1,100	1.6	95.1
Other	3,325	4.9	100.0
World	67,825	100	

Global Phosphate Rock Reserves
Million Tonnes Phosphate Rock
Source: USGS, 2016

Global Phosphate Rock Production

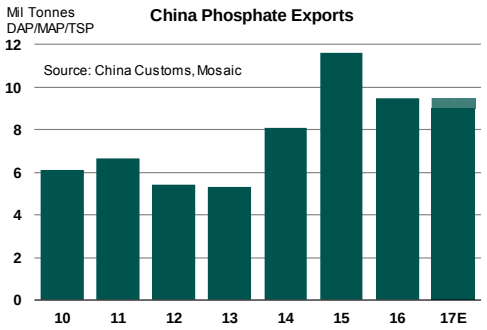


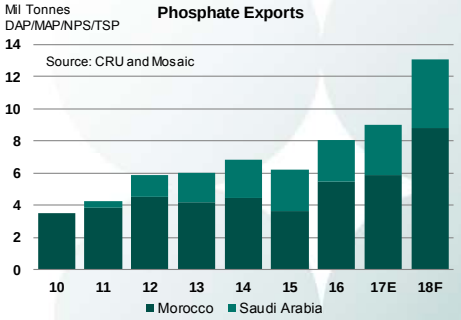
Key Phosphate Trade Flows (DAP/MAP/TSP)

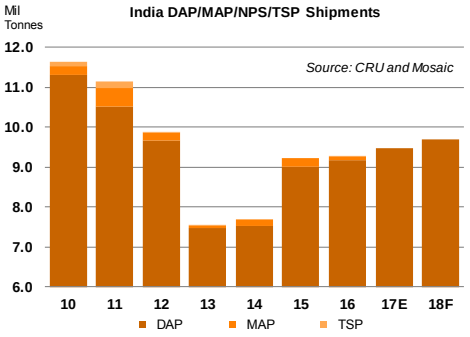


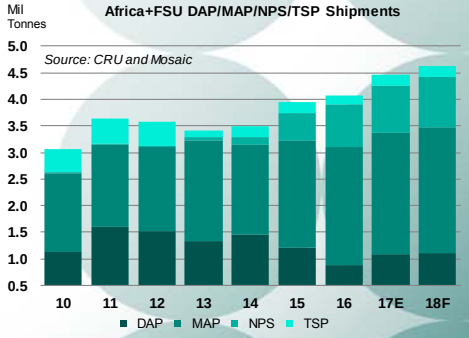
Phosphate Factors to Watch

- Chinese production and exports
  - Market-driven industry restructuring
  - More stringent environmental regulations
- Ramp-up of new capacity
  - Saudi Arabia (MWSPC)
  - Morocco (JPH 3 & JPH 4)
- Absolute and relative raw materials costs
- Demand trends
  - China stabilizes and India gets back on track
  - Africa takes off and FSU continues to recover
  - Brazil keeps growing plus gains elsewhere
- Demand drivers
  - Agricultural commodity prices
  - Balanced nutrient use initiatives





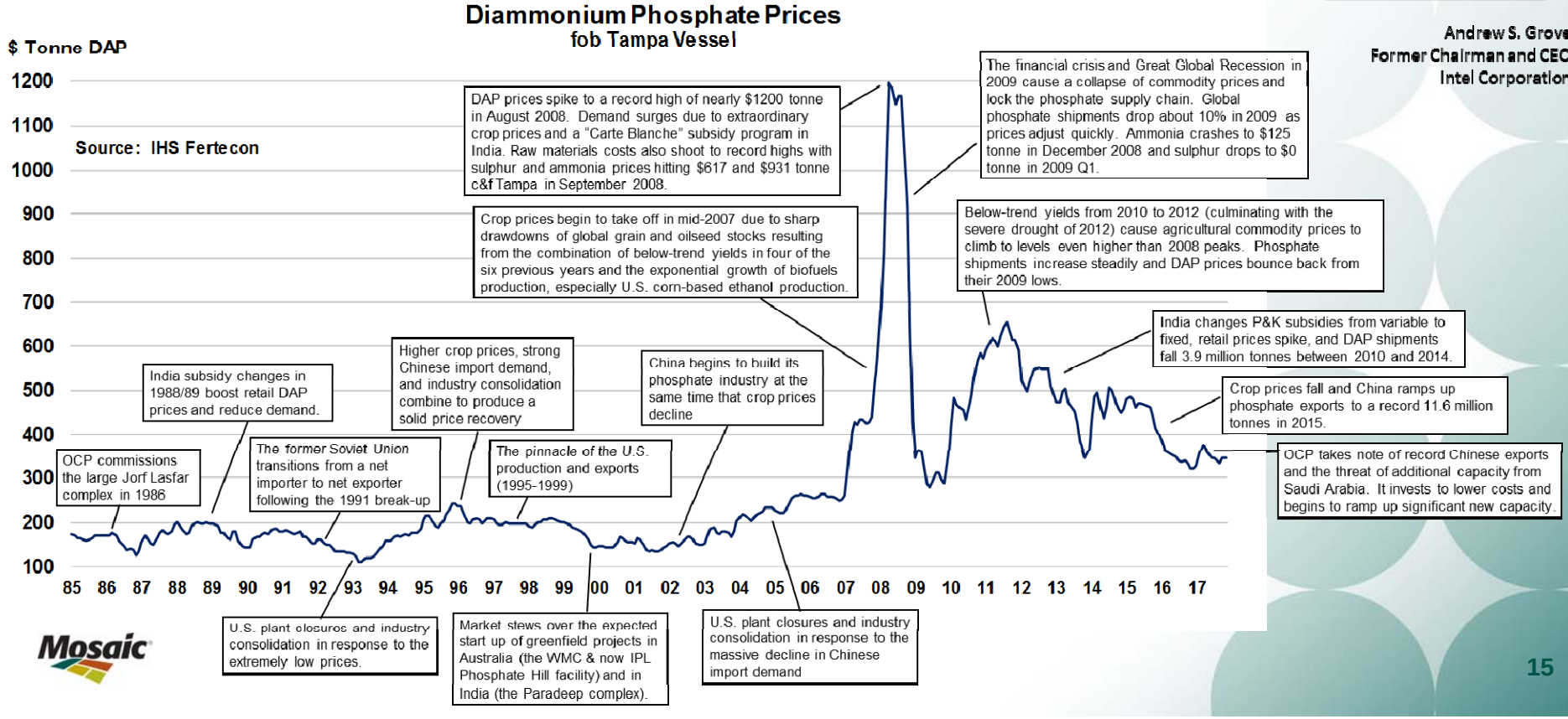




Phosphate Prices – Historical Perspective: A Global Cyclical Commodity Market

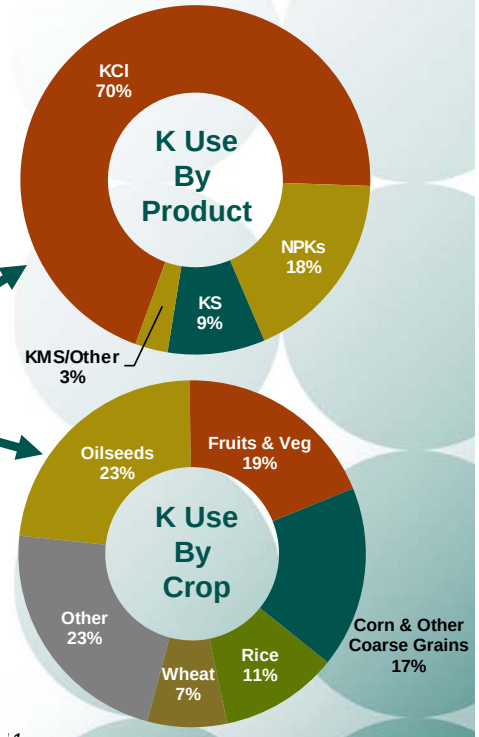
"Success breeds complacency. Complacency breeds failure. Only the paranoid survive."

Andrew S. Grove
Former Chairman and CEO
Intel Corporation



Primary Nutrient Overview: Potassium (K)

- Production process: separation processes involving no chemical reaction
  - For sylvinite ore, potassium chloride typically is separated from sodium chloride using conventional flotation technologies
- Key input: potash mineral ore (sylvinite, carnallite and langbeinite)
  - Shaft mines (up to 1000+ meters deep accounting for ~70% production)
  - Solution mines (accounting for ~4% of production)
  - Surface brines (e.g. Dead Sea, Qinghai and Great Salt Lake and accounting for ~26% or production)
- 2017 global use estimates (IFA)
  - Agricultural: ~35 million tonnes K_2O or ~95 million tonnes final K products
  - Industrial/Other use: ~7 million tonnes K_2O or ~12 million tonnes final K products
- Main potash products
  - Potassium chloride (KCl) AKA muriate of potash (MOP) (60-62% K_2O – solid)
  - Potassium sulphate (KS) AKA sulphate of potash (SOP) (50% K_2O – solid)
  - Potassium-magnesium-sulphate (KMS) (22% K_2O – solid & typically sold as a branded product)
- Leading producers: Canada, Russia, Belarus, China, Germany, Israel



Source: IFA, CRU, Fertecon and Mosaic

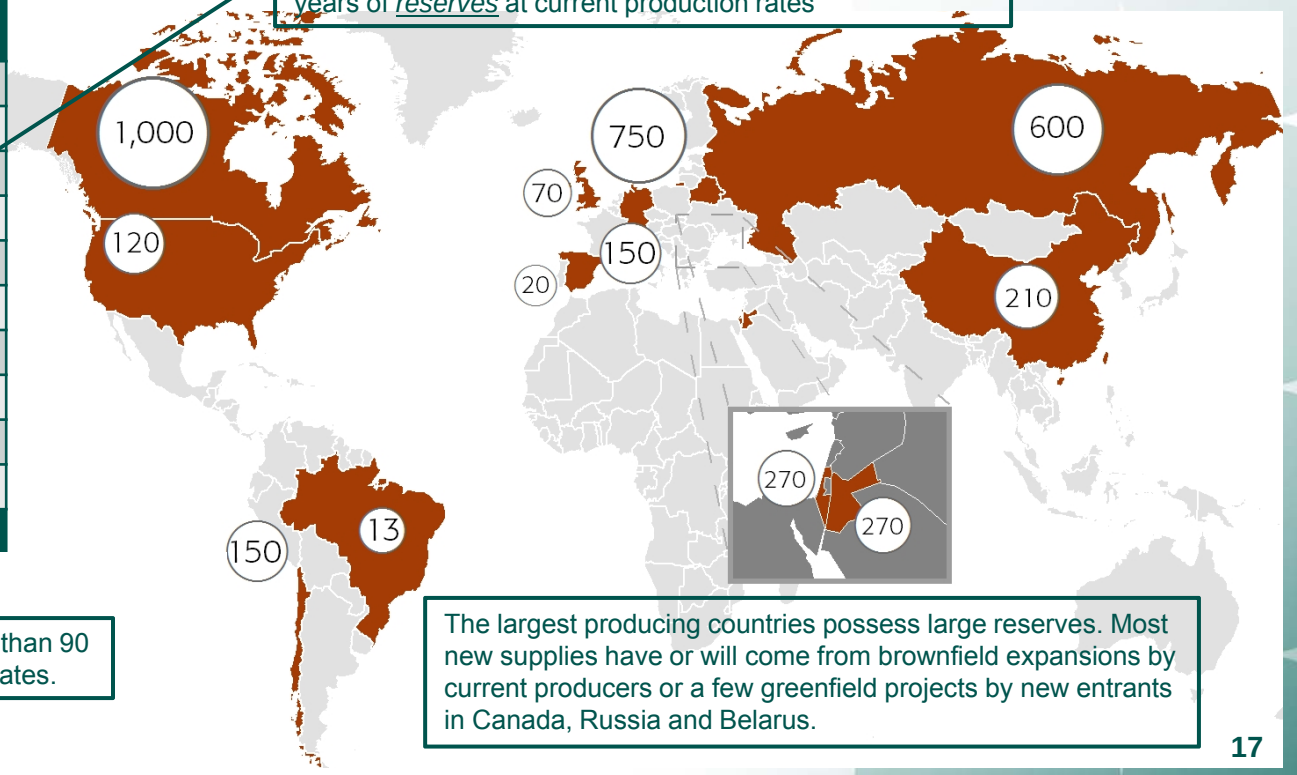
Mosaic

Global Potassium Mineral Reserves

Country	Mil Tonnes K_2O	Percent of Total	Cumulative Percent
Canada	1,000	27.0	27.0
Belarus	750	20.3	47.3
Russia	600	16.2	63.5
Israel	270	7.3	70.8
Jordan	270	7.3	78.1
China	210	5.7	83.8
Chile	150	4.1	87.8
Germany	150	4.1	91.9
USA	120	3.2	95.1
Other	180	4.9	100.0
World	3,700	100	

Source: USGS, 2016.

The three largest producing countries account for nearly two-thirds of global *reserves* and have roughly 80-120 years of *reserves* at current production rates

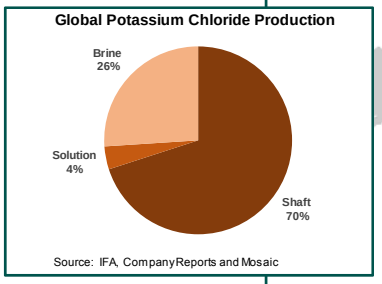


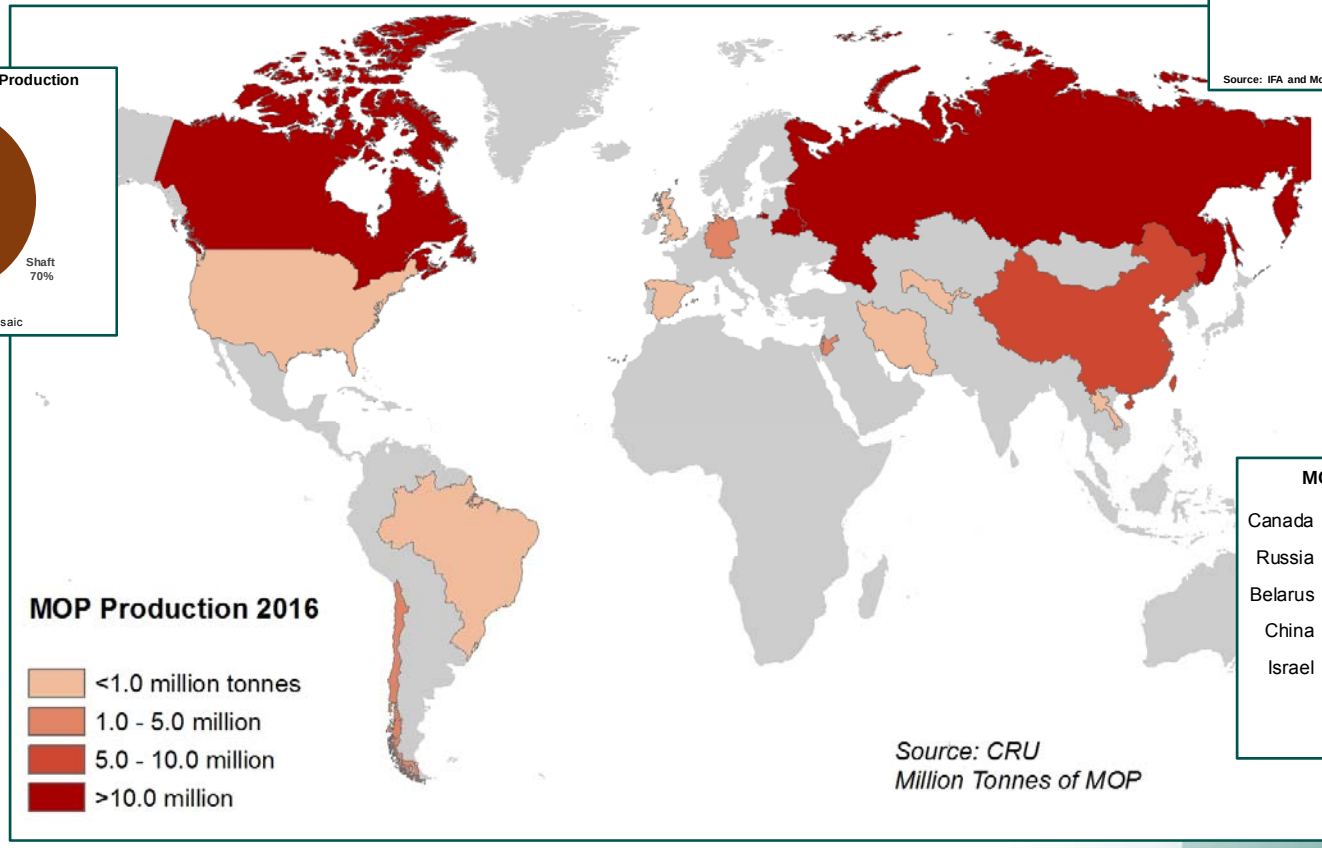
Global *reserves* equal to more than 90 years of production at current rates.

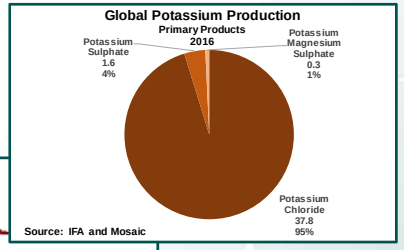
The largest producing countries possess large reserves. Most new supplies have or will come from brownfield expansions by current producers or a few greenfield projects by new entrants in Canada, Russia and Belarus.

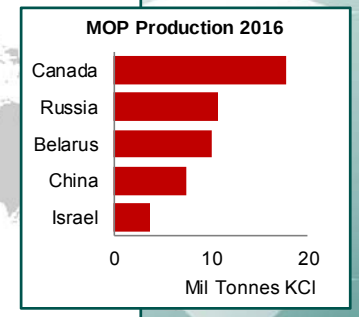
Mosaic

Global Potassium Chloride Production

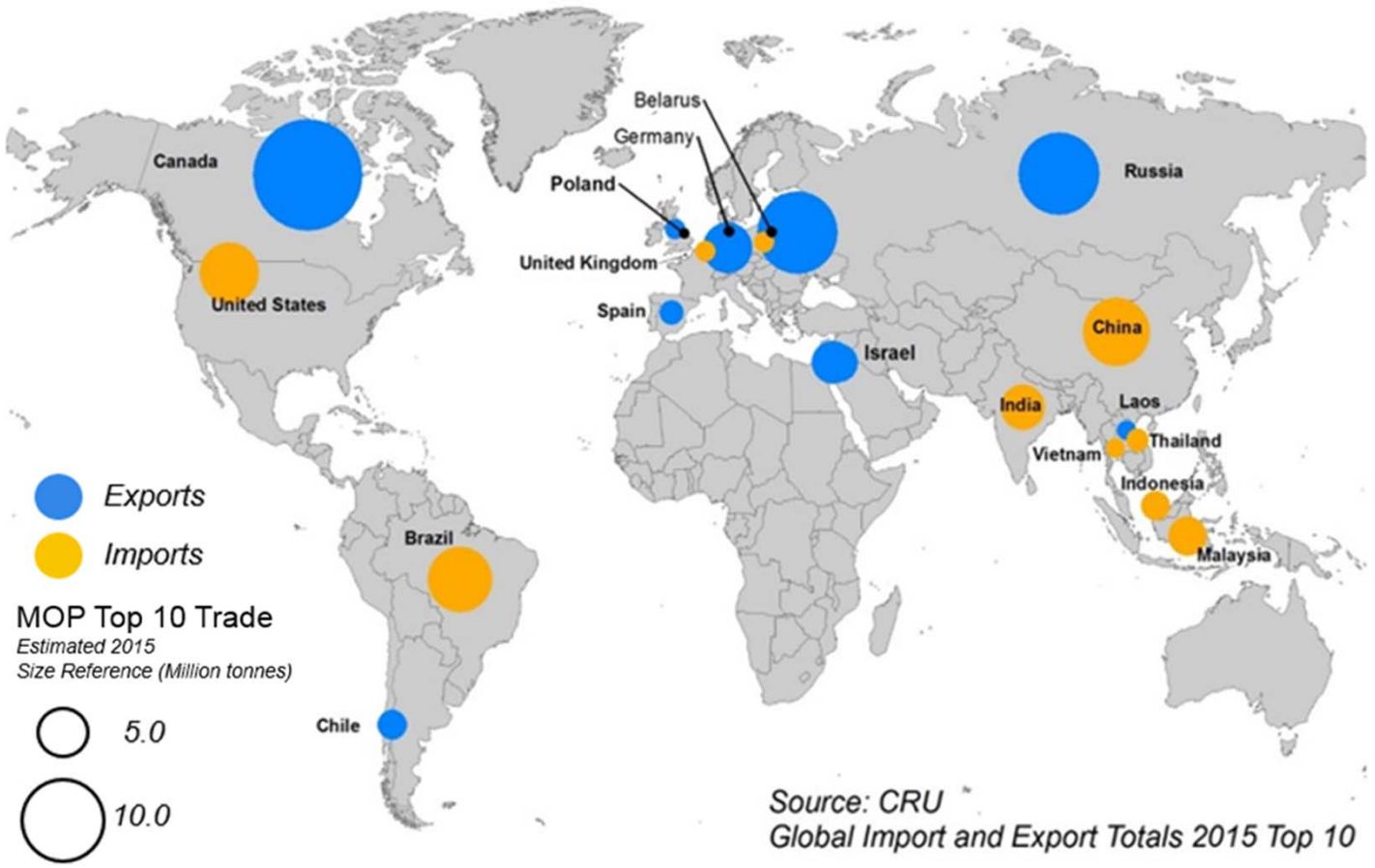








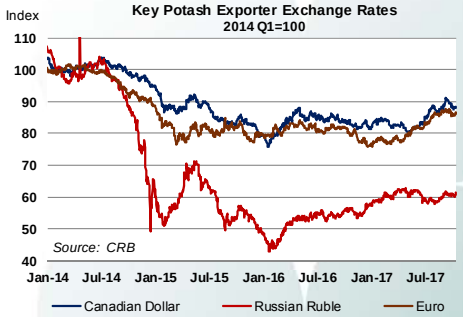
Key Potash Trade Flows (MOP)

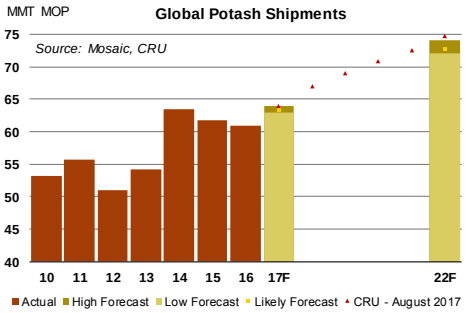


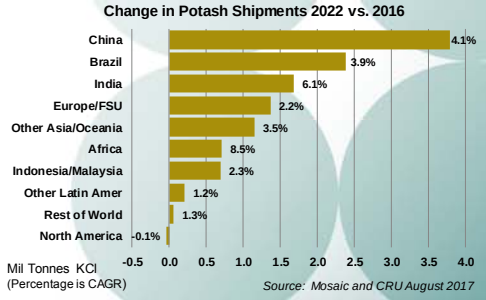
Potash Factors to Watch

- Further industry optimization/restructuring
  - Especially in Canada
  - Closures due to depleted resources
- Start-up of new greenfield capacity
  - Canada (K+S Bethune)
  - Russia (EuroChem Usolskiy and Volgakaliy)
- Exchange rates
- Further strong broad-based demand gains
  - Chinese demand continues to increase
  - India back on track and Brazil keeps going
  - Help from Africa, FSU and others
- Demand drivers
  - Agricultural commodity prices
  - Balanced nutrient use initiatives

Company	Facility	Capacity (Tonnes)	Date Closed
Mosaic	Hersey	50,000	Mid-2014
Mosaic	Carlsbad	450,000	December 2014
PotashCorp	Penobsquis	800,000	December 2015
PotashCorp	Picadilly	2,000,000	December 2015
PotashCorp	Cory Red	600,000	November 2016
Intrepid	West Mine	350,000	July 2016
Intrepid	East Mine	200,000	Conversion to Trio
Total		3,650,000	



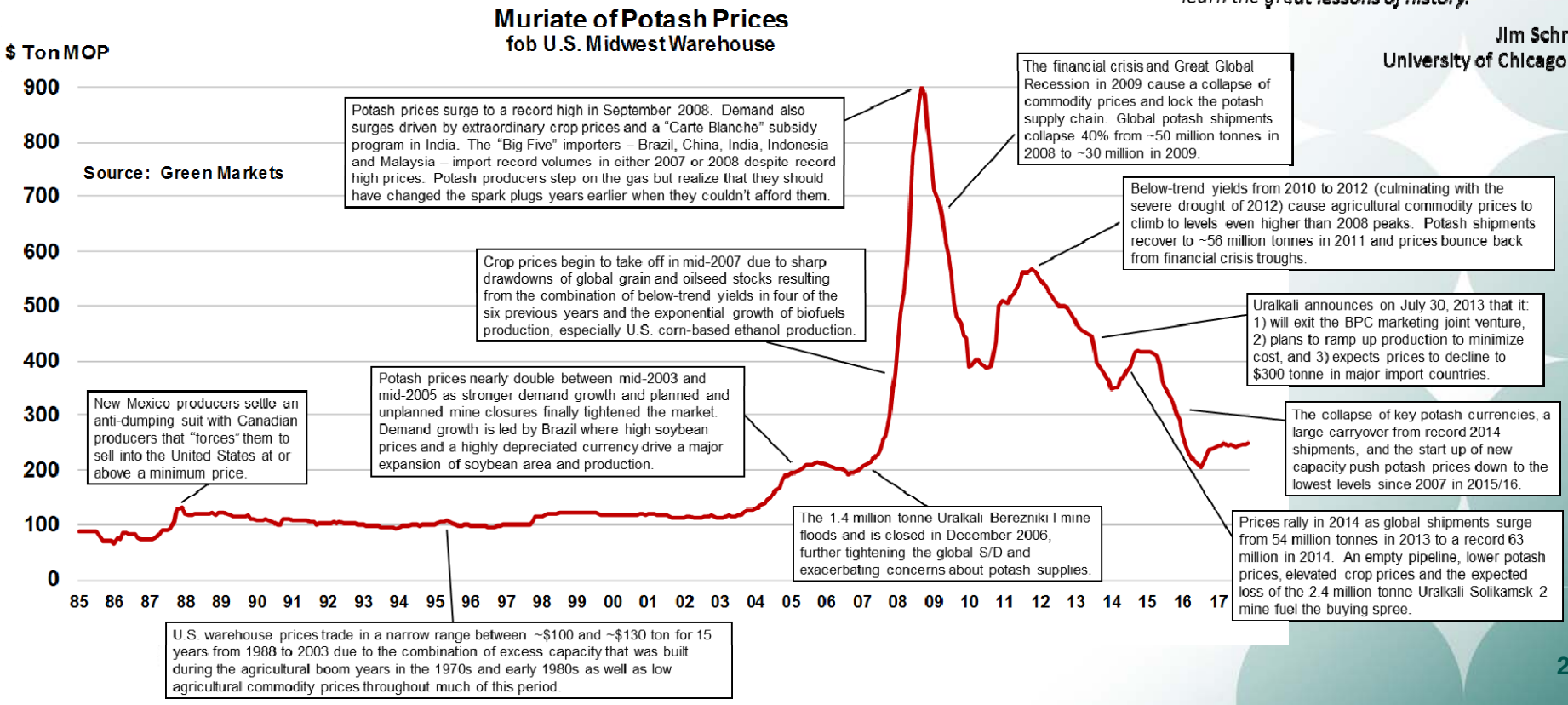




Potash Prices – Historical Perspective: Also Global Cyclical Commodity Market

"The greatest lesson of history is that we do not learn the great lessons of history."

Jim Schrager
University of Chicago GSB



Positive Demand Drivers

- Near Term
  - Agronomic
    - Need to replenish NPK removed by record harvests
    - Focus on nutrient use efficiency and balanced nutrient use
  - Economic
    - Still OK agricultural commodity prices +
    - More moderate and stable NPK prices =
    - Affordable plant nutrients
- Long Term
  - The Food Story not in vogue today but still intact
  - Need to plant more area and increase yields at least at trend rates to meet projected food demand

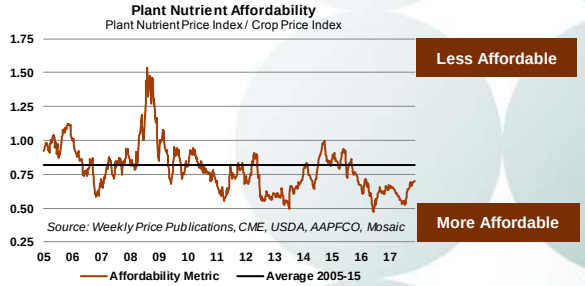
Record Harvests Have Removed Record Amounts of NPK

World Grain & Oilseed Nutrient Removal

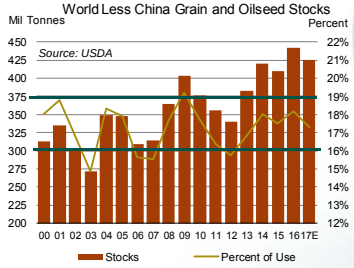
Mil Tonnes	2015	2016	Chg MT	Chg %	Product
N Removal	64.7	67.7	3.0	4.6%	6.5
P_2O_5 Removal	24.7	25.8	1.1	4.3%	2.3
K_2O Removal	20.8	21.9	1.1	5.3%	1.8

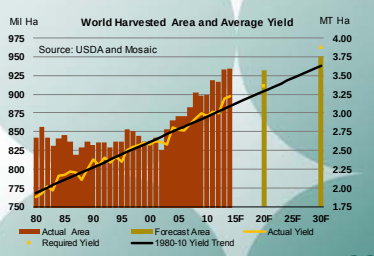
Source: USDA, IPNI, Mosaic

Affordable Nutrients Underpin Demand Growth



The Food Story Not in Vogue Today But Still in Tact





Demand Challenge: Maintaining Soil Fertility AND Safeguarding the Environment

- Soil fertility is maintained by replenishing the nutrients removed by crops each year
- Farmers maintain soil fertility and safeguard the environment by following best practices and the 4-Rs
- Best practices
  - Soil testing
  - Plant nutrient accounting
  - Variable rate technology
  - Multiple applications
  - Nitrogen inhibitors and controlled release products
- The 4-Rs of nutrient stewardship
  - Right Source - Right Rate - Right Time - Right Place

4 nutrient stewardship

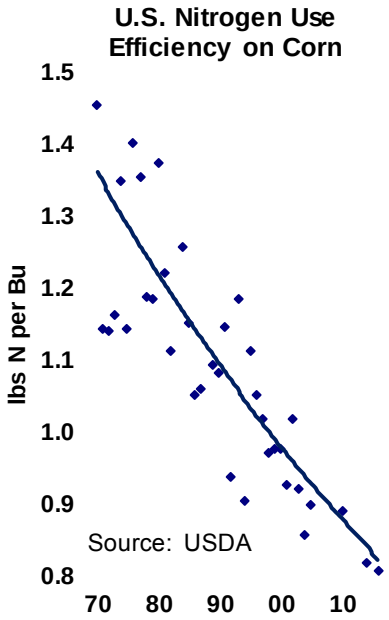
Nutrient Removal by Crop

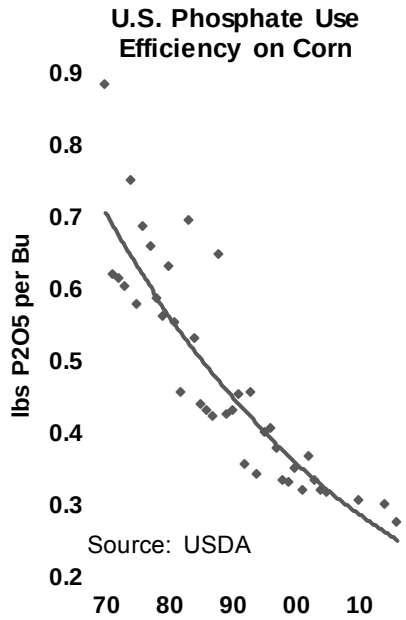
lbs Acre	N	P_2O_5	K_2O	S
Corn - 200 Bu Acre Yield				
Grain	180	76	54	16
Stalks	90	32	220	14
Total	270	108	274	30
Soybeans - 70 Bu Acre Yield				
Grain	266	59	91	13
Stover	77	17	70	12
Total	343	76	161	25
Wheat - 80 Bu Acre Yield				
Grain	120	48	27	8
Straw	56	13	96	11
Total	176	61	123	19

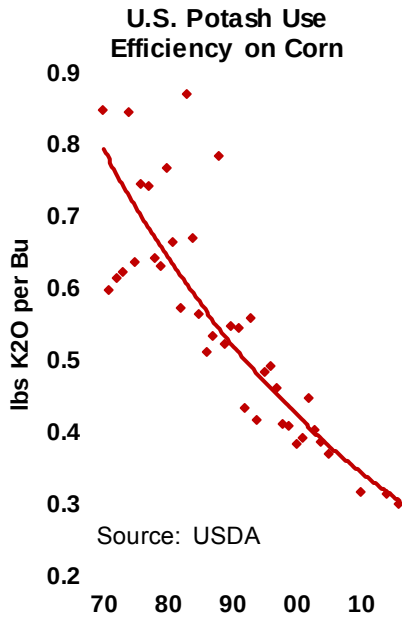
Source: IPNI

Mosaic

Increasing Efficacy of Plant Nutrient Use







Manure usage has increased during this period, but ***U.S. farmers today are harvesting more than twice as much corn per acre with the same amount of commercial plant nutrients applied per acre as in 1970!***

The efficacy of plant nutrient use has increased significantly in the United States during the last few decades.

The average U.S. corn yield increased 120% from 79 bushels per acre in 1970 to 174 in 2016. Yet primary nutrient application rates remained flat at about 230 pounds per acre during the same period.

- **N** use per bushel of corn harvested declined 44% from 1.45 pounds in 1970 to 0.81 pounds in 2016.
- **P_2O_5** use per bushel of corn dropped 68% from 0.88 pounds in 1970 to 0.28 pounds in 2016.
- **K_2O** use per bushel of corn also dropped 65% from 0.85 pounds in 1970 to 0.30 pounds in 2016.

Mosaic

The Mosaic Company

What We Do – Our Core Businesses



A Leading Miner of Agricultural Minerals

Mosaic helps the world grow the food it needs by mining phosphorus (P) and potassium (K) minerals and refining these ores into plant nutrient and animal feed products that are essential for global agriculture.

We also produce smaller but significant quantities of other products that are used in a variety of non-agricultural uses ranging from the production of potassium hydroxide to the fluoridation of municipal water supplies.

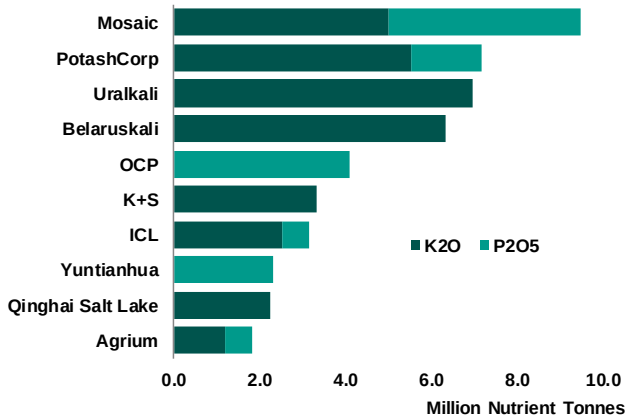
In big round numbers, our North American operations typically dig, pump, cut, convey and hoist more than 105 million tonnes of raw P&K ores from the earth each year.

We remove the sand, clay, salt and other elements to produce about 23 million tonnes of refined P&K ores.

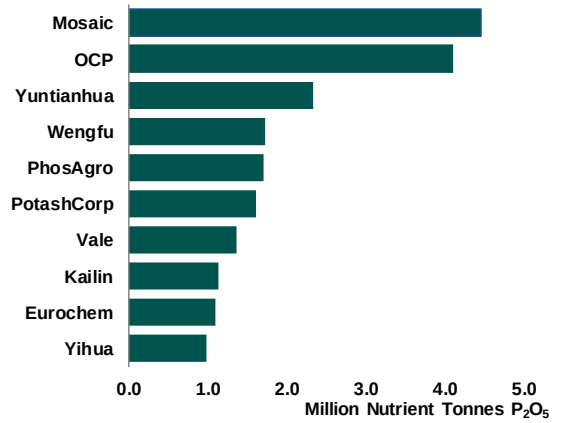
We then process these refined ores into approximately 18 million tonnes of finished P&K products using an additional seven million tonnes of purchased or manufactured raw materials such as sulphur, anhydrous ammonia and phosphate rock.

Where We Rank Globally (Based on 2015 Production Estimates)
Who We Compete Against

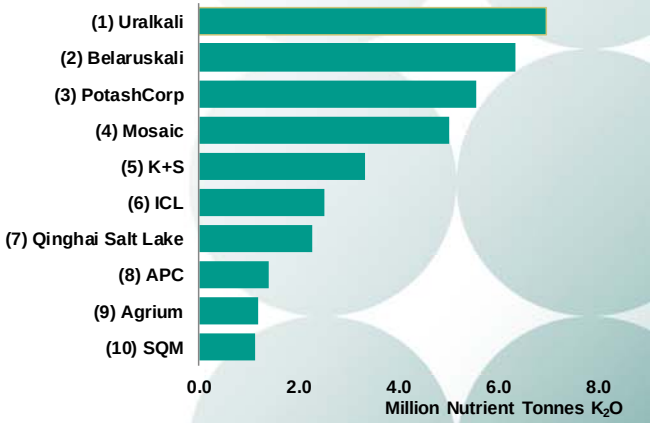
The Largest P&K Producer



The Largest P Producer



The Fourth Largest K Producer

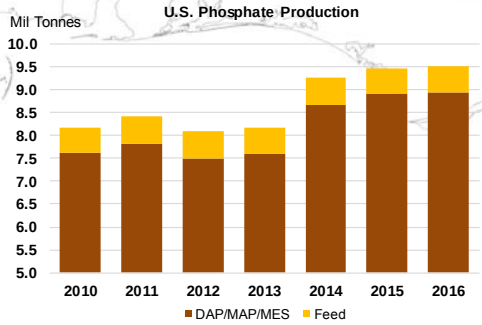


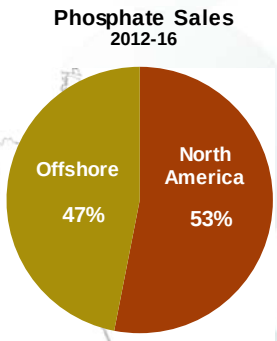
Phosphate (P_2O_5) production includes phosphoric acid and single superphosphate (SSP) production.
Potash (K_2O) production includes potassium chloride (KCl), potassium sulphate (KS), and potassium magnesium sulphate (KMS) production.
Source: Company reports, IFA, CRU, and Mosaic estimates.

Our Phosphate Operations

United States

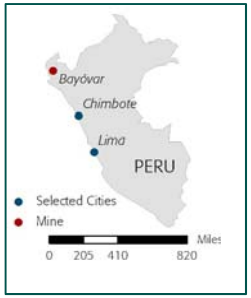


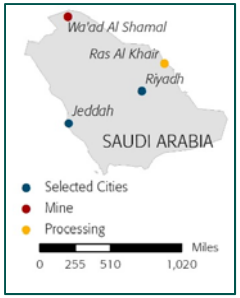




Offshore

- 35% equity stake in the 3.9 million tonne Bayovar phosphate rock mine in Peru (equity stake increases to 75% after completion of the Vale Fertilizantes acquisition)
- 25% equity stake in the Ma'aden Wa'ad Al Shamal Phosphate Company's (MWSPC) 6.0 million tonne mine and 3.0 million tonne chemical complex in Saudi Arabia





Our Phosphate Operations
A Leading Innovator - MicroEssentials®

- MicroEssentials® products deliver significant value to farmers
  - Contain sulphur in elemental and sulphate form as well as key micronutrients such as zinc and boron
  - Nutrients ribboned throughout each ammonium phosphate granule using a patented technology
  - Corn yield increases of 3-7 bu/ac based on thousands of field trials conducted since 2002
  - *Largest yield boost in the most intensive cropping systems*
  - Value share across supply chain from farmer to retail dealer to Mosaic
- Rapid adoption of MicroEssentials®
  - Production has increased from less than one-half million tonnes from 2005-09 to 2.3 million in 2016
  - Production is expected to reach 2.7-2.8 million tonnes in 2017
  - Marketed to strategic customers mostly in North America and Brazil
  - But marketed in several other countries as well
- Investing to meet future demand growth
  - Produced today in five granulation plants with annual capacity of 3.6 million tonnes
  - Most recently invested ~$225 million to convert two granulation plants at New Wales in 2016
  - Capable of increasing capacity to 4.5 million tonnes in the future

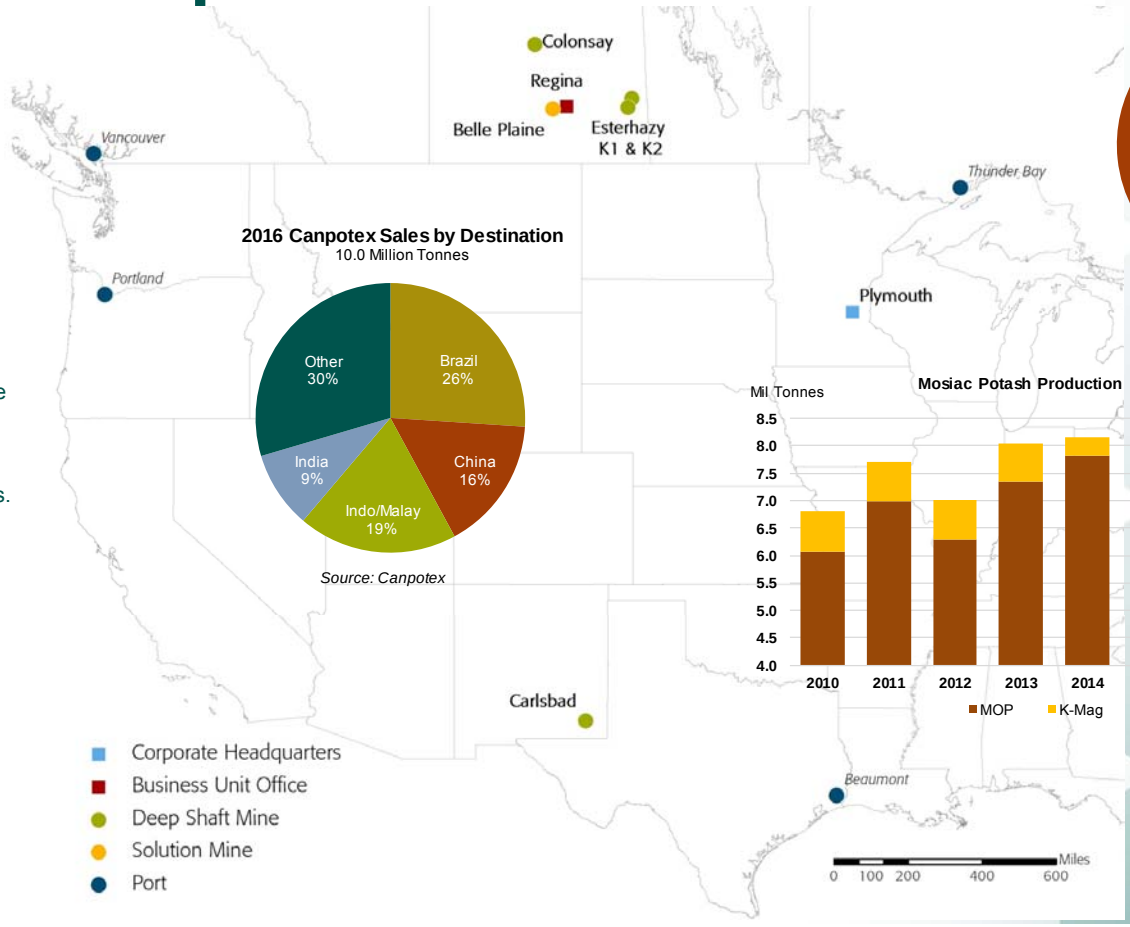
Mosaic

Our Potash Operations

Canpotex



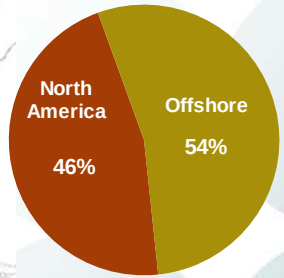
Potash is exported to offshore customers by Canpotex, an export association owned by Nutrien and Mosaic, through Vancouver and Portland ports.



2016 Canpotex Sales by Destination
10.0 Million Tonnes

Source: Canpotex

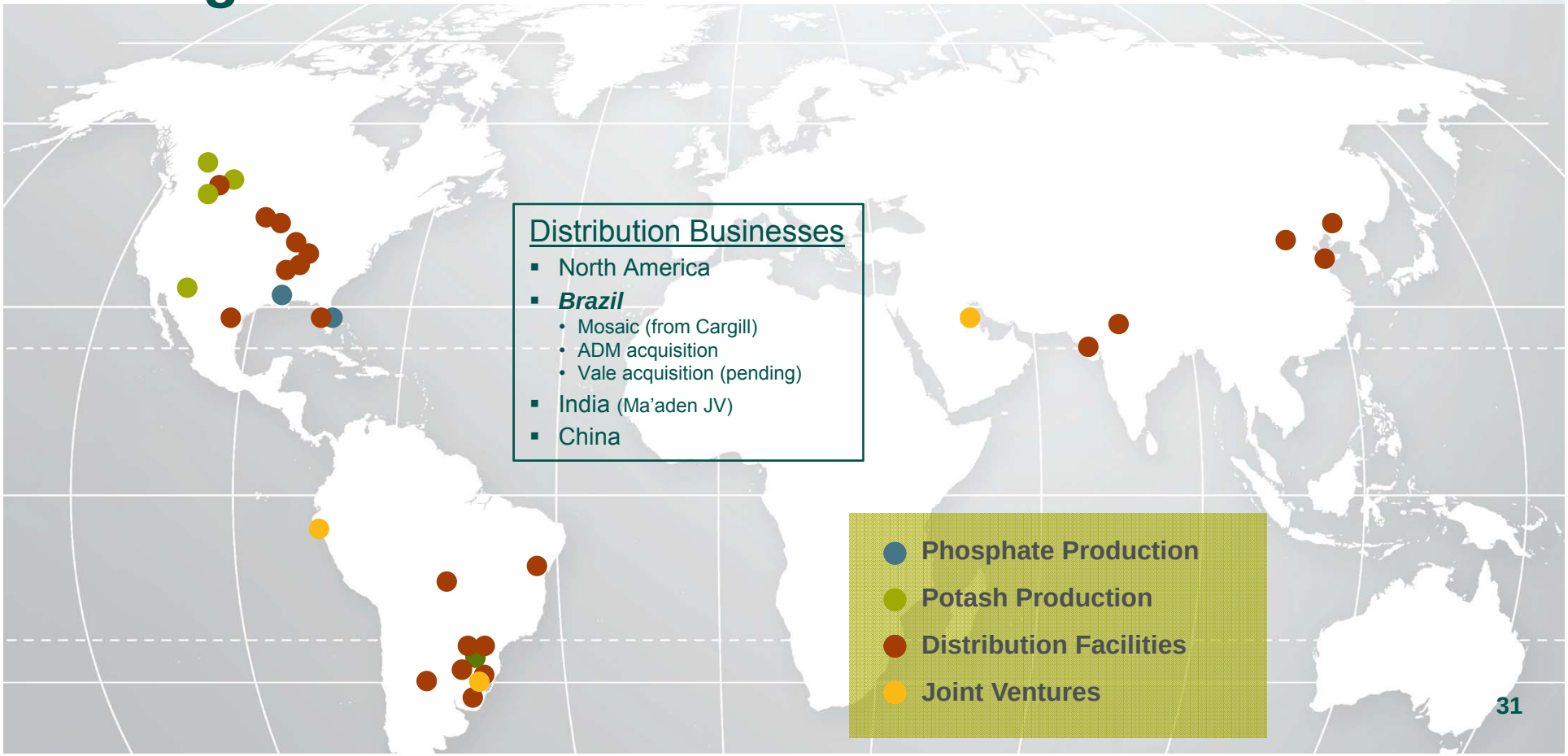
Potash Sales
2012-16



Mosiac Potash Production

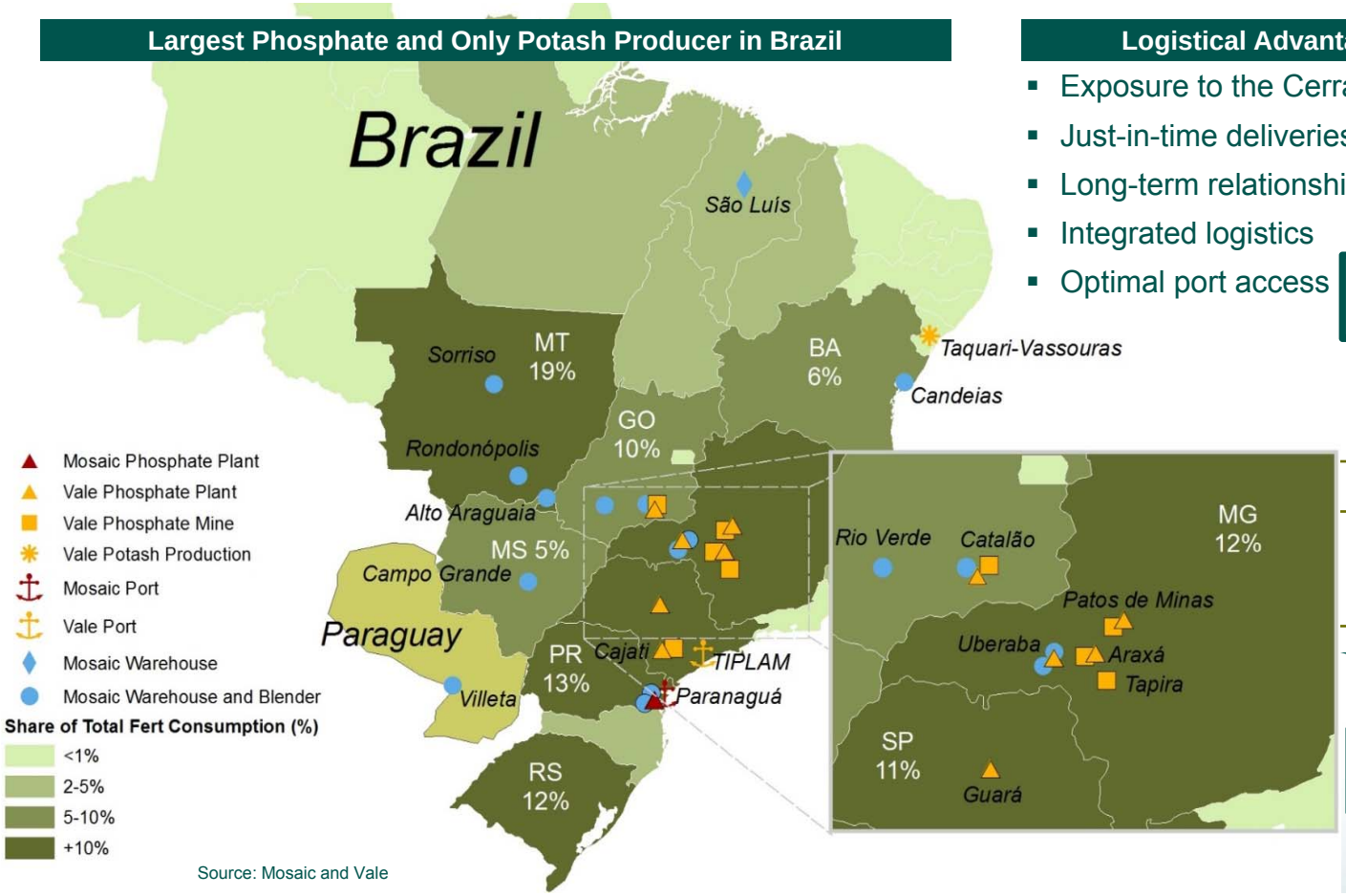
Mosaic

Long Life and Low Cost Asset Portfolio



Pending Vale Acquisition

Largest Phosphate and Only Potash Producer in Brazil



Source: Mosaic and Vale

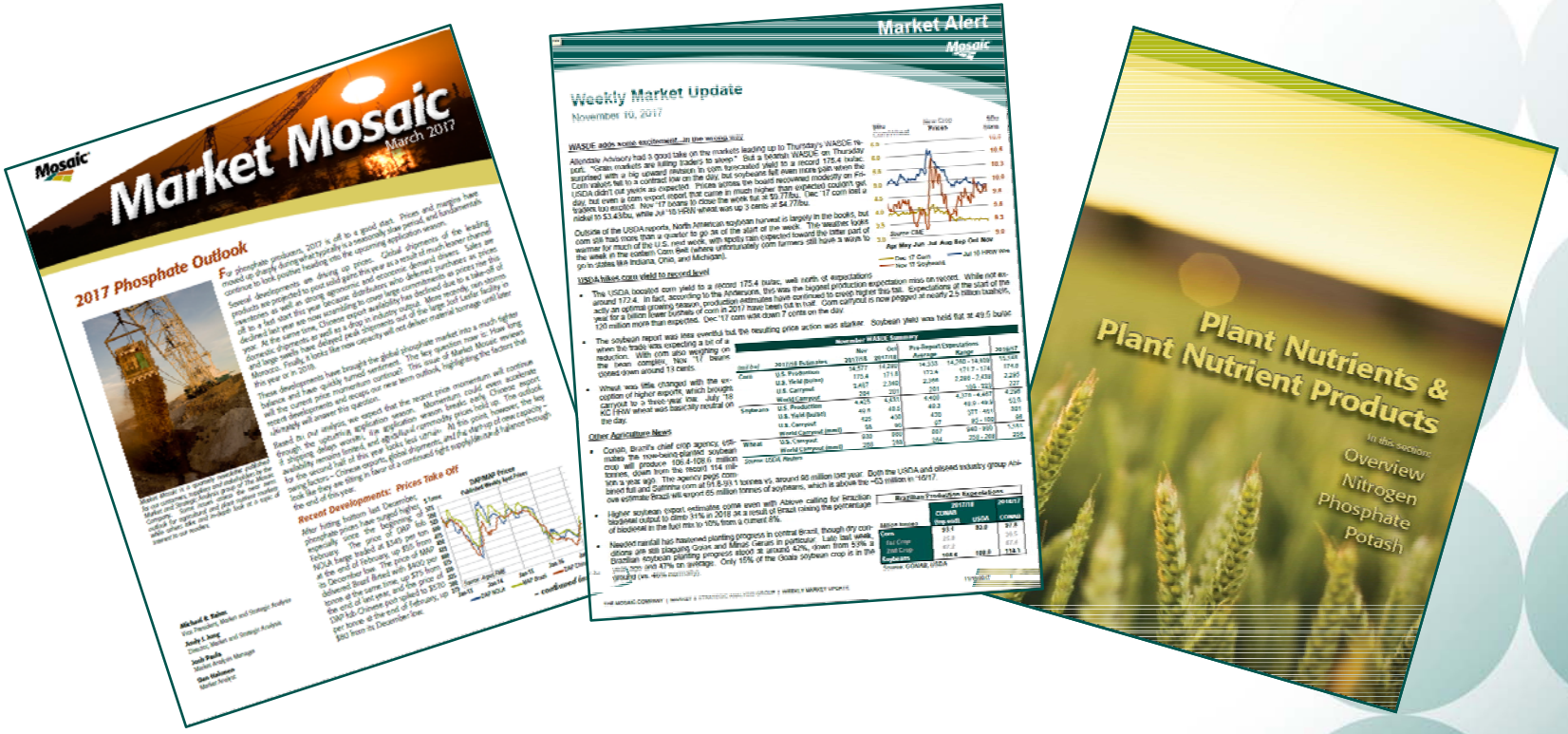
Logistical Advantage to Key Growing Areas

- Exposure to the Cerrado region
- Just-in-time deliveries
- Long-term relationships with customers
- Integrated logistics
- Optimal port access

Illustrative Logistics Advantage	
Seaborne Shipping Costs	$ 15 - $20/MT
Port Charges	$ 10/MT
Truck to In-land Blenders	$ 40/MT

$65-70/MT logistics advantage to key in-land markets

Resources Available on mosaicco.com



http://www.mosaicco.com/resources/market_analysis.htm

Thank You!

Questions?

Chemicals for the Non-Chemist

Plant Nutrients and Plant Nutrient Markets

Citi Basic Materials Conference
New York, NY
November 27, 2017

Dr. Michael R. Rahm
Vice President Market and Strategic Analysis

Mosaic