Soda ash & the environment

How environmental considerations influence both soda ash supply & demand

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How have environmental concerns effected the soda ash market?

• Chinese production and demand effected by environmental restrictions
  – Raw material price changes effect costs
  – Related markets also impacted

• Global soda ash supply/demand dynamics shifting

• New environmentally focused demand sectors

• Old demand sectors driven by environmental concerns
Supply
Impacts of environmental concerns on supply
China has been focusing on environmental concerns

- China government’s move to greener economy
- Reducing pollution through government checks
- Implementing stricter controls on industrial capacity
- Incentivising air/water waste emission reduction
- Decrease energy consumption by 15% by 2020
- Reduce VOC emissions by 10% by 2020
China has been focusing on environmental concerns

- Pilot round of checks in Hebei province in Dec 2015
- Followed by further checks throughout 2016/2017
- Checks caused impacts to Soda Ash production
- Costs increased: restrictions in raw material output
- Tightness in Soda Ash resulted in price increases
- Effects worse in high demand areas

Source: IHS Markit
In the past, plants in China have closed due to environmental reasons.
CHINA GLASS
• Shahe, in the city of Xingtai, Hebei province is China’s ‘glass capital’

• 2.9MMT float-glass capacity closed in Shahe in 2017

• There are still 10~20 float-glass lines facing closure due to the failure to meet environmental standards

Hebei is under great Environmental Pressure
Flat glass faces tighter environmental standards

• Flat Glass production was 39.6 MMT in 2017
  – Consumption of 7.9 MMT soda ash

• New, tighter, environmental standards, with respect to air pollutants, to be imposed on flat glass producers from June 1, 2018 in ‘26 Cities’

<table>
<thead>
<tr>
<th>Unit</th>
<th>Current</th>
<th>From June 1, 2018</th>
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<tbody>
<tr>
<td>Nitrogen Oxides</td>
<td>mg/m³</td>
<td>700</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>mg/m³</td>
<td>400</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>mg/m³</td>
<td>50</td>
</tr>
</tbody>
</table>
ENVIRONMENTAL IMPACT ON COSTS
China restrictions impact on costs

**Solvay Process**

1. 2 NaCl Brine → 2 NaHCO₃
2. Limestone → CO₂
3. 2NH₃
4. 2 NH₄Cl → Soda Ash

**Overall Stoichiometric Reaction:**

2 NaCl + CaCO₃ → Na₂CO₃ + CaCl₂

**Hou Process**

1. 2 NaCl Brine → 2 NaHCO₃
2. Limestone → CO₂
3. CaO
4. 2NH₃

**Overall Stoichiometric Reaction:**

2NaCl + CO₂ + 2NH₃ + H₂O → Na₂CO₃ + 2NH₄Cl
Environmental restrictions in China helped push up prices from Jan 2016 to Dec 2017

- **Thermal coal**: ¥399 to ¥748 per ton
- **Coke**: ¥629 to ¥2204 per ton
- **Metallurgical coal**: 536¥ to 1418¥ per ton
- **Power**: ¥0.47/kWh to ¥0.60/kWh
- **Steam**: ¥62.1 to ¥107.4 per ton
- **Ammonia**: ¥326 to ¥451 per ton
- **Steel**: output grew 5.7% in 2017
China fertiliser restrictions impact

**Solvay Process**

1. 2 NaCl Brine → 2NaHCO₃ → CO₂ → 2NH₃ → 2 NH₄Cl → Soda Ash → 2 NH₄Cl → 2NaHCO₃ → CO₂ → 2NaCl Brine

2. Limestone → CaO → Calcium Chloride

Overall Stoichiometric Reaction:

2 NaCl + CaCO₃ → Na₂CO₃ + CaCl₂

**Hou Process**

1. 2 NaCl Brine → 2NaHCO₃ → CO₂ → 2NH₃ → 2 NH₄Cl → Soda Ash

2. Limestone → CaO

Overall Stoichiometric Reaction:

2NaCl + CO₂ + 2NH₃ + H₂O → Na₂CO₃ + 2NH₄Cl

**Ammonium Chloride by-product needs a market**

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China is aiming for 0% growth in fertilizers due to eutropification: what's the impact?

- **Urea market**
  - Size: 91 MMT
  - Urea is China’s main fertilizer
  - Demand slumped; Op Rates: 61%
  - Price stayed high due to high costs

- **NH₄Cl Market**
  - Size: 15 MMT
  - Urea drives NH₄Cl prices
  - NH₄Cl competes with urea
  - NH₄Cl prices help cover NH₃ cost

- NH₄Cl competes with urea
- NH₄Cl prices help cover NH₃ cost
- Urea is China’s main fertilizer
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Demand
Impacts of environmental concerns on demand
Lithium is one world’s hottest commodities driven by environmental imperatives

- Solar energy production costs falling
- EV uptake drives demand in at-home solar power generation
- Growing at home, and utility scale solar power, requires storage
- Li-Ion batteries fast growing EV propulsion solution
- Li-Ion batteries fast growing energy storage solution
- EV uptake drives demand in Lithium batteries

Lithium is one world’s hottest commodities driven by environmental imperatives.
Soda ash demand from this sector is small and its influence depends on location

**SAM**
- Soda ash demand from LiCO$_3$ ~ 183,000 mt
- % of SAM demand ~ 7.0

**NAM**
- Soda ash demand from LiCO$_3$ ~ 10,000 mt
- % of NAM demand ~ 0.2%

**China**
- Soda ash demand from LiCO$_3$ ~ 210,000 mt
- % of China demand ~ 0.6%

**Australia**
- Soda ash demand from LiCO$_3$ = 0 mt
- Lithium exported as Spodumene Conc
- Plans for LiOH plant
As future of power and transportation changes, it will push demand for soda ash

Increasing presence of solar power will require more solar glass – requires **soda ash**

EVs require Li-ion batteries and window glass, driving **soda ash** demand

Li-ion battery production requires Li Carbonate supply – in turn requires **soda ash**
Container glass
Impacts of environmental concerns on demand for soda ash
Container glass demand for soda ash is impacted by the environment

- Historically container glass was no. 1 use for soda ash
- Increased use of cullet decreases need for soda ash
- Competition from other packaging materials mainly PET
- Environmental concerns becoming more important – is glass green?
- Alcoholic beverages as niche packaging for glass
- Light weighting, lower soda ash use per bottle
Weight for weight glass production produces less CO$_2$ than PET production

US EPA greenhouse gas output for glass production

US EPA greenhouse gas output for PET production

Source: IHS Markit © 2018 IHS Markit
Bottle for bottle, PET production produces less CO₂ than glass production

**US EPA greenhouse gas output for glass production**

- Virgin Glass
- 100% Recycled Glass

**US EPA greenhouse gas output for PET production**

- 3% Recycled PET
- 100% Recycled PET

- But doesn’t consider other greenhouse gases
- Standard LCA cuts off impacts after 100 years
- Plastic emits significant CO₂ after 100 years
So why is glass seen to be better for the environment?

- Other environmental impacts – resource depletion, water consumption
- Glass infinitely recyclable
- Glass inert and non porous
- Some of these other environmental impacts are higher for PET
- PET often recycled into lower grade material
- PET thought to leach – public perception important
- Glass shatters and breaks up
- Issue of plastic collecting in the sea
Good example is FEVE’s view of Europe’s circular glass economy

- 85% of Europeans prefer glass
- 73% of Europeans think glass is safer packaging for drinks
- 74% of glass bottles are recycled in Europe
- 580kg CO₂ saved per ton of cullet in Europe
- Glass is 100% recyclable
Conclusions

2017 – 2018 saw significant shifts in soda ash supply-demand dynamics

Outcomes of these shifts were not as expected due to new drive for environmental stability in China

New environment-driven demand sectors are altering soda ash market

Cultural changes to environment are also having an impact on soda ash demand