RECOVERY OF MAGNESIUM FROM ALUMINUM SCRAP

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TIMELINE
SEEKING FINANCIAL & INDUSTRIAL PARTNERS

• Established Proof of Concept - Phase I (2014)
• Scale-Up - Phase II (2015)
• Develop Commercialization Plans (2015)
• Initiate Commercial Partnership (2016)
• Manufacture and Sell (2018)

TARGETS

<table>
<thead>
<tr>
<th>Metric</th>
<th>ARPA-E Program Goals</th>
<th>Demonstrated Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumption (kWh/kg Mg)</td>
<td>&lt;10</td>
<td>9.4</td>
</tr>
<tr>
<td>Emission (kg CO₂/kg Mg)</td>
<td>&lt;4</td>
<td>3.2</td>
</tr>
<tr>
<td>Cost ($/kg Mg)</td>
<td>&lt;2</td>
<td>1.80</td>
</tr>
<tr>
<td>Current Efficiency (%)</td>
<td>&gt; 95</td>
<td>97</td>
</tr>
<tr>
<td>Current Density (A/cm²)</td>
<td>&gt; 1</td>
<td>2.4</td>
</tr>
<tr>
<td>Magnesium Recovery (%)</td>
<td>&gt; 90</td>
<td>93</td>
</tr>
<tr>
<td>Purity (%)</td>
<td>&lt; 0.3 Si + Fe</td>
<td>&gt; 99.7 Mg+Al</td>
</tr>
</tbody>
</table>

IMPACT
MILLION TONS / YEAR*

• Produce 0.045* of primary quality Mg
• Reduce 2* of Al scrap export
• Lower 0.2* of Al melt loss & landfilled wastes
• Lower imports of primary Al (3.7*) and Mg (0.014*)

PROCESS
OBJECTIVES

• Patent & Trademark Applications Filed
• Produce Mg and/or Desired Al-Mg Alloys (ZERO CHLORINE)

Metric ARPA-E Program Goals
Energy Consumption (kWh/kg Mg) <10
Emission (kg CO₂/kg Mg) <4
Cost ($/kg Mg) <2
Current Efficiency (%) > 95
Current Density (A/cm²) > 1
Magnesium Recovery (%) > 90
Purity (%) < 0.3 Si + Fe

** Commercial Design **