

International Lead Association



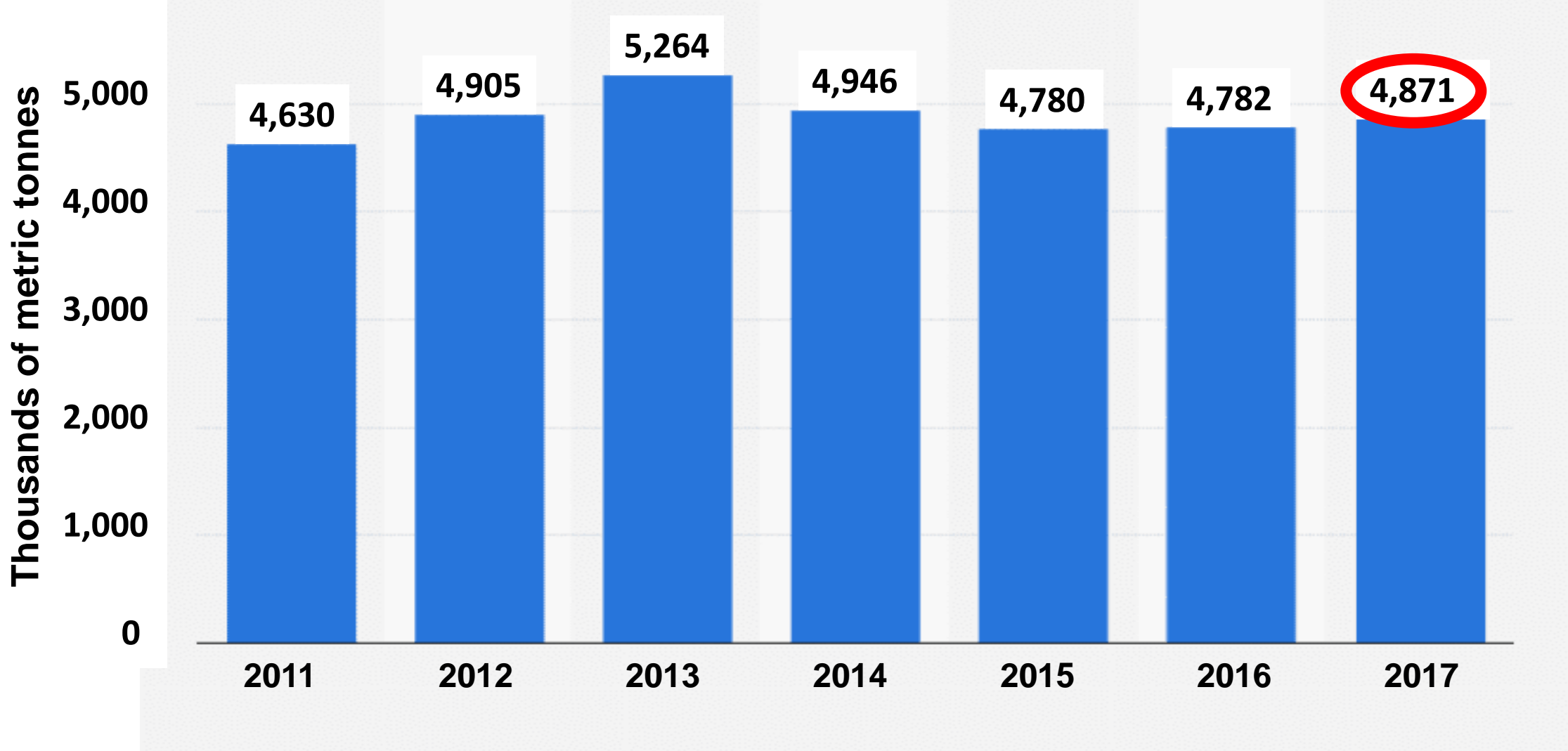
Responsible Pyro-Metallurgical Recycling of Used Lead Batteries

Brian Wilson

International Lead Association



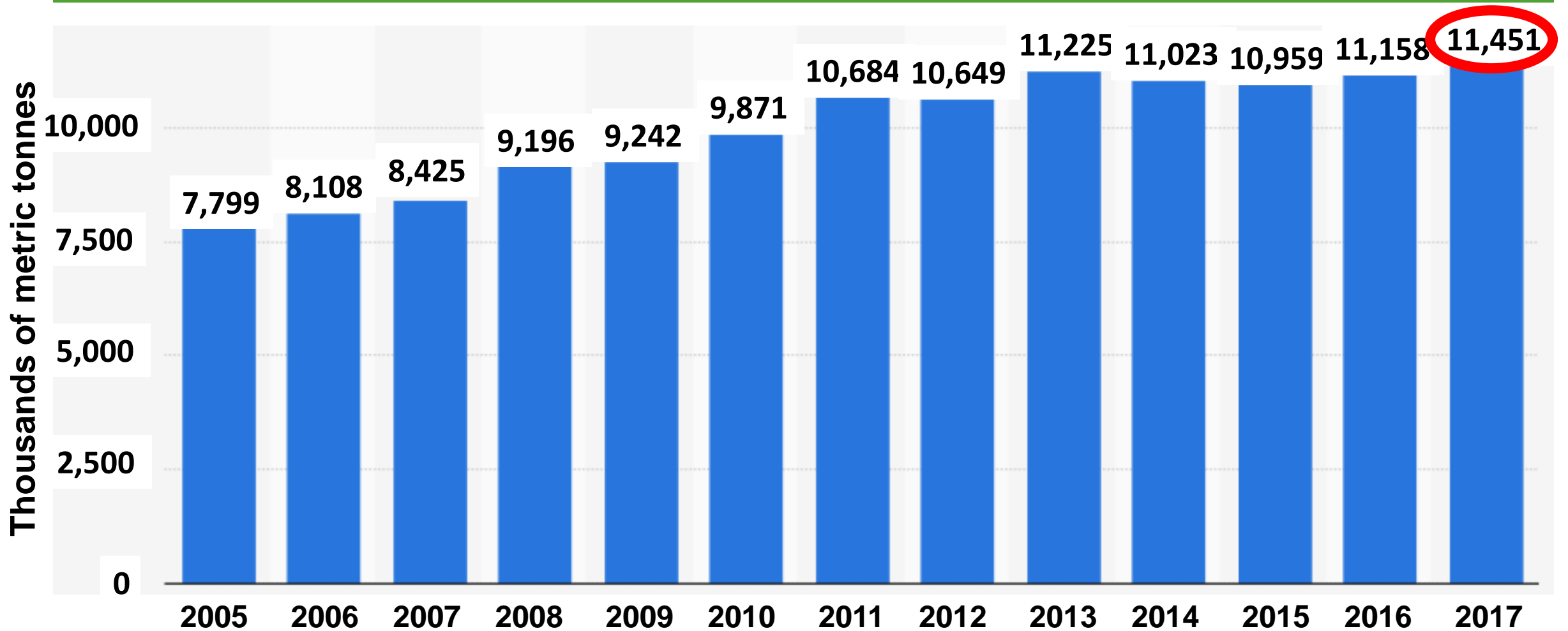
Global Lead Mine Production



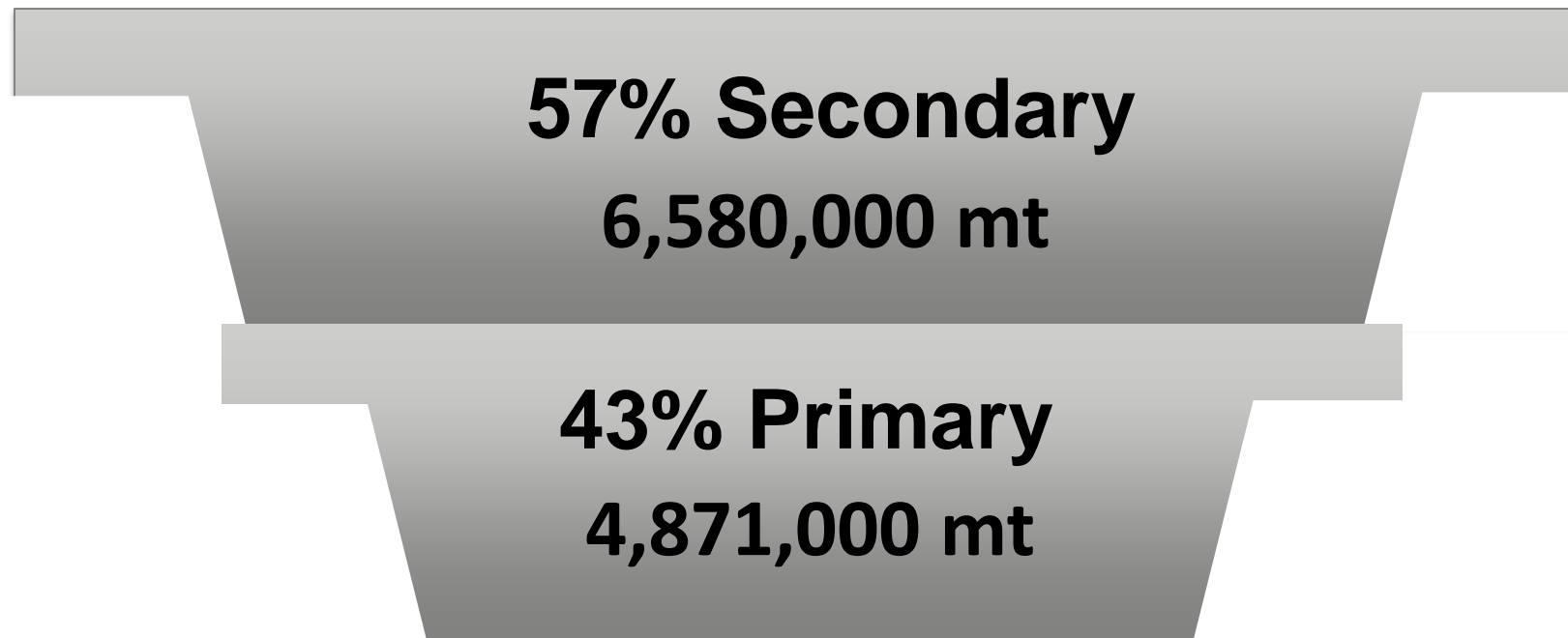
UN ILZSG



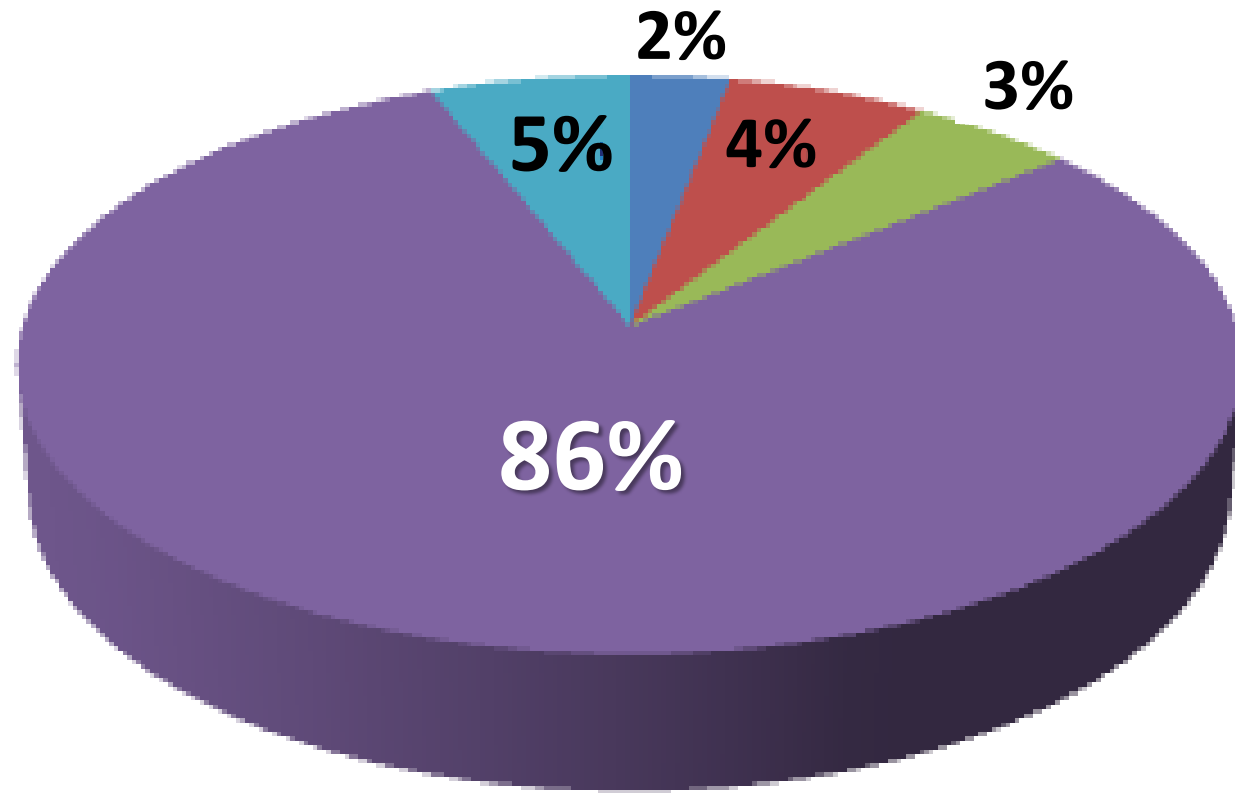
Global Lead Production: Primary and Secondary



Global Lead Production: Primary vs Secondary



Lead Batteries: Power the World



- Ammunition
- Extruded Products
- Pigments/Paints
- Lead Batteries
- Other Uses

Uses of Lead

Lead Batteries: Power the World



Lead Batteries: Power the World

GSM Mobile Telecoms Tower



Lead Batteries: Power the World



UPS for Data Storage



Lead Batteries: Power the World



Standby Power Banks



Lead Batteries: Power the World

Renewable Sustainable Energy



Lead Batteries: Power the World

SLI Automobile Battery



Lead Batteries: Power the World

Mobile Plant



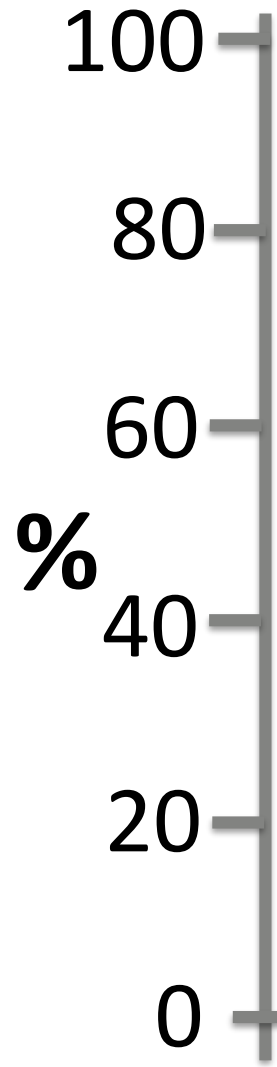
Lead Batteries: Power the World



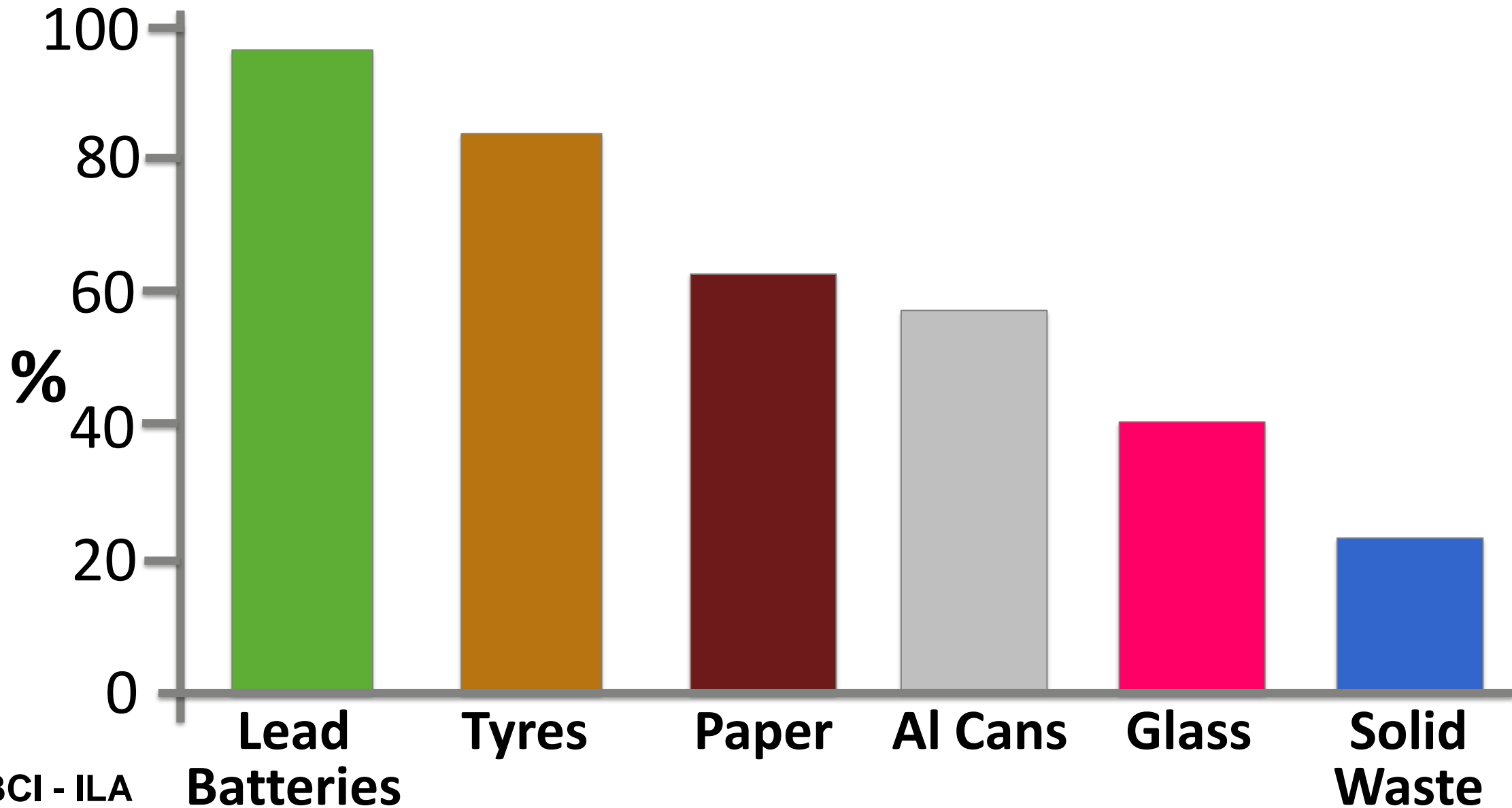
Stop Start Vehicle Technology



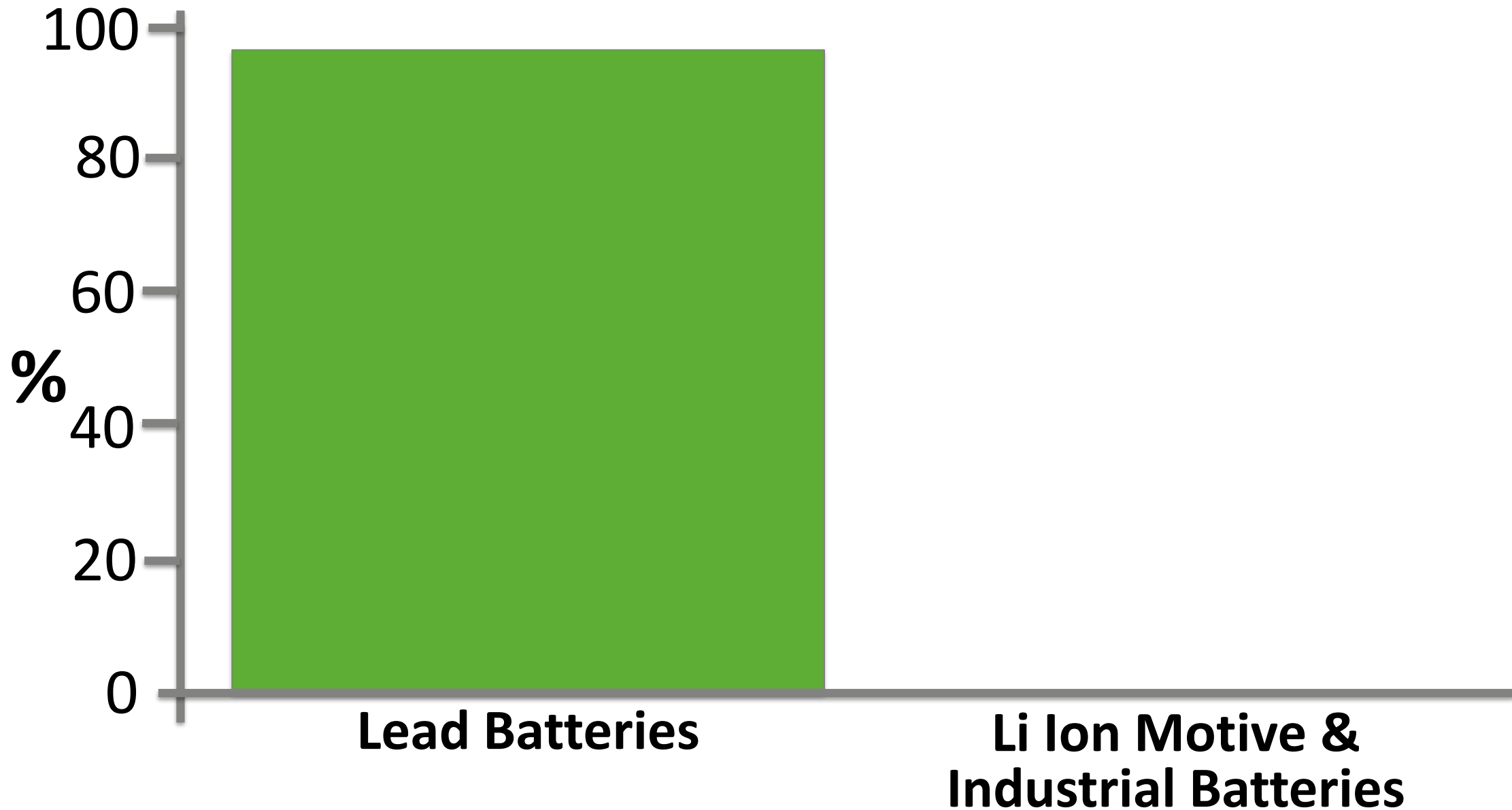
Recycling: Key Recycling Rates...



Recycling: Key Recycling Rates...



Recycling: Key Recycling Rates...



To Ensure Recycling is Environmentally Sound..

- 1. Enact Health, Safety & Environmental Laws**
- 2. Comply with the Basel Technical Guidelines**
- 3. Monitor & manage the ULAB supply chain**
- 4. Do not let ULAB enter the informal sector**
- 5. Use only Licensed Recyclers**

To Ensure Recycling is Environmentally Sound..

Regulatory Inspection



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To Ensure Recycling is Environmentally Sound..

Regulatory Inspection: To check for -

- ✓ **The Health and Safety of the Workers**
- ✓ **Delivery of whole ULAB**
- ✓ **Environmentally sound recycling process**
- ✓ **Closed Loop Effluent Treatment & Containment**
- ✓ **Effective Emission Control (Filtration)**

To Ensure Recycling is Environmentally Sound..

- ✓ **Include Inspection in the Licensing Procedure**
- ✓ **Based on physical inspection by.....**
- ✓ **Trained Regulators and Inspectors**
- ✓ **There is an Assessment Tool for the Job (BAT)**
- ✓ **Developed in conjunction with Beijing BCRC**



What are the Criteria Responsible Recycling?

Activity	Process	Green/Clean
Collection	Reverse Logistics	
Transportation	Leakproof	
Breaking	Hammer Mill	
Electrolyte	Closed Loop	
Polypropylene	Recovered	
Smelting	Lead Recovery	
Emissions	Ventilation/Filtration	
Occupational	PPE	

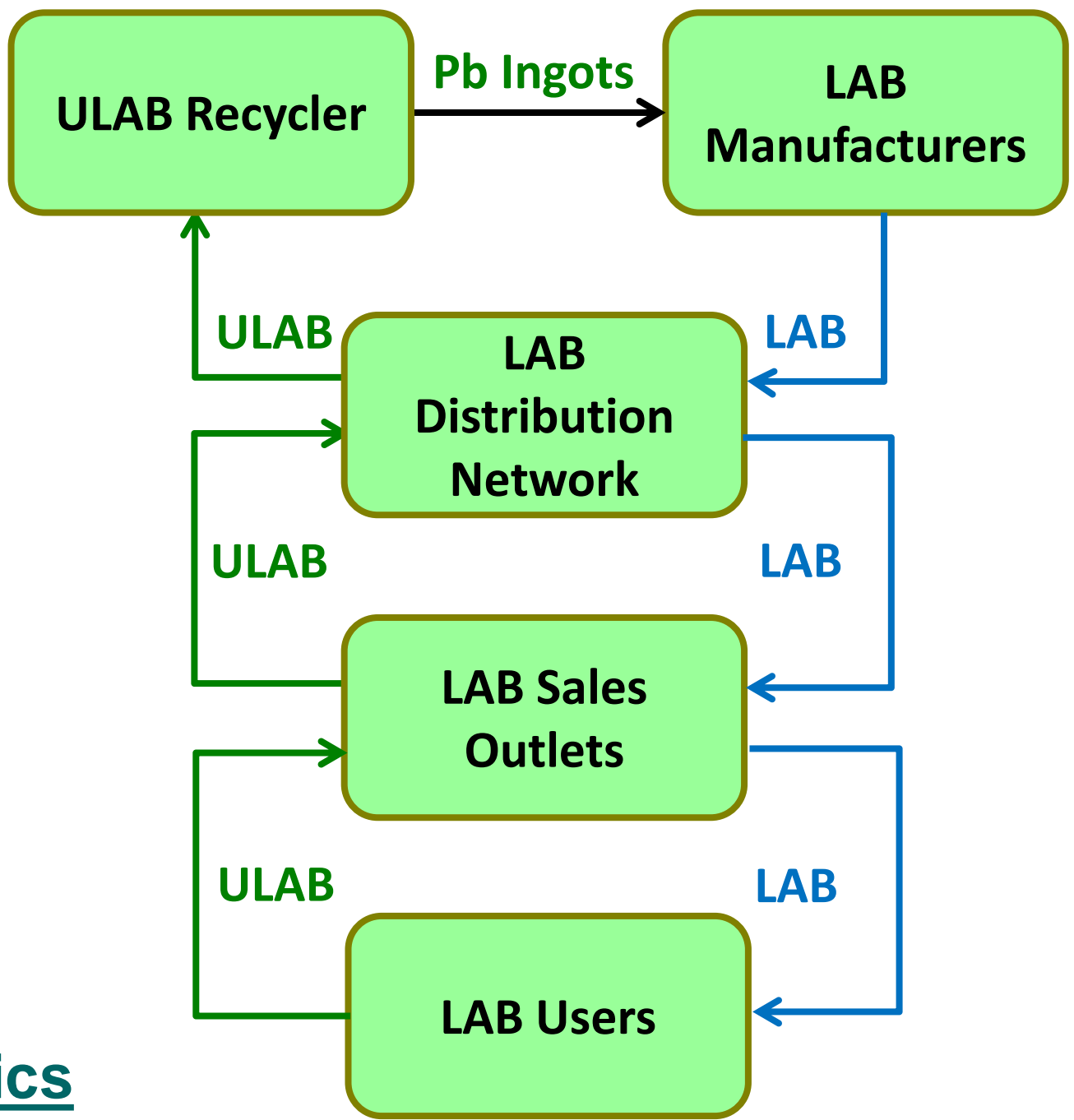
What are the Criteria Responsible Recycling?

Activity	Process	Green/Clean	
Collection	Reverse Logistics	Undrained ULAB	✓
Transportation	Leakproof	Minimum Distance	✓
Breaking	Hammer Mill	Automated	✓
Electrolyte	Closed Loop	No Discharge	✓
Polypropylene	Recovered	New Products	✓
Smelting	Lead Recovery	No Toxic Residues	✓
Emissions	Ventilation/Filtration	No Emissions	✗
Occupational	PPE	No Exposure	✗

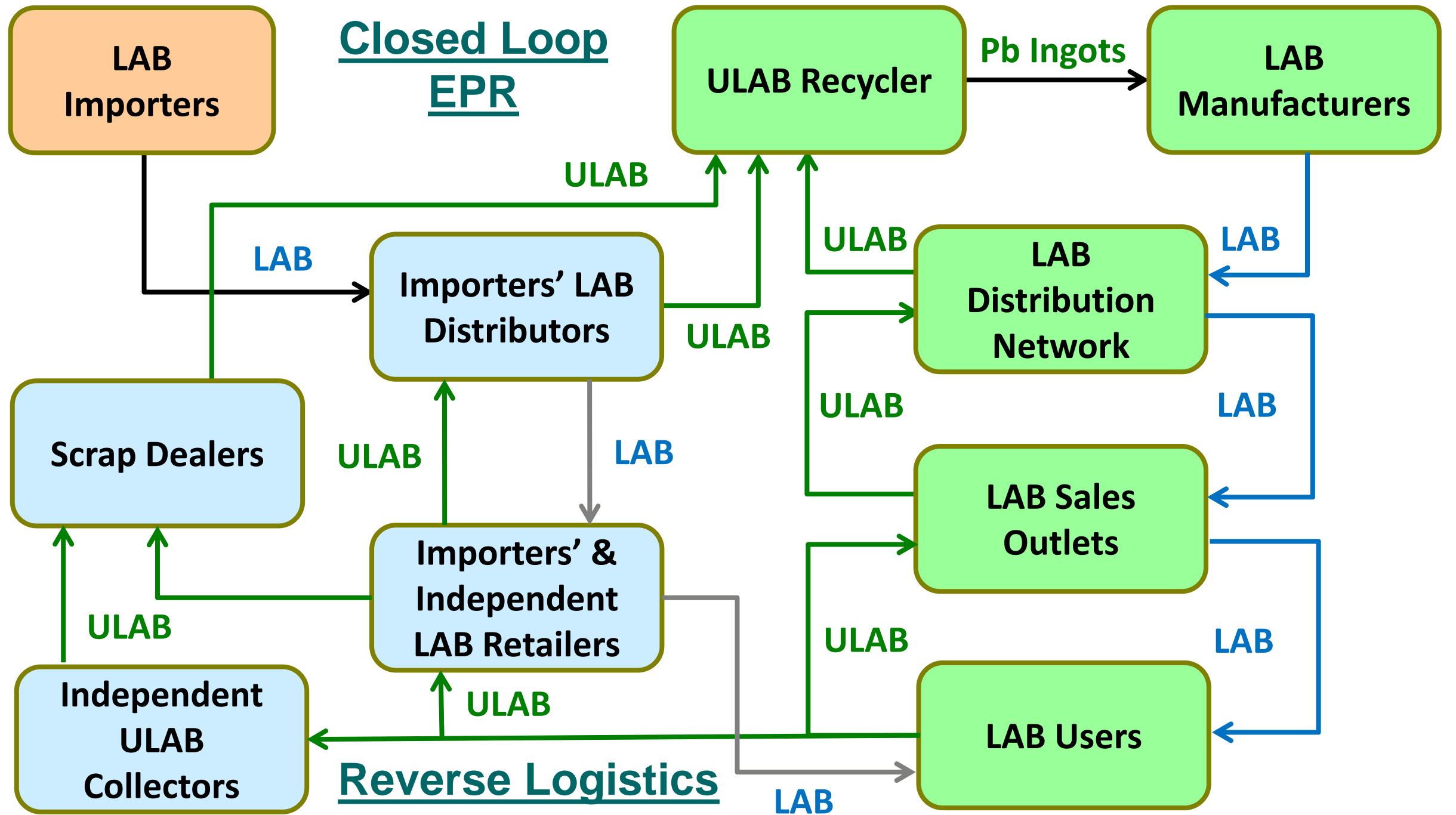
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Polypropylene	Recovered	New Products	✓
Smelting	Lead Recovery	No Toxic Residues	✓
Emissions	Ventilation/Filtration	Controlled Emissions	✓
Occupational	PPE	Manage the Risk	✓

Closed Loop
EPR



Reverse Logistics



Why Extended Producer Responsibility?

Makes the Battery Manufacturer Responsible for:

- ❖ **The Health and Safety of the workers**
- ❖ **Collection of whole ULAB and their safe storage**
- ❖ **Safe transportation to a sound recycling plant**
- ❖ **Environmentally sound recycling**
- ❖ **Applies to domestic & imported LAB**

ULAB Collection: Environmental Risks – Acid Dumping

How much Sulfuric Acid is Dumped by Informals?

For Every:

20,000 mt of Drained ULAB = 12,000 mt Refined Lead

= mt of Acid

Do Not Drain the Battery Electrolyte!



ULAB Collection: Environmental Risks – Acid Dumping

How much Sulfuric Acid is Dumped by Informals?

For Every:

**20,000 mt of Drained ULAB = 12,000 mt Refined Lead
= 6,000 mt of Acid**

Do Not Drain the Battery Electrolyte!



ULAB Collection: Environmental Risks – Acid Dumping

Battery Electrolyte is Sulfuric Acid and it is:

- ❖ Classified as a Hazardous Waste**
- ❖ Irritant to Skin and Internal Organs**
- ❖ If splashed in the Face - Can Cause Blindness**
- ❖ Carcinogen**
- ❖ Corrosive – will dissolve concrete**

Do Not Drain the Battery Electrolyte!

Temporary Storage: Undercover is Ideal...



Tanzania

ila

Temporary Storage: Undercover is Ideal...



Resin Coated Impermeable Floor



Transportation: UN Certified Leak Proof Container



Benefits

- ✓ UN Certified
- ✓ Use in Any Vehicle
- ✓ Lightweight

Transportation: UN Certified Leak Proof Container



Benefits

- ✓ UN Certified
- ✓ Use in Any Vehicle
- ✓ Lightweight
- ✓ Fork Truck Friendly
- ✓ Stackable
- ✓ Reusable

ULAB Packaging and Storage: Risks – Acid Leakage



Sort by size and stack evenly



ULAB Transportation: Dedicated Licensed Vehicle



Closed Truck with Hazchem Decals



Battery Breaking: Informal Manual Breaking...



Unsafe

Unsound

Unwise



Avoid

Manual

Breaking

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Battery Breaking: Hammer Mill...



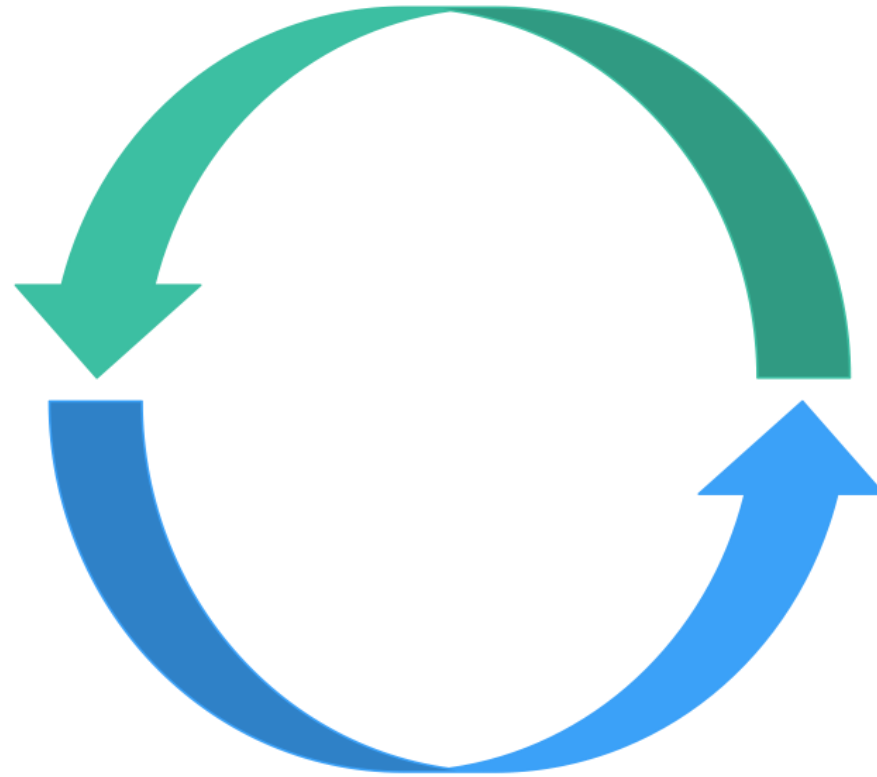
**Electrolyte
must not
be drained
from the
ULAB
prior to
entering
the mill**



Video courtesy of Pb Metals – Costa Rica



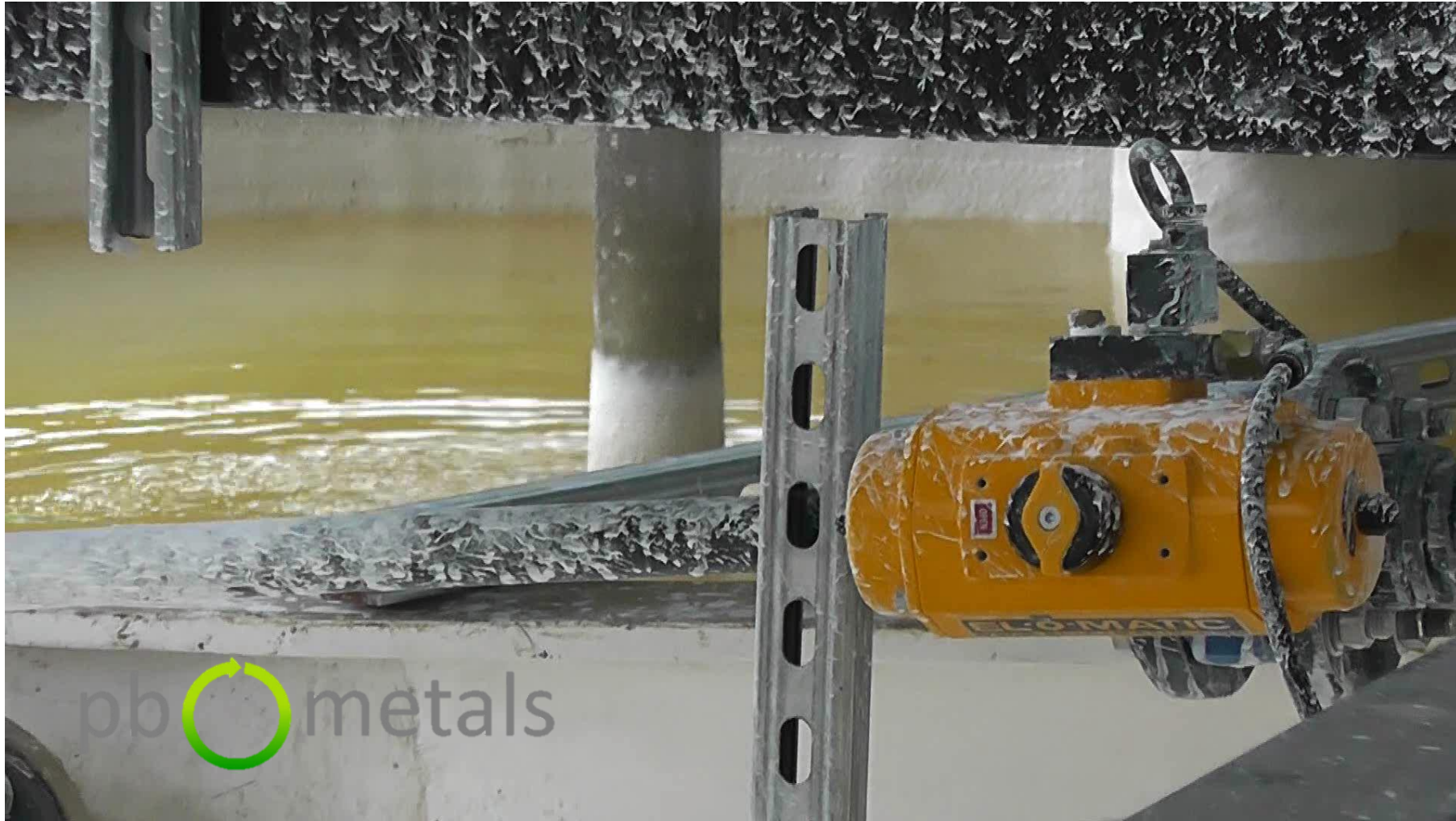
Battery Electrolyte: Neutralisation – No discharge



Effluent Treatment – Closed Loop

Effluent Treatment: Battery Electrolyte

Electrolyte must be treated In an ETP to produce a saleable by-product



pb  metals

Picture courtesy of pb metals, Costa Rica



Eco - friendly process without any discharges



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By-Product Sales Options...

Sodium Sulfate

- **Glass Making**
- **Paper Making**

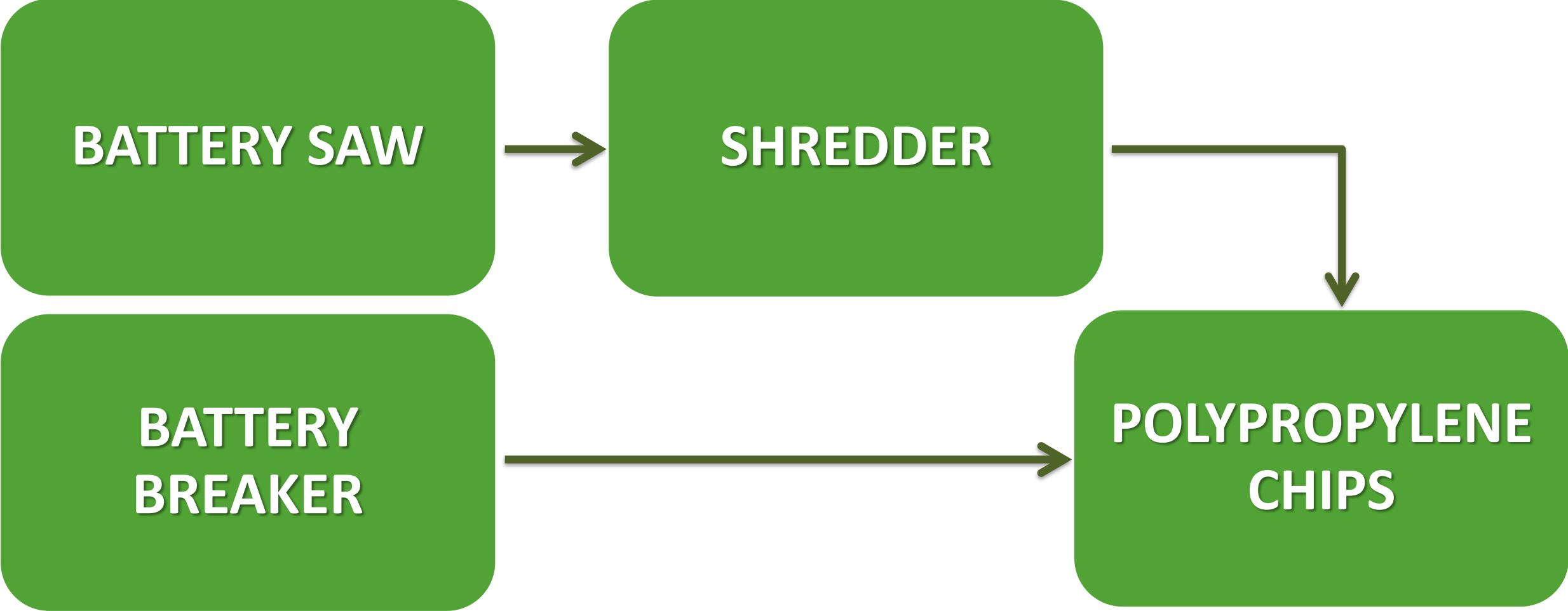
Gypsum

- **Cement Industry**
- **Building Materials**

Ammonium Sulfate

- **Fertilizer**

By-Product Sales - Polypropylene Options...



Smelting: Energy Efficient Furnace Operation

Smelting: Energy Efficient Furnace Operation



Rotary Furnace - Pb Metals – Costa Rica



Smelting: Energy Efficient Furnace Operation

Environmental and Cost Benefits

- ✓ **Double Pass through the furnace makes best use of energy**
- ✓ **Cycle times are reduced and with it energy consumption**
- ✓ **Reduced cycle times results in increased daily production**
- ✓ **Reduced energy consumption means lower GHG emissions**
- ✓ **Reduced energy consumption means lower fuel bills**
- ✓ **Rear mounted burner reduced risk of damage during charging**

Rear Mounted Burner - Reverberatory Furnace



ULAB Recycling: Environmental Threats

Furnace residues:

- ⚠ Can contain Lead Prills and Lead compounds
- ⚠ Hydrosopic and will break down on exposure to air
- ⚠ Broken down – irritant – eyes, skin and lungs
- ⚠ Broken down – certain toxic compounds are soluble
- ⚠ Toxic

Dump the Residues..... Anywhere?

ULAB Recycling: Environmental Threat - Slag...



Informals Dump Residues Anywhere!

ULAB Recycling: Environmental Threat -

Dispose at a
hazardous
Waste
Treatment
Plant



Problem:
Landfill
Sites
come at
a cost



Licensed Recyclers use Hazardous Waste Sites



Residues Can be Converted to Hexagonal Paving

Tegal



Indonesia



Hexagonal Paving Slab Machine

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Residues Can be Converted to Hexagonal Paving

Tegal



Indonesia



Hexagonal Paving Slabs

ila

Residues Can be Converted to Hexagonal Paving

**Summit
Hill**



Nepal



Essential to undertake Market Research

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Smelting: Environmental Threat : Fume - Capture?

Smelter emissions can be controlled.....

Smelting: Fume – Capture by Encapsulation



EcoGlobal – The Philippines

ila

Smelting: Fume – Capture by Encapsulation



EcoGlobal – The Philippines



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Smelting: Environmental Threat : Fume Capture

Front
ventilation



Rear
ventilation

pp metals



Ventilation Hooding - Rotary Furnace

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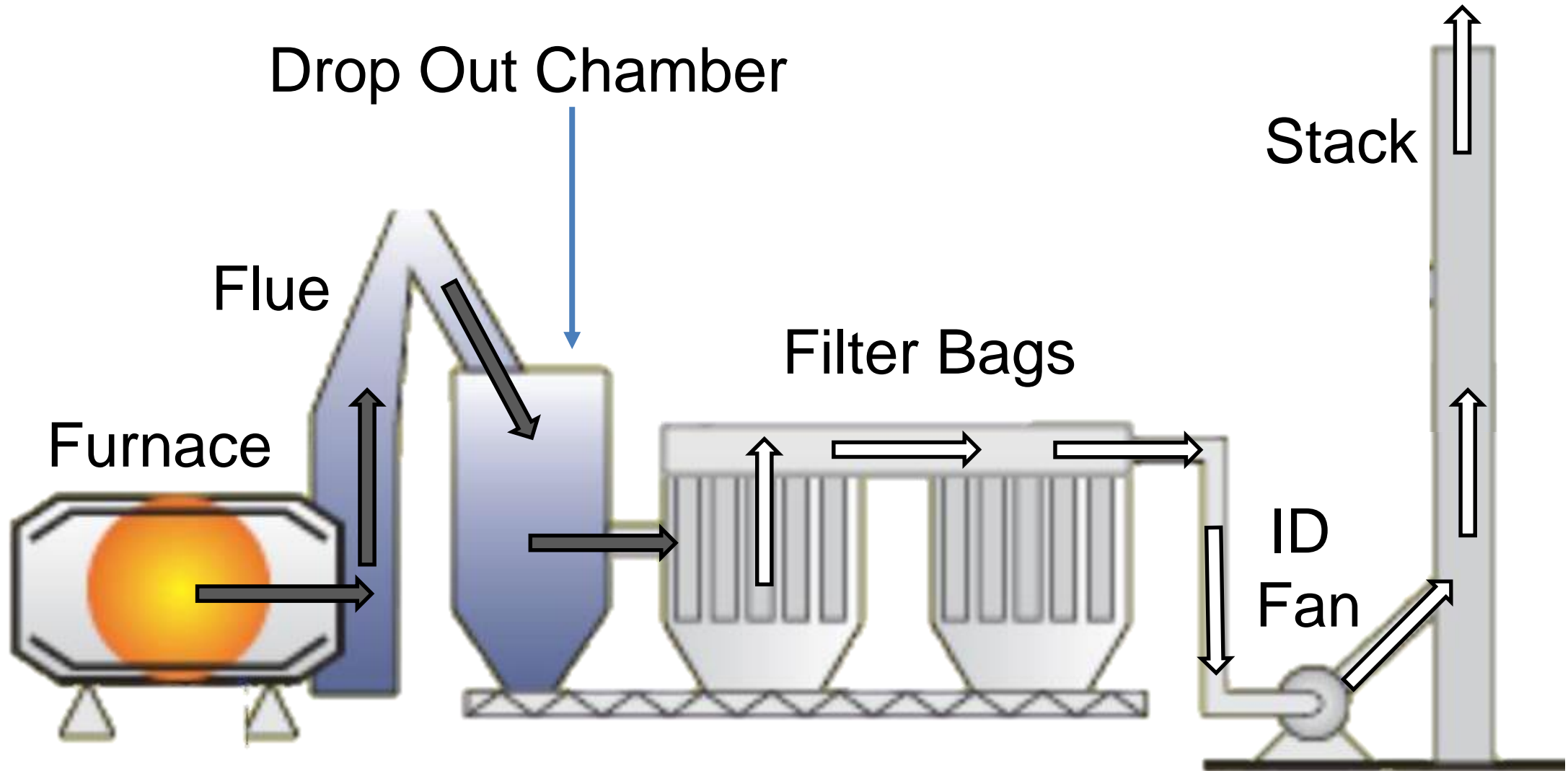
Smelting: Environmental Threat : Fume Capture



Front Tap Hole



Smelting: Fume Capture - Control Measure - Filtration



Smelting: Fume & Dust Capture – Financial Cost

Informal Operations:

Losses ~ 2%

24,000 mt of ULAB =

~ 14,100 mt of Lead +

~ 300 mt losses

= USD \$ ~

Installing and Operating a Baghouse - Economical



Smelting: Fume and Dust Capture – Financial Risk

Informal Operations:

Losses ~ 2%

24,000 mt of ULAB =

~ 14,100 mt of Lead +

~ 300 mt losses

= USD \$ ~ 600,000

Installing and Operating a Baghouse - Economical



Smelting: Environmental Threat: SO₂ Emissions



SO₂ is Toxic & Contributes to Acid Rain



Smelting: SO₂ Control Measures – De-Sulfurization

Three Options:

- **Before Smelting**
- **During Smelting**
- **After Smelting**

Paste De-Sulfurization

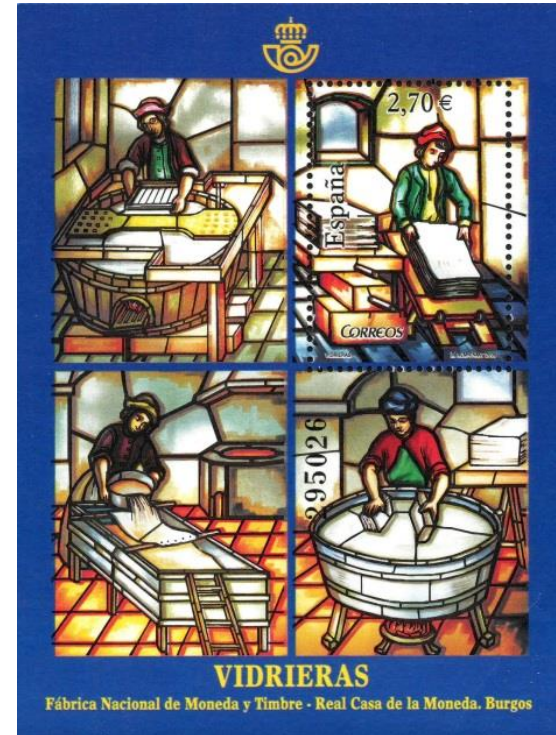
Smelting: SO₂ Control Measures – De-Sulfurization

Two Options: 1

Produces Sodium Sulfate

Paper Production: Kraft Process

Paste De-Sulfurization



Smelting: SO₂ Control Measures – De-Sulfurization

**Two Options: 2
Produces Gypsum
Cement Manufacture**



Paste De-Sulfurization



Smelting: SO₂ Control Measures – De-Sulfurization

Three Options:

- Before Smelting
- During Smelting
- After Smelting

Paste De-Sulfurization

Smelting: SO₂ Control Measures – De-Sulfurization

**Add Scrap
Iron
to the
Furnace
Charge**



**95% of
Sulfur is
Removed
By Iron
Addition**

Paste De-Sulfurization



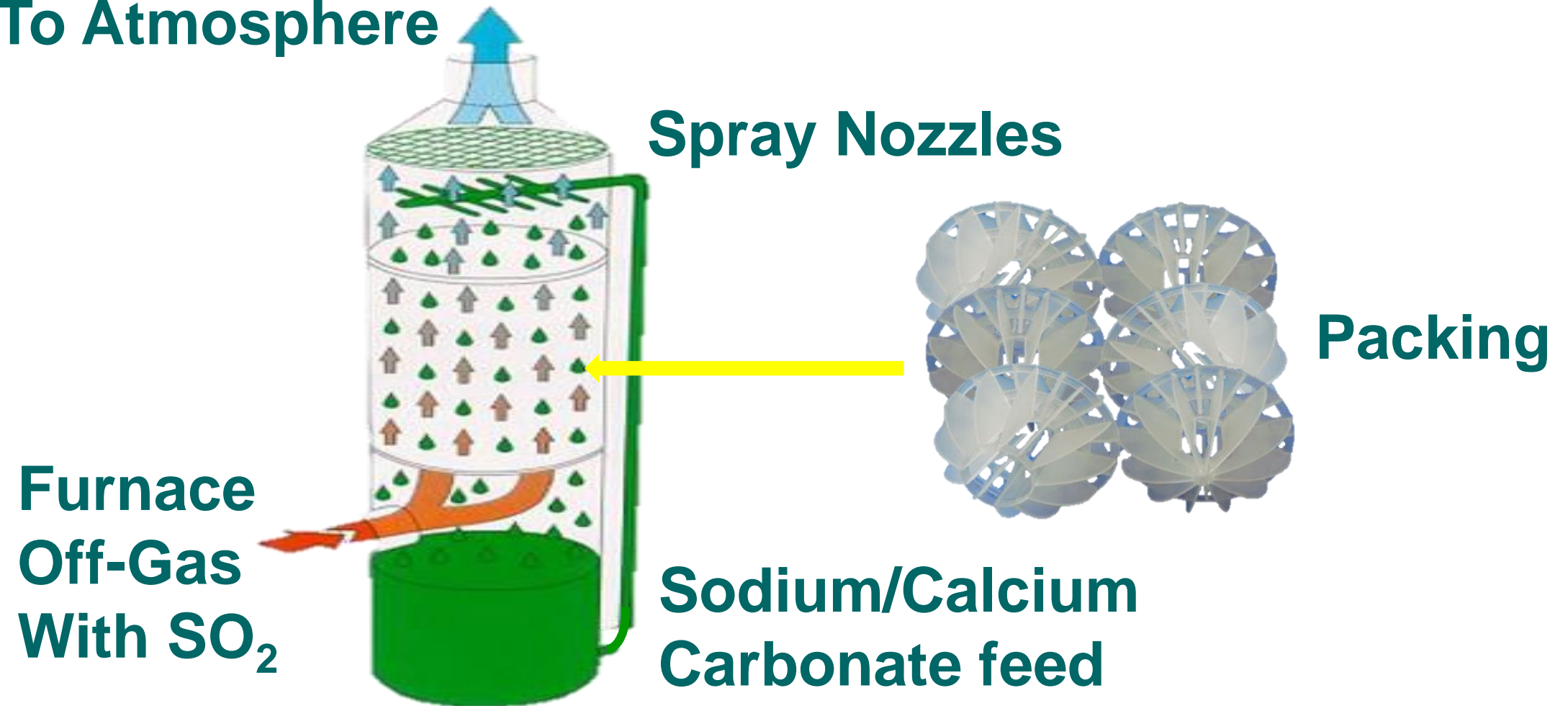
Smelting: SO₂ Control Measures – De-Sulfurization

Three Options:

- Before Smelting
- During Smelting
- After Smelting

Smelting: SO₂ Control Measures – De-Sulfurization

To Atmosphere



Scrubbing Tower

ULAB Battery Smelting: Control Measures



Personal: Always wear the correct PPE

Smelting: Occupational Health Threat : Fume Capture??

Particle Size for Lead Dusts and Fume

Lead Fume: 0.1 to 0.7 microns

Smelter dust: up to 500 microns

Respiratory Protection: N95 Dust Mask filters -

- ✓ 95% of all particles over 0.3 microns



Why Dust and Fume must be captured.



ULAB Battery Smelting: Control Measures



**Most Important!
Use full mask
and coveralls
when working in
a Filter Plant**

Full Face Respirators and Coveralls

ULAB Battery Smelting: Control Measures



Clean Work Clothes – Every Day/Shift



ULAB Battery Smelting: Control Measures



Segregated and Clean Changing Rooms



ULAB Battery Smelting: Control Measures

**Shower
Block**



**Dong Mai
Vietnam**

Shower at the End of Every Day/Shift



ULAB Battery Smelting: Control Measures



A Clean Canteen with HEPA Filter



ULAB Battery Smelting: Control Measures



Housekeeping: Dust Free - Clean & Tidy



ULAB Battery Smelting: Control Measures



Housekeeping: Damp Down Working Areas

Enclose: Apply Negative Pressure via Baghouse



Thank You

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