WE’RE ABOUT SOLUTIONS

Solutions to meet the growing demand for multi nutrients in Europe
Presentation by J.T. Starzecki
ArgusFMB, Athens
October 2018
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SIRIUS MINERALS
CHANGING THE EUROPEAN FERTILIZER MARKET
COMPANY HIGHLIGHTS

- World’s largest and highest grade source of polyhalite
- POLY4’s agronomic validation demonstrates value globally
- Proven and growing market demand
- Commercial success with 8.2 Mtpa of offtake agreements
- Stage 1 financing secured (US$1.2 billion)
- Stage 2 financing well advanced – financial close planned for Q1 2019

**2011 – 2015**
Resource definition, minerals rights and approvals

**Nov 2016**
Stage 1 financing complete

**2017 – 2021**
Construction and development

**2021**
First polyhalite

**2024**
10 Mtpa ramp-up
Existing agreements total 8.2 Mtpa of POLY4 sales both into the fertilizer and animal feed markets.

In addition, options within existing offtake agreements of 1.15 Mtpa bring the total to 9.4 Mtpa.
SIRIUS MINERALS R&D PROGRAMME

Trials
339

Crops
36

Countries
25

Collaborators
119

Notes: Trials as of September 2018
EUROPEAN MARKET
EUROPEAN NUTRIENT DEFICIENCIES

Sigma deficit

Source: CRU, European Commission Joint Research Centre, Roland Berger, Sirius Minerals
EUROPEAN DRIVE FOR SUSTAINABILITY

SOIL HEALTH
Prevention and mitigation of soil degradation process.

NUE
Regulation/policy stimulate leaching reduction.

EMISSION CONTROL
Due to emission controls, EU soils are deficient in sulphur.

ORGANICS
Demand for environmentally-friendly fertilizers.

Source: Sirius Minerals
EUROPE: THE REGIONAL CHALLENGES

- Supporting organic growth
- Addressing the nutrient requirement
- Unmet chloride-free demand
GROWTH IN EUROPEAN ORGANIC MARKET

Growth in organic market

- Organic land in Europe has been growing at a CAGR of 7% since 2000

13.5 million hectares of organic land in Europe in 2016 – 21% increase since 2012.

POLY4 IS A CERTIFIED ORGANIC PRODUCT WHICH CAN BE USED TO SUPPLY A HIGH GROWTH MARKET IN BULK

Sources: IFOAM EU Group, 2016
Based on crops produced in 2016

Sources: CRU, FAOSTAT

European magnesium deficiency map

Magnesium responsive crops, European hectares harvested and % of world total

<table>
<thead>
<tr>
<th>Crop</th>
<th>European Hectares</th>
<th>% of World Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>10.1</td>
<td>45%</td>
</tr>
<tr>
<td>Grapes</td>
<td>3.2</td>
<td>5%</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1.8</td>
<td>10%</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>0.3</td>
<td>6%</td>
</tr>
</tbody>
</table>

Notes: 1). Based on crops produced in 2016
Sources: CRU, FAOSTAT
SUSTAINING EUROPEAN CROP NUTRIENT DEMAND: SULPHUR

- Sulphur demanding crops such as cereals, oilseed rape, potatoes and vegetables account for 66% of the total hectares planted in Europe.

Sulphur demand based on satisfying crop specific requirement¹ (Mtpa)

- Wheat: 0.8 Mtpa, 41% of total sulphur requirement
- Barley: 0.4 Mtpa, 19%
- Maize: 0.3 Mtpa, 14%
- Oilseed rape: 0.3 Mtpa, 17%
- Potatoes: 0.1 Mtpa, 0.1%
- Vegetables: 0.1 Mtpa, 0.1%
- Total: 2.0 Mtpa, 100%

Notes: ¹ Sulphur requirement based on crop specific sulphur requirement: wheat 30 kg S ha⁻¹; barley 30 kg S ha⁻¹; maize 30 kg S ha⁻¹; oilseed rape 50 kg S ha⁻¹; potato 70 kg S ha⁻¹; vegetables 30 kg S ha⁻¹. Based on total hectares planted 2016.
Sources: Sirius Minerals, FAOSTAT
EUROPEAN UNMET CHLORIDE-FREE DEMAND

• Consumption of chloride-free products accounts for 10% of total K₂O consumption
• 15% of the total K₂O consumption is used on chloride-sensitive crops, which identifies an unmet demand of 5%
• This unmet demand in Europe equates to 0.43 Mtpa of SOP or 1.53 Mtpa in POLY4 equivalent

European K₂O demand based on crop requirement

85%
10%
5%

Relatively tolerant & Cl demanding crops
Cl sensitive crops
Cl sensitive crops unmet demand

Unmet demand

KEY TAKEAWAY: EUROPEAN UNMET CHLORIDE-FREE DEMAND CAN BE FULLFILLED BY POLY4

Notes: Based on European K₂O consumption in 2017. Unmet demand based on crop requirements versus chloride free consumption. Assumed 50:50 ratio of SOP:MOP application on potato crop. Sources: Fertecon, FAO, Sirius Minerals
THE NATURAL SOLUTION
THE POLY4 CORNERSTONES

Notes: 1) Based on 90% polyhalite grade. Macro nutrients based on w/w % and micro nutrients based on mg/kg; micro nutrients’ content: B 169, Zn 1.9, Mn 3.1, Mo 0.3, Se>0.5, FE>0.5, Cu 1.1, Sr 1414. 2) POLY4 is the trademark name for polyhalite products from the Sirius Minerals polyhalite project in North Yorkshire, *48% SO₃. B – boron, Cu – copper, Se – selenium, Zn – zinc, Fe – iron, Sr – strontium, Mo – molybdenum, Mn – manganese.

THE POLY4 CORNERSTONES

EFFICIENCY

EFFECTIVENESS

FLEXIBILITY

SUSTAINABILITY

POLY4 CHARACTERISTICS

Effective nutrient release
Balanced
Compatibility
Critical relative humidity
Low chloride
Low CO₂
Crush strength
Soil enhancer
Organic
Effective spreading
Improves FUE
Implements yield
Diversification
Profitability
pH neutral

Notes: 1) Based on 90% polyhalite grade. Macro nutrients based on w/w % and micro nutrients based on mg/kg; micro nutrients’ content: B 169, Zn 1.9, Mn 3.1, Mo 0.3, Se>0.5, Fe>0.5, Cu 1.1, Sr 1414. 2) POLY4 is the trademark name for polyhalite products from the Sirius Minerals polyhalite project in North Yorkshire, *48% SO₃. B – boron, Cu – copper, Se – selenium, Zn – zinc, Fe – iron, Sr – strontium, Mo – molybdenum, Mn – manganese.
EFFECTIVE NUTRIENT RELEASE PROFILE

• A plant’s nutrient requirement changes through its life cycle

• Common fertilizer practice – nutrients are lost through leaching, run-off and erosion etc

• POLY4’s nutrient release profile more closely aligns with a plant’s nutrient requirements
EU: SUSTAINED MACRO-NUTRIENT DELIVERY

Macro-nutrient uptake results from EU trials

<table>
<thead>
<tr>
<th>Soil measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P (mg kg⁻¹)</td>
<td>56</td>
</tr>
<tr>
<td>K (mg kg⁻¹)</td>
<td>113</td>
</tr>
<tr>
<td>Mg (mg kg⁻¹)</td>
<td>98</td>
</tr>
<tr>
<td>Ca (mg kg⁻¹)</td>
<td>2047</td>
</tr>
<tr>
<td>S (mg kg⁻¹)</td>
<td>5</td>
</tr>
<tr>
<td>OM (g kg⁻¹)</td>
<td>19</td>
</tr>
</tbody>
</table>

**Improvements in macro-nutrient uptake compared to MOP**

<table>
<thead>
<tr>
<th>Element</th>
<th>Control</th>
<th>MOP</th>
<th>POLY4</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>-2%</td>
<td></td>
<td>+13%</td>
</tr>
<tr>
<td>P</td>
<td>-1%</td>
<td></td>
<td>+4%</td>
</tr>
<tr>
<td>K</td>
<td>-9%</td>
<td></td>
<td>+8%</td>
</tr>
<tr>
<td>Ca</td>
<td>+9%</td>
<td></td>
<td>+19%</td>
</tr>
<tr>
<td>Mg</td>
<td>+7%</td>
<td></td>
<td>+20%</td>
</tr>
<tr>
<td>S</td>
<td>-5%</td>
<td></td>
<td>+35%</td>
</tr>
</tbody>
</table>

**KEY TAKEAWAY:** POLY4 OUTPERFORMED MOP IN MACRO-NUTRIENT UPTAKE

Notes: 1) The results are based on 11 EU trials covering both high-value and broad-acre crops such as potato, wheat, barley, oilseed rape, silage corn, corn and celery. Source: Sirius Minerals.
SOIL STABILISATION

**Soil tensile strength (kPa)**

- 0% application rate: 23 kPa
- 2.5% application rate: 32 kPa
- 5% application rate: 36 kPa
- 50% application rate: 59 kPa

**Soil resilience to compaction (Young’s Modulus MPa)**

- 0% application rate: 1.7 MPa
- 2.5% application rate: 2.7 MPa
- 5% application rate: 2.9 MPa
- 50% application rate: 4.6 MPa

**KEY TAKEAWAY:**

POLY4 HELPS TO REBALANCE AND RECONSTRUCT THE SOIL STRUCTURE SUPPORTING SUSTAINABLE LAND MANAGEMENT

Notes: 1) Genstat means; 2) Young’s Modulus is a measurement of the elasticity of solid materials. Source: University of Aberdeen 2015.
The increase in yield reflects the potential of POLY4 to increase economic returns of farms.

The results show that with POLY4, farmers can achieve both economic and environmental sustainability.

**Trial results**

<table>
<thead>
<tr>
<th>Yield (kg ha⁻¹)</th>
<th>CO₂e emission (kg CO₂e ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>48,800</td>
<td>48,900</td>
</tr>
<tr>
<td>50,000</td>
<td>306</td>
</tr>
<tr>
<td>48,900</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>73</td>
</tr>
</tbody>
</table>

**Key takeaway:** POLY4 can deliver high crop yield and reduce CO₂e emission.

Notes: UK potato trial – 22000-MAC-22010-15. Based on yield results at recommended K₂O application of 200kg ha⁻¹. All plots received 220 kg N ha⁻¹ from AN, 100 kg P₂O₅ ha⁻¹ from TSP and 300 kg K₂O ha⁻¹ from MOP, SOP or POLY4. Initial soil analysis: P 28 mg kg⁻¹, K 106 mg kg⁻¹, Mg 46 mg kg⁻¹. Source: Commercial partner (22000-MAC-22010-15), Sirius Minerals.
## FERTILIZER PLANS OF THE FUTURE

Value-in-use by a European farmer

### Trial results and economic analysis: Wheat trial in Poland

<table>
<thead>
<tr>
<th>Economic Indicator</th>
<th>MOP + AS</th>
<th>MOP + POLY4</th>
<th>Diff.</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent mass required (kg ha⁻¹)</td>
<td>672</td>
<td>726</td>
<td>54</td>
<td>8%</td>
</tr>
<tr>
<td>Wheat yield (t ha⁻¹)</td>
<td>8.09</td>
<td>8.38</td>
<td>0.3</td>
<td>4%</td>
</tr>
<tr>
<td>Wheat price (US$/t)</td>
<td>158</td>
<td>158</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gross income (US$/ha)</td>
<td>1,278</td>
<td>1,324</td>
<td>46</td>
<td>4%</td>
</tr>
<tr>
<td>Total cost (US$/ha)</td>
<td>171</td>
<td>185</td>
<td>14</td>
<td>8%</td>
</tr>
<tr>
<td>Net income (US$/ha)</td>
<td>1,107</td>
<td>1,139</td>
<td>32</td>
<td>3%</td>
</tr>
</tbody>
</table>

### Trial results and economic analysis: Wheat trial in France

<table>
<thead>
<tr>
<th>Economic Indicator</th>
<th>MOP + AS</th>
<th>MOP + POLY4</th>
<th>Diff.</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent mass required (kg ha⁻¹)</td>
<td>672</td>
<td>726</td>
<td>54</td>
<td>8%</td>
</tr>
<tr>
<td>Wheat yield (t ha⁻¹)</td>
<td>7.34</td>
<td>7.55</td>
<td>0.2</td>
<td>3%</td>
</tr>
<tr>
<td>Wheat price (US$/t)</td>
<td>160</td>
<td>160</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gross income (US$/ha)</td>
<td>1,174</td>
<td>1,208</td>
<td>34</td>
<td>3%</td>
</tr>
<tr>
<td>Total cost (US$/ha)</td>
<td>171</td>
<td>185</td>
<td>14</td>
<td>8%</td>
</tr>
<tr>
<td>Net income (US$/ha)</td>
<td>1,003</td>
<td>1,023</td>
<td>20</td>
<td>2%</td>
</tr>
</tbody>
</table>

Notes: 1) Wheat results presented are based on data from GenStat regression analysis at K₂O rate of 75 kg ha⁻¹. MOP+AS treatment plan – 100% K₂O supplied by MOP. MOP+POLY4 treatment plan – K₂O supplied at a rate of 70% MOP and 30% POLY4. Economic analysis based on European quoted prices 2016: urea granular FOB US$205/t, ammonium sulphate granular FOB US$163/t, DAP FOB US$343/t, MOP granular US$284/t, POLY4 US200/t. 2) POLY4 value at a breakeven margin scenario versus MOP+AS.

THANK YOU

Any questions please contact:

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