Energy and commodity price benchmarking and market insights


illuminating the markets
North American fertilizer: Nitrogen context and trends
For Pemex Petroquimica
Lauren Williamson
5 June 2013
About Argus

• Leading international and independent price reporting organisation
• Founded in 1970 – over 40 years experience
• Today over 120 publications
• Consulting services and events
• Over 400 employees and 40 freelancers (news journalists)
• Customers in 110 countries
• Twenty offices around the globe...
Argus FMB World Ammonia Outlook to 2027

- Strategy report examines merchant ammonia market amid structural changes
- 100 pages for long-term decision making
- Country-by-county projections
- Shale gas revolution impact analyzed
- Phosphate fertilizer trends and impact

Contact fertilizer@argusmedia.com for table of contents or to order a copy
Argus Fertilizer

- International presence, global coverage
- 8 reports, 170+ price assessments
- Robust methodology
- Extensively used in indexation of physical and financial markets
- FMB founded in 1982; Argus acquired FMB in 2011
Agenda

• Global perspectives on ammonia
• US & Canada, in context
• Fertilizer past, present, future
• Price trends
• Product preference trends
Global perspective
Global ammonia trade

- Traded ammonia = 19-20 million t/yr
  - Long term increases
- Almost 90% of nitrogen produced converted in situ
- Trend growth of last 15 yrs due to demand growth for technical uses and phosphate production
- Most phosphate producers rely on imports
  - Saudi Arabia’s Ma’aden an exception
Merchant (traded) ammonia market

- Global food security concerns will continue to spur fertilizer demand
  - Cellulosic and next-generation biofuels to exacerbate
- Government, private industry will invest to meet fertilizer demand
- Long-term growth in merchant ammonia market will be limited, but a significant shift in trade patterns expected
## Demand drivers - trade

<table>
<thead>
<tr>
<th>Country</th>
<th>Comment</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morocco</td>
<td>OCP Jorf Phosphate Hub Programme (DAP/MAP)</td>
<td>↑</td>
</tr>
<tr>
<td>US</td>
<td>Decline in direct application NH3 Less nh3 required for production of new phosphate types</td>
<td>↓</td>
</tr>
<tr>
<td>Brazil, China</td>
<td>Increasing domestic capacity to reduce imports</td>
<td>↓</td>
</tr>
<tr>
<td>Japan</td>
<td>Replacement of high cost capacity with imports (post Fukushima)</td>
<td>↑</td>
</tr>
<tr>
<td>Latin America, India, Australia, Africa</td>
<td>New LDAN capacity</td>
<td>↑</td>
</tr>
<tr>
<td>Australia, Madagascar, PNG</td>
<td>Metals Leaching, pollutants removal ‘Scrubbing’</td>
<td>↑</td>
</tr>
<tr>
<td>East Asia</td>
<td>Plastics/Textiles: MDI/TDI for rigid/semi polyurethane foams; acrylonitrile (Asia); Caprolactam (global trend decline, except China)</td>
<td>↑</td>
</tr>
</tbody>
</table>
## Supply drivers - trade

<table>
<thead>
<tr>
<th>Country</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Exports diverted to domestic LDAN</td>
</tr>
<tr>
<td>US</td>
<td>New import substituting capacity (Mosaic &amp; Dyno), but up to 5.3mn t imports tied and capacity limited by environmental planning and permitting</td>
</tr>
<tr>
<td>Trinidad</td>
<td>Resumption of production, deliveries</td>
</tr>
<tr>
<td>Indonesia</td>
<td>KPA/KPI tonnage to be used in NPKs/urea once gas contracts expire 2018/2020</td>
</tr>
<tr>
<td>Ukraine, Russia</td>
<td>Swing production, more upgrading expected but capacity/trade increases longer term</td>
</tr>
<tr>
<td>Middle East, North Africa,</td>
<td>Continued investments set against political difficulties in certain key producing regions</td>
</tr>
</tbody>
</table>
Anhydrous direct applications

- Majority of direct apps are in North America
  - Some in Australia, Mexico, Denmark
- Direct applications in long-term trend decline
- Move towards other N products
- Increased environmental regulation of nitrogen fertilizer applications in West Europe, North America
The N options

- Anhydrous ammonia - 82% N
  - Transport, logistics more expensive
  - High N but less flexible
- Urea - 46% N
  - Dry, bulk
  - Greater risk for volatilization
- UAN- 28-32% N
  - Fertigation, precision
  - Flexible w/other products

- AN - 34% N
  - More stable, doesn’t lose N to atmosphere as easily as urea
  - Volatile, explosive under certain conditions
  - Market share is eroding

- Other custom solution or suspension blends or dry bulk mixes available
  - Solutions applications increasing, displacing ammonia
Canada & the US, in context
US vs Canada

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat exports</td>
<td>25.5 mn t</td>
<td>18.5</td>
</tr>
<tr>
<td>Coarse grain exports</td>
<td>33 mn t corn</td>
<td>1.5 barley</td>
</tr>
<tr>
<td>GDP</td>
<td>$15.08tn</td>
<td>$1.4tn</td>
</tr>
<tr>
<td>Land area (excl water)</td>
<td>9.2 mn sq km</td>
<td>9.1 mn sq km</td>
</tr>
<tr>
<td>% Arable</td>
<td>18</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: USDA, CIA World Fact Book

*Copyright © 2013 Argus Media Ltd. All rights reserved.*
## Country, cash crop profiles

<table>
<thead>
<tr>
<th>Country</th>
<th>Crop</th>
<th>Area ('000 ha)</th>
<th>Rate (kg nutrient/ha)</th>
<th>Consumption ('000 tons) N-P-K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>N-P-K</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>corn</td>
<td>1,111</td>
<td>156-52-95</td>
<td>173-58-106</td>
</tr>
<tr>
<td></td>
<td>canola</td>
<td>4,894</td>
<td>75-20-15</td>
<td>367-98-73</td>
</tr>
<tr>
<td></td>
<td>wheat</td>
<td>11,162</td>
<td>50-26-6</td>
<td>558-290-67</td>
</tr>
<tr>
<td>US</td>
<td>corn</td>
<td>31,205</td>
<td>150-70-90</td>
<td>4,681-2,184-2,808</td>
</tr>
<tr>
<td></td>
<td>soy</td>
<td>28,506</td>
<td>30-60-95</td>
<td>599-1,197-1,896</td>
</tr>
<tr>
<td></td>
<td>wheat</td>
<td>31,978</td>
<td>70-30-10</td>
<td>2,015-863-288</td>
</tr>
</tbody>
</table>

*Source: FAO*
Crop fertilizer rates

US consumption

K
21%
P
20%
N
59%

Source: FAO

Source: FAO

Kg nutrient/ha

Canada corn
US corn
Canada wheat
US wheat
Canada canola
US soy

K
P
N
## Crop economics

<table>
<thead>
<tr>
<th></th>
<th>Corn after soy</th>
<th>Corn after corn</th>
<th>Soy after corn</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bushel/acre yield</strong></td>
<td>190</td>
<td>180</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td><strong>Price $/bushel</strong></td>
<td>6.00</td>
<td>6.00</td>
<td>12.50</td>
<td>8.50</td>
</tr>
<tr>
<td><strong>Gross revenue</strong></td>
<td>1,140</td>
<td>1,080</td>
<td>700</td>
<td>638</td>
</tr>
<tr>
<td><strong>Total non-land costs</strong></td>
<td>563</td>
<td>578</td>
<td>308</td>
<td>318</td>
</tr>
<tr>
<td><strong>Return</strong></td>
<td>577</td>
<td>502</td>
<td>392</td>
<td>320</td>
</tr>
</tbody>
</table>

Corn most favorable, barring significant price change or weather pattern.

*Source: University of Illinois*
Corn production

World corn production

359.17 mn t projected for US

Million tonnes

2011/2012
2012/2013
2013/2014
US total consumption 1960-now

Post-1980 decreasing P,K consumption

Source: USDA
Fertilizers past, present, future
Historical points

1921
- First commercial US NH3 plant

1930s
- Ammoniated solutions marketed
- 10 NH3 plants on stream
- Urea sold to US market

1944
- NH3 directly applied to fields

1950s
- Retail blending booms 1950s-1970s
- Nearly 60 NH3 plants on stream by 1960

1970s
- Energy shortage and costs become growing concern

1980
- 5500 blending units across US
- Several thousand fluid fertilizer retail plants

1990s-2000s
- High gas costs squeeze margins, price numerous plants out of the market

Source: Argus, market survey, TFI
US NH3 production, consumption 2002-2011

Nearly 3mn t decrease in production 2002-2005

Source: IFA
US urea production, consumption 2002-2011

![Graph showing US urea production and consumption from 2002 to 2011. The x-axis represents the years 2002 to 2011, and the y-axis represents production and consumption in '000 t nutrient N. The graph indicates a general increase in production and consumption over the years, with consumption slightly exceeding production in most years.]
US N production capacity shifts 2005-2012

Source: TFI
N production, trade flows 2012

US production mostly near end-users, river transport, pipelines

NH3 imports from Canada, Ukraine, Trinidad
- Large volume to Tampa, Florida for phosphate production

Urea from Middle East, Egypt, Indonesia

UAN from Black Sea/Baltic, Egypt, Trinidad

illuminating the markets
N fertilizer benchmarks vs nat gas

Meanwhile... shale gas revolution prompts decoupling
# Intended US & Canada N projects

<table>
<thead>
<tr>
<th></th>
<th>Debottleneck</th>
<th>Brownfield &amp; Revamp</th>
<th>Greenfield</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Announcements</strong></td>
<td>7</td>
<td>6</td>
<td>10</td>
<td>5 (Coal, coke, biomass)</td>
</tr>
<tr>
<td><strong>Some key players</strong></td>
<td>Koch, Agrium, PCS, LSB, Rentech</td>
<td>CF, IPL, Koch, Mosaic, Agrium (Borger, Redwater)</td>
<td>OCI, CHS, OVR, NPN, etc</td>
<td>Miss Power, Summit, CVR, Bionitrogen, Dakota Gas</td>
</tr>
<tr>
<td><strong>Probability</strong></td>
<td>High</td>
<td>Med high</td>
<td>V. low-med (depending on project)</td>
<td>Low-med (depending on project)</td>
</tr>
<tr>
<td><strong>Considerations</strong></td>
<td>None</td>
<td>Increasing market competition</td>
<td>High capex, longterm gas/crop prices</td>
<td>Tax, financing, process viability</td>
</tr>
</tbody>
</table>

Copyright © 2013 Argus Media Ltd. All rights reserved.
**Transport**

- 13 mn t/yr dry, bulk ferts transported by barge
  - Only 33 NH3 barges in operation; UAN needs liquid barges, competes against oil
- 2.5-3 mn t/yr NH3 transported by pipeline
  - Nustar, Magellan transport majority vs. other lines in US Gulf, Florida

---

illuminating the markets
US ammonia capacity projections

- Domestic capacity increases and tied tonnage to impact import dependence
- Domestic projects likely to face delays
  - Permitting, environmental concerns slow the process
  - Difficulties for non-traditional entities
- US NH3 import demand to reduce 50% by 2027

Source: IFA
Increasing capacity trends

- Most new NH3 capacity intended for upgrading
- Industrial consumption increasing on increased production of downstream products
- Liquidity increasing?
  - More production in the US Gulf, esp around New Orleans
  - Transport/logistics challenges
    • New barge costs $13-15mn
    • Nustar, Magellan used near capacity
- Tampa benchmark viability in question
  - Mosaic reducing NH3 consumption on increased added-value phosphate production (MicroEssentials)
  - Considering NH3 plant at Faustina
    • Reduce import reliance down to around 200-300,000t/yr
Price trends
Farmer prices 1960-2012

Source: USDA

Copyright © 2013 Argus Media Ltd. All rights reserved.
• N prices strong positive correlation to corn
• UAN to corn $R 0.69; NH3 to corn $R 0.73; urea to corn $R 0.56
• Urea had held stronger correlation until latest downward correction in global prices against still elevated corn prices
Nitrogen complex tightly correlated
On average, UAN at slight premium to urea, ammonia at greatest discount
UAN more closely follows urea ($R 0.89$) from 2008-2013; however Jan-May 2013 a departure from the trend ($R 0.24$)
Domestic ammonia prices

- Producer margins been above $400/st this year
- Added US NH3 capacity to weaken domestic price relationship to Tampa?
- Increased capacity abroad to put pressure on Tampa prices (beyond fob origin + freight)
Other trends...

• Location of new plants will impact regional variations
• E and W Corn Belt premiums to decrease
• Security of supply may decrease N price volatility and seasonal swings

Copyright © 2013 Argus Media Ltd. All rights reserved.
Product preference trends
US N direct application trends

Source: APPFCO, Interchem
Corn acre concentration

- Urea used widely
- NH3 concentrated in Midwest
  - Proximity to supply, pipelines
- UAN widely used but 28% used further north
- AN preferred in South, Southeast
Getting the right N

- NO3 (nitrate)
  - Preferred, ideal for uptake, instant supply
  - Risk of leaching esp. in high temps and water
- NH3 (ammonia) converts to NH4 (ammonium) in soil
  - Ammonification
  - Soil needs moisture to attach to organic matter
- NH4 absorbed at low rates
  - Takes time to convert to NO3 (nitrification) at warmer temps
- Urea → NH4 by urease enzymes
  - Risks some volatizing to NH3 and escapes to atmosphere (denitification)
  - Urease inhibitors and sulfur or polymer coatings to slow
Nitrate availability over time

Source: University of Kentucky
Evolving regulatory environment

- **Safety**
  - NH3 tank inspections
  - Risk of theft
  - Operational safety courses mandatory by DOT and under HMR

- **Transportation**
  - NH3 barges limited, old fleet
  - Rail tariffs cost-prohibitive - risk and hazard
  - Trucking common, causes municipal concerns on leaks/accidents

- **Environment**
  - NH3 fall dates to assist w/ appropriate temperature observance
  - Mandatory vs voluntary BMPs (state specific) and precision ag techniques
  - Nitrogen credits reducing runoff into watersheds

- **AN**
  - Dept of Homeland Security monitored
  - Further restrictions expected after West, Texas incident...
    - Could impact other N products such as NH3
Key takeaways

• Ammonia outlook
  ◦ 19-20mn t/yr traded, trade patterns to change
  ◦ Growth trend on technical, phosphate demand increases

• North America market
  ◦ Corn is king; crop-fertilizer price connection strong
  ◦ Nat gas prices inspiring investment, increasing N capacity to pressure pricing

• Trends
  ◦ Regulatory environment tightening
  ◦ Product preference and techniques are evolving, though overall fertilizer demand is stable
Any questions?
illuminating the markets