Limelight Carbide

Steelmaking Partners

Calcium Carbide based Mixtures

Metallurgy Applications

- Hot Metal / Pig Iron:
  - Desulfurization
- Slag:
  - Deoxidizing
- Steel:
  - Deoxidizing
  - Desulfurization

Calcium Carbide based Mixtures

Metallurgy Applications

- Benefits and Results* of Calcium Carbide based Mixtures use in Metallurgy

- *Production:*
  - *Endogenous limpidity*
  - *Inclusion modifications*
  - *Castability*
  - *Lower sulfur achievements*
- *Costs:*
  - *Alloy Consumption Reduction*
  - *Deoxidizer Consumption Reduction*
  - *Ladle flux Consumption Reduction*
  - *Improved ladle refractory life*
- *Productivity*
  - *Increased Alloy Yield*
  - *Reduced Time per Batch*
  - *Reduced Energy Consumption*
  - *Reduced Maintenance Stops*

* +40 Studies Published in ABM and AISI. References are listed in the last page of this document.

Calcium Carbide based Mixtures

Hot Metal (Pig Iron) Desulfurization

- Technology

Desulfurization

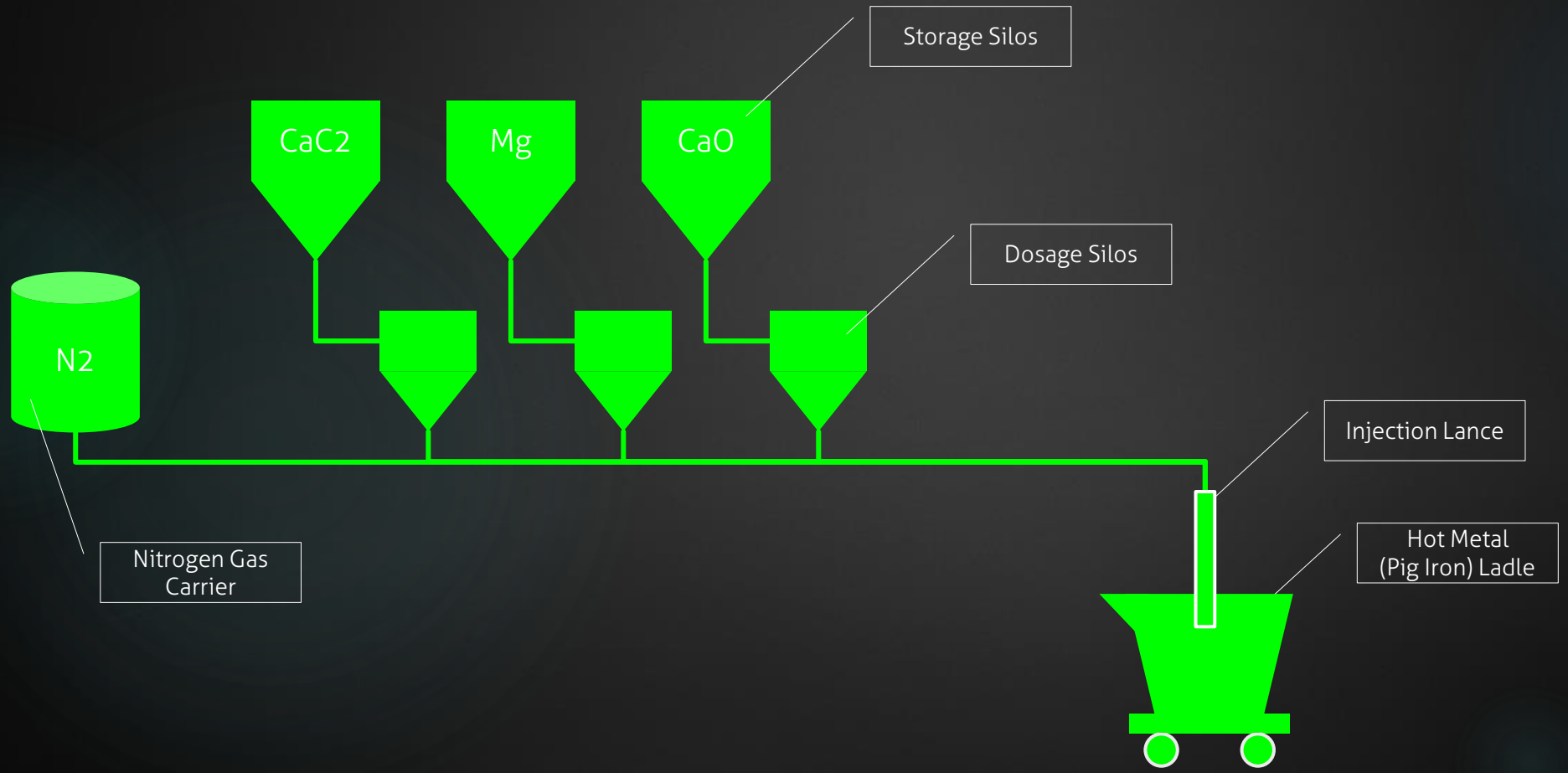
$$CaC_{2(s)} + S \rightarrow CaS + 2C$$
$$C + O \rightarrow CO$$

- Method
  - CaC2 0.035-0.045mm
  - Injector / Impeller
    - Torpedo Cars
    - Hot Metal (Pig Iron) Ladle

- Results
  - Sulfur Contents: 0.001-0.002%
  - Increased Fe yield

Calcium Carbide based Mixtures

Hot Metal (Pig Iron) Desulfurization



Calcium Carbide based Mixtures

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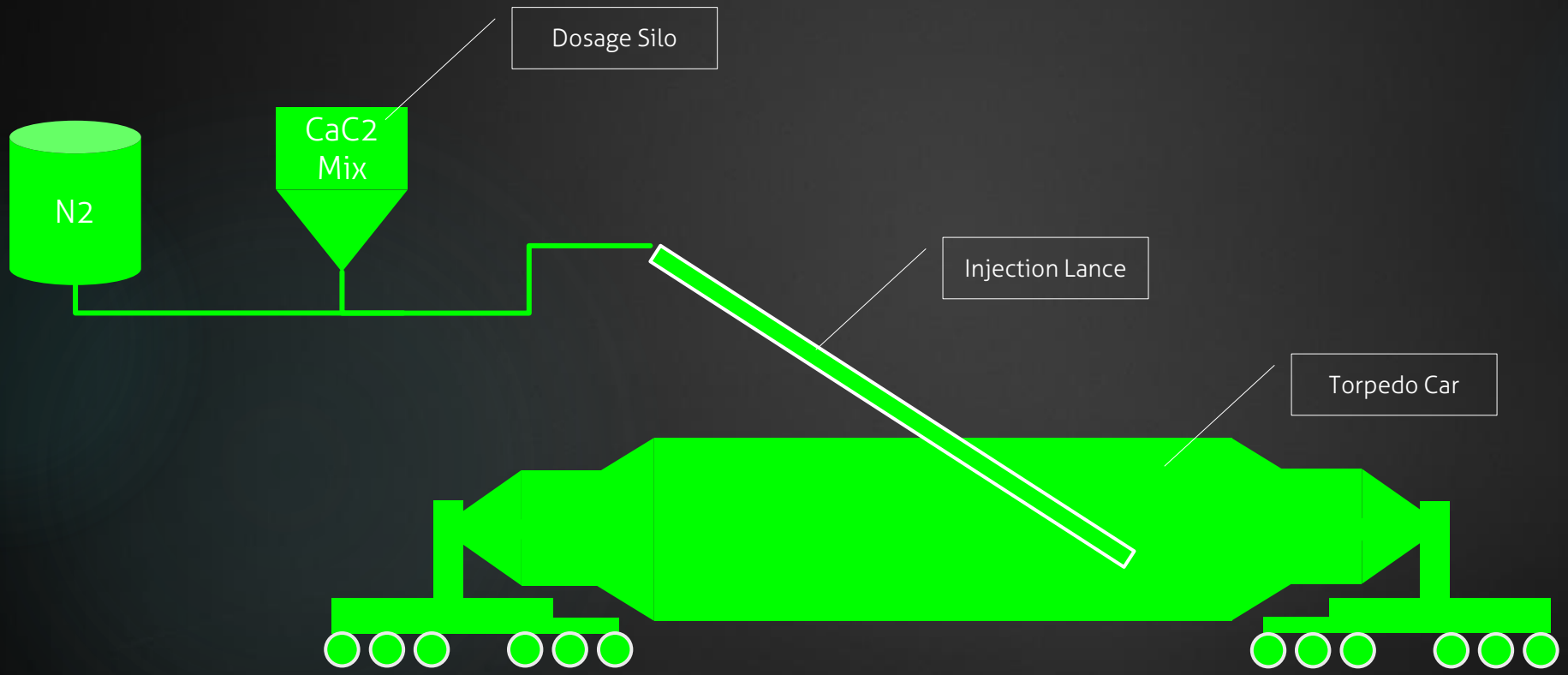


Calcium Carbide based Mixtures

Slag and Steel Deoxidizing

- Technology

Deoxidizing

$$CaC_{2(s)} + 3(FeO)_{(L)} \rightarrow CaO_{(L)} + 2CO\uparrow + 3Fe_{(L)}$$

$$CaC_{2(s)} + 3(MnO)_{(L)} \rightarrow CaO_{(L)} + 2CO\uparrow + 3Mn_{(L)}$$

Stoichiometrically: 1lb CaC2 reduces 2.5lb FeO/MnO

- Methods
  - Method A*:
    - CaC2 10x25mm
    - 1.25lb of CaC2 per Ton of Steel on ladle before tapping
    - Fine tunning at LMS if needed: 02x10mm CaC2, after addition of the alloys
  - Method B**:
    - CaC2 02x10mm
    - 1.7-2.6lb of CaC2 per Ton of Steel on ladle during tapping

Calcium Carbide based Mixtures

Slag and Steel Deoxidizing

- **Results**[*,**,***]
  - Manganese recovery: +3pp (US$0.2/ton)
  - Ladle life: +48%*
  - %S Diversion rate reduction: -27%
  - Flux savings:
    - 13.5lb/ton (US$363k/year)
    - 5.7lb/ton (27% MT Reduction)***
  - Nozzle clogging: -5pp
    - Al2O3 inclusions: <5.6µm**,***
  - Aluminum
    - Recovery: 3-4%
    - Consumption Reduction: 24-41%

* SMI Texas, 2005; ** ArcelorMittal, Gerdau, CSN, VSB 2004-2013; *** JSPL Angul, 2017

Calcium Carbide based Mixtures

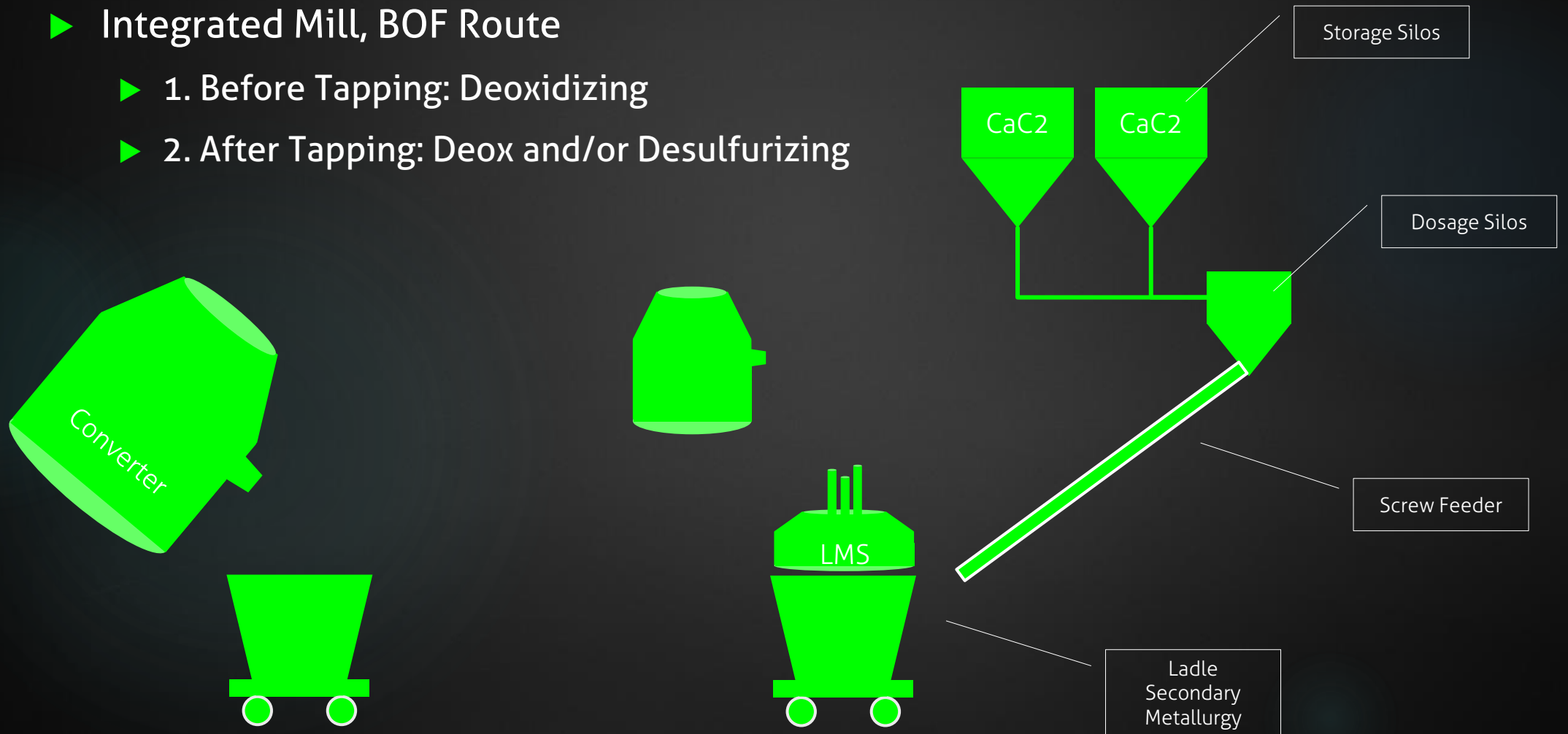
Steel Desulfurization

- Technology
  - $CaC_{2(s)} + S \rightarrow CaS + 2C$
- Method
  - Fully deoxidized steel and slag (<2% FeO + MnO)
  - High basicity of slag
  - Liquidity and mixing of slag/metal
- Results
  - 1lb Cac2 = 2.5lb FeO/MnO reduction, 2lb Metallics
  - %S removal to 0.001-0.002%

Calcium Carbide based Mixtures

Secondary Metallurgy

- Integrated Mill, BOF Route
  - 1. Before Tapping: Deoxidizing
  - 2. After Tapping: Deox and/or Desulfurizing



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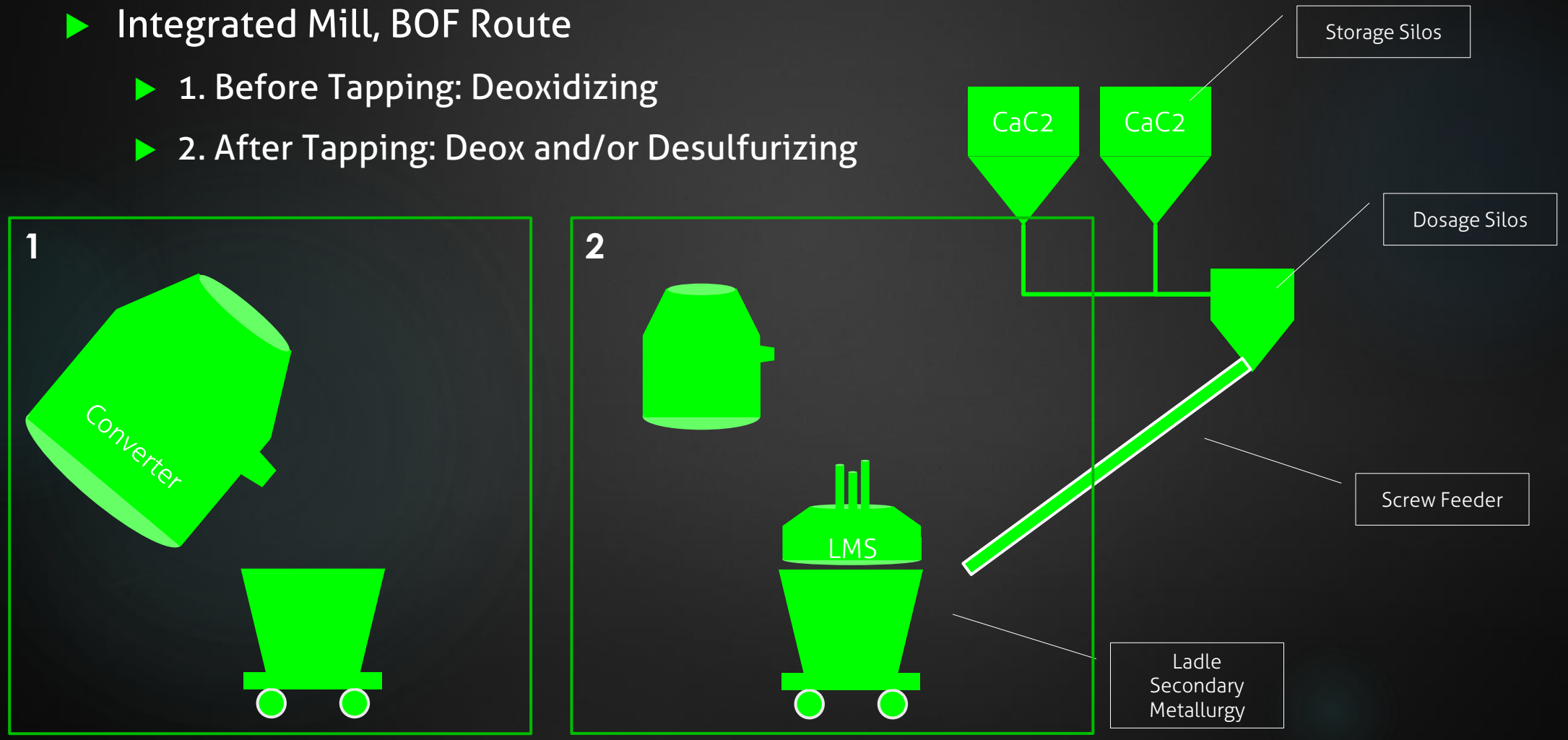

Calcium Carbide

Secondary Metallurgy

- Mini Mill, EAF Route
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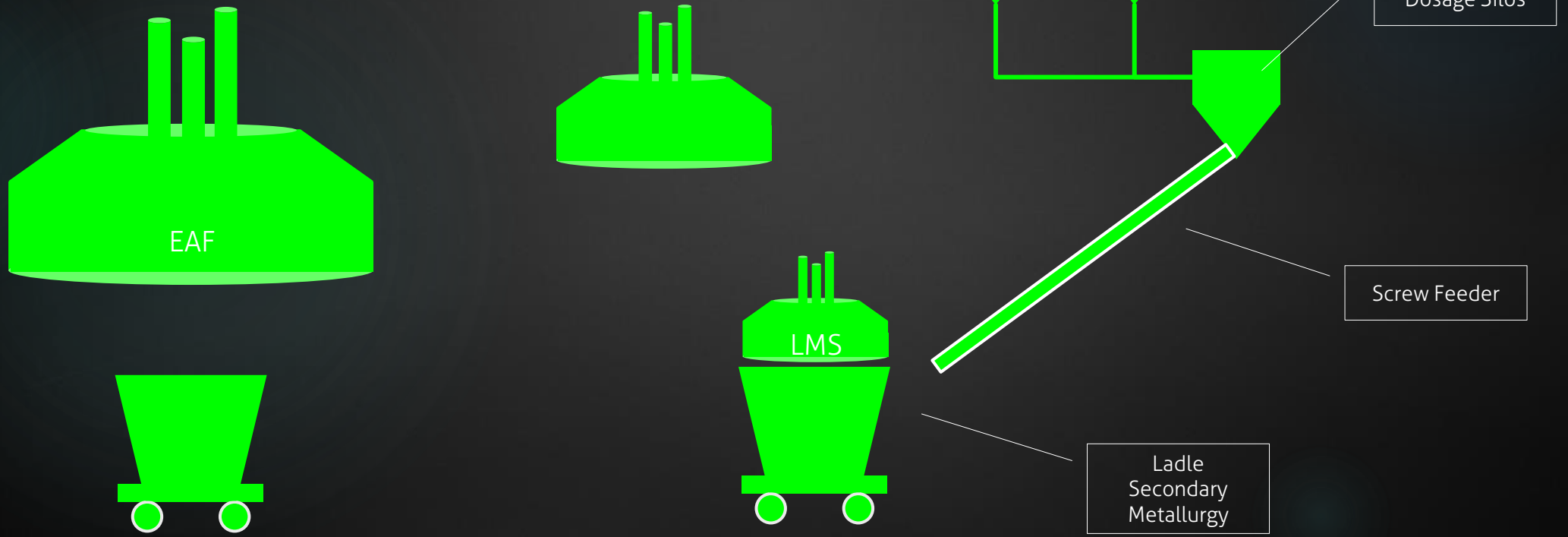
  - 2. After Tapping: Deox and/or Desulfurizing



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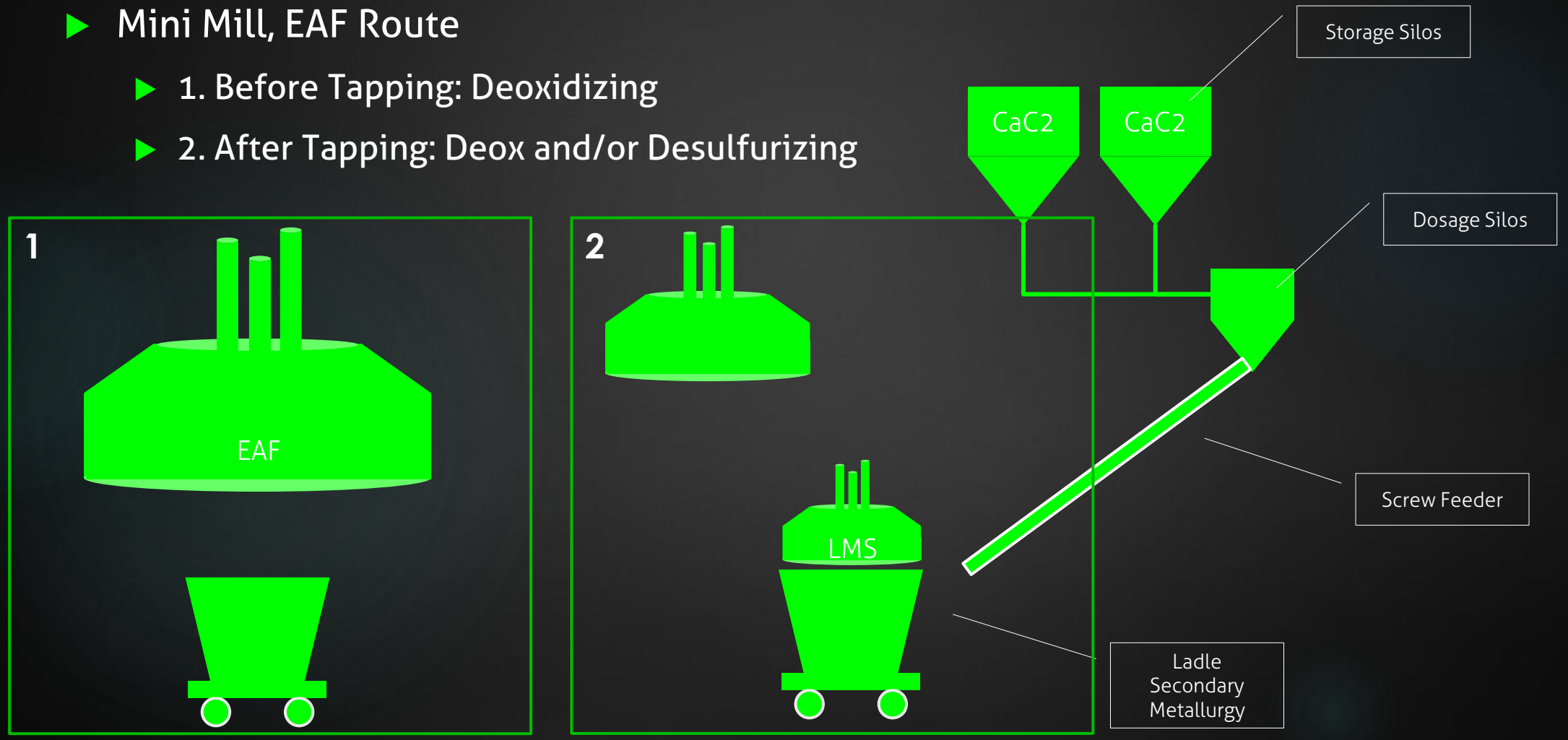

Calcium Carbide based Mixtures

Application Full Diagram