Sulphur Consumption by End Use

- **Fertilizer (about 50%)**
  - **Phosphates**
    - Phosphoric Acid
    - SSP
  - **Non-Phosphates**
    - Ammonium Sulphate
    - Potassium Sulphate
    - Elemental Sulphur-based fertilizers
Sulphur Consumption by End Use

- Non-fertilizer (the balance)
  - Metallurgical processing
  - Caprolactam
  - Feed and industrial phosphates
  - Titanium dioxide
  - Petroleum refining
  - Hydrofluoric acid
  - Pulp and paper industry
  - Other
Elemental sulphur demand 2011-2013

Demand 2011-2013 (million tons)

Source: IFA

For non-acid production

For acid production
Variables - Demand

- China
- Saudi Arabia
- Industrial activity
Asia and Latin America Are the Key Fertilizer Growth Markets

Data reported by individual countries in a combination of fertilizer and calendar years. For example, 2010F is based on 2010 calendar year and 2010/11 fertilizer year data.

* Rest of world

Source: Argus, IFA, Fertecon
Chinese Sulphur Imports in 1996 – 2012, tons

Source: BAIINFO
China – world’s largest importer

- 2012 imports were 11 million tons
- One-third of world trade
- Fertilizer industry consumes bulk
- Nearly 16 million tons was used to produce phosphoric acid
- Trend is for phosphoric acid production to increase and SSP continue to reduce
- …domestic sulphur production will rise

Source: CSAIA, IFA
Consumption in the Middle East could reach 4.5 million tons in 2016

Source: Integer, IFA
Variables - Supply

- Middle East
- Caspian Sea
Majority of supply growth to come from gas processing

- **Sour Gas Processing**
  - To reach 36.9 million tons in 2017
  - Regional output from Middle East, FSU, China

- **Oil Refining**
  - To reach 30.3 million tons in 2017
  - Oil sands in Canada
  - Crude oil in the US

Source: Integer
Middle East production shows significant growth
Middle East sulphur production to grow by 6 million tons in 2013-2018

Source: Integer, IFA
Abu Dhabi to become a top global sulphur exporter

• Annual production to rise to 7 million tons
  – Gas production at Shah scheduled to start end 2014
  – Impact on sulphur supply from 2015
  – 120 km rail infrastructure between Shah and Ruwais under construction for sulphur transportation
  – ADNOC’s granular sulphur storage close to 290,000 tons at port, further 290,000 ton storage facility to be added at plant

Source: Integer
Expansion at Habshan to increase export potential

- Habshan gas processing plant built in 1984
- Habshan-5, an Abu Dhabi Gas Industries (GASCO) facility to add 5,200 tons/day sulphur production
- October 2013: rail transport between Habshan and Ruwais undergoing testing
- Habshan Sulphur Granulation Plant (HSGP): liquid sulphur to be transported from Habshan 1-4 via heated pipelines
- Discussion over stockpiling options

Source: Integer
Over 3 million tons production to be added by other Middle East producers

- **Kuwait**
  - Clean fuels project to push production over one million tons, from 2015
- **Iran**
  - Increases to come from South Pars gas expansions, potential to reach two million ton mark in 2016
- **Iraq**
  - Sour gas processing plant at Kirkuk; volume uncertain
  - Badra oil field development, second half 2015: 100,000 tons/year sulphur
- **Qatar**
  - Barzan gas developments scheduled
  - Potential to reach 2.6 million tons in 2017

Source: Integer
Another Supply Variable - China

- Puguang is operational
- Now extracting about 2 million tons
- Expected to grow an additional 1 million tons

Source: Devco
Puguang Summary

- Gas - Design Capacity: 36 MMCM/d
- Gas – Design Composition: 15-17% H2S
- Sulphur – Design Production Capacity: 8,640 metric t/d, or 3 million t/y
- Molten sulphur storage: 100,000 tons in 10 tanks
- Formed sulphur storage, bulk: 230,000 tons in 2 silos
- Bagged sulphur storage: 9,000 tons
- Sulphur shipment: bag and bulk by rail and truck

Source: Devco
Other Chinese projects

• Chuandongbei - 2013
  – 1.5 million tons per year capacity

• Yuanba – 2015
  – Smaller than Puguang or Chuandongbei

• Smelter acid increases also expected

Source: CSAIA, IFA
## China Top 10 Sulphur Producers 2012

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>2012</th>
<th>2011</th>
<th>Change (YoY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puguang Gasfield</td>
<td>1,983,710</td>
<td>1,573,416</td>
<td>26.08%</td>
</tr>
<tr>
<td>Zhenhai Oil Refining &amp; Chemical</td>
<td>210,300</td>
<td>211,800</td>
<td>-0.71%</td>
</tr>
<tr>
<td>Qingdao Oil Refining &amp; Chemical</td>
<td>18,307</td>
<td>162,700</td>
<td>12.79%</td>
</tr>
<tr>
<td>Fujian Oil Refining &amp; Chemical</td>
<td>169,000</td>
<td>131,000</td>
<td>29.01%</td>
</tr>
<tr>
<td>Jinling Petrochemical</td>
<td>161,400</td>
<td>176,100</td>
<td>-8.35%</td>
</tr>
<tr>
<td>Tianjin Petrochemical</td>
<td>160,600</td>
<td>193,400</td>
<td>-16.96%</td>
</tr>
<tr>
<td>Maoming Petrochemical</td>
<td>148,200</td>
<td>151,400</td>
<td>-2.11%</td>
</tr>
<tr>
<td>Dalian Petrochemical</td>
<td>140,000</td>
<td>101,700</td>
<td>37.66%</td>
</tr>
<tr>
<td>Qilu Petrochemical</td>
<td>138,700</td>
<td>146,100</td>
<td>-5.07%</td>
</tr>
<tr>
<td>Guangzhou Petrochemical</td>
<td>132,200</td>
<td>126,900</td>
<td>4.18%</td>
</tr>
</tbody>
</table>

Source: BAIINFO
Chinese import outlook

- With increasing domestic production will come, decreasing imports.
- Import levels have been averaging about 10 million tons per year recently.
- New projects…and some new demand…will have number at about 7 million tons per year.

Source: BAIINFO, CSAIA
Canadian inventory augments supply

- Inventory at gas plants depleted
  - 9.1 million tons end of 2002
  - 1.4 million tons end of 2012

- Inventory at oil sands grows
  - 9.5 million tons end of 2012

Source: ERCB, Argus
US sulphur production

Production (thousand tons)

Source: USGS
US takes large volume of Canadian production

Imports (thousand tons)

- 2009: 1,463
- 2010: 2,308
- 2011: 2,585
- 2012: 2,319

Source: CN Rail, CP Rail
Gas Recovered Sulphur Storage
Tengiz, Kazakhstan
Sulphur exports - 2012

Exports 2011/12 (million tons) - preliminary

Source: IFA
Sulphur imports - 2012

Imports 2011/12 (million tons) - preliminary

Source: IFA
Canadian offshore exports

2.98 million tons in 2012

- China, 35%
- Mexico, 33%
- Australia, 22%
- South Africa, 13%
- Cuba, 5%
- Israel, 6%
- New Zealand, 5%
- Chile, 2%
- Others, 8%

Source: Argus
Middle East sulphur producers reliant on Asian import markets

2011 Middle East sulphur export destinations

- East Asia: 50%
- Latin America: 19%
- Africa: 19%
- West Asia: 4%
- South Asia: 1%
- North America: 1%
- Oceania: 1%

Source: IFA
Canadian exports to China decline as Middle East exports increase

Source: Integer, GTIS
Ras Laffan, Qatar
Trade patterns to shift as Middle East production increases

- Block storage options limited
- Additional surplus production to go to export market?
- Production close to ports – further competition for other exporters
- Different end-user markets being researched for sulphur
- Metals leach projects gain interest
Plant Nutrient Sulphur Deficit in 2010

<table>
<thead>
<tr>
<th>Region</th>
<th>Million Tons Sulphur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>5.8</td>
</tr>
<tr>
<td>China</td>
<td>2.4</td>
</tr>
<tr>
<td>India</td>
<td>1.8</td>
</tr>
<tr>
<td>North America</td>
<td>1.5</td>
</tr>
<tr>
<td>Africa</td>
<td>1.5</td>
</tr>
<tr>
<td>Latin America</td>
<td>0.9</td>
</tr>
<tr>
<td>Western Europe</td>
<td>0.5</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Source: TSI
Demand Versus Production

- Demand – Increasing...
- Deficit supply – End near?
- Sulphur stockpiles – Reversing trend?
## All forms of sulphur potential balance

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>86,925</td>
<td>89,381</td>
<td>91,598</td>
<td>93,514</td>
<td>95,655</td>
</tr>
<tr>
<td>Supply</td>
<td>87,735</td>
<td>92,659</td>
<td>96,970</td>
<td>100,591</td>
<td>103,421</td>
</tr>
<tr>
<td><strong>Potential Balance</strong></td>
<td><strong>810</strong></td>
<td><strong>3,278</strong></td>
<td><strong>5,372</strong></td>
<td><strong>7,077</strong></td>
<td><strong>7,767</strong></td>
</tr>
<tr>
<td>Share of total supply</td>
<td>1%</td>
<td>4%</td>
<td>6%</td>
<td>7%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Source: IFA
### Elemental Sulphur Potential Supply / Demand Balance

(‘000 tons S)

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>49,423</td>
<td>50,875</td>
<td>52,126</td>
<td>53,846</td>
<td>55,941</td>
</tr>
<tr>
<td>Non-sulphuric acid</td>
<td>7,902</td>
<td>8,017</td>
<td>8,132</td>
<td>8,202</td>
<td>8,272</td>
</tr>
<tr>
<td><strong>Total Demand</strong></td>
<td>57,325</td>
<td>58,892</td>
<td>60,258</td>
<td>62,048</td>
<td>64,213</td>
</tr>
<tr>
<td><strong>Supply</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>26,255</td>
<td>27,620</td>
<td>28,700</td>
<td>29,600</td>
<td>30,300</td>
</tr>
<tr>
<td>Gas</td>
<td>28,165</td>
<td>30,760</td>
<td>33,060</td>
<td>35,310</td>
<td>36,885</td>
</tr>
<tr>
<td>Other</td>
<td>3,715</td>
<td>3,790</td>
<td>3,870</td>
<td>4,215</td>
<td>4,795</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>58,135</td>
<td>62,170</td>
<td>65,630</td>
<td>69,125</td>
<td>71,980</td>
</tr>
<tr>
<td><strong>Potential Balance</strong></td>
<td>810</td>
<td>3,278</td>
<td>5,372</td>
<td>7,077</td>
<td>7,767</td>
</tr>
<tr>
<td>Share of total supply</td>
<td>1%</td>
<td>5%</td>
<td>8%</td>
<td>10%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Source: IFA, May 2013
# Elemental sulphur potential balance

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>50.7</td>
<td>53.1</td>
<td>54.9</td>
<td>56.5</td>
<td>57.6</td>
</tr>
<tr>
<td>Non-sulphuric acid</td>
<td>7.7</td>
<td>7.8</td>
<td>8.0</td>
<td>8.1</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>Total Demand</strong></td>
<td>58.4</td>
<td>60.9</td>
<td>62.8</td>
<td>64.6</td>
<td>65.9</td>
</tr>
<tr>
<td><strong>Supply</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>25.1</td>
<td>26.2</td>
<td>27.2</td>
<td>28.1</td>
<td>28.6</td>
</tr>
<tr>
<td>Gas</td>
<td>27.5</td>
<td>28.7</td>
<td>32.4</td>
<td>35.9</td>
<td>36.2</td>
</tr>
<tr>
<td>Other</td>
<td>3.5</td>
<td>3.7</td>
<td>4.0</td>
<td>4.3</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>56.1</td>
<td>58.6</td>
<td>63.6</td>
<td>68.2</td>
<td>69.6</td>
</tr>
<tr>
<td><strong>BALANCE</strong></td>
<td>-2.3</td>
<td>-2.3</td>
<td>0.8</td>
<td>3.6</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Source: IFA / Argus, September 2013
Middle East balance forecast reflects increased export potential

Middle East sulphur balance 2012-2021 (million tons)

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2015</th>
<th>2018</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>11.5</td>
<td>15.0</td>
<td>17.8</td>
<td>21.8</td>
</tr>
<tr>
<td>Consumption</td>
<td>2.7</td>
<td>4.1</td>
<td>5.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Export Potential</td>
<td>8.80</td>
<td>10.90</td>
<td>12.80</td>
<td>15.90</td>
</tr>
</tbody>
</table>

- Export potential growth to impact trade patterns
- Increased volatility in market has led Middle East producers to shift to short term contracts

Source: Integer, IFA
Thank You

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  • The Sulphur Institute
    • www.sulphurinstitute.org