Closing the Loop - Aluminum Scrap Sorting: Challenges and Opportunities

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Düsseldorf

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4600+ EMPLOYEES GLOBALLY

Publicly listed on Oslo Stock Exchange (OSEBX: TOM)

1 bn EUR REVENUES in 2020

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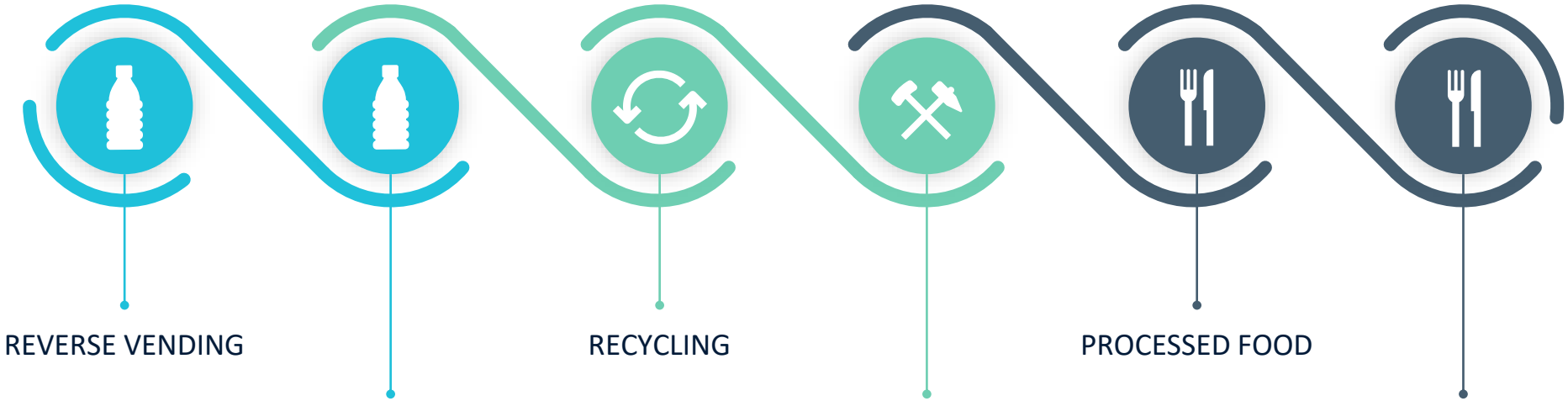
TOMRA COLLECTION SOLUTIONS

TOMRA RECYCLING MINING

TOMRA FOOD



REVERSE VENDING

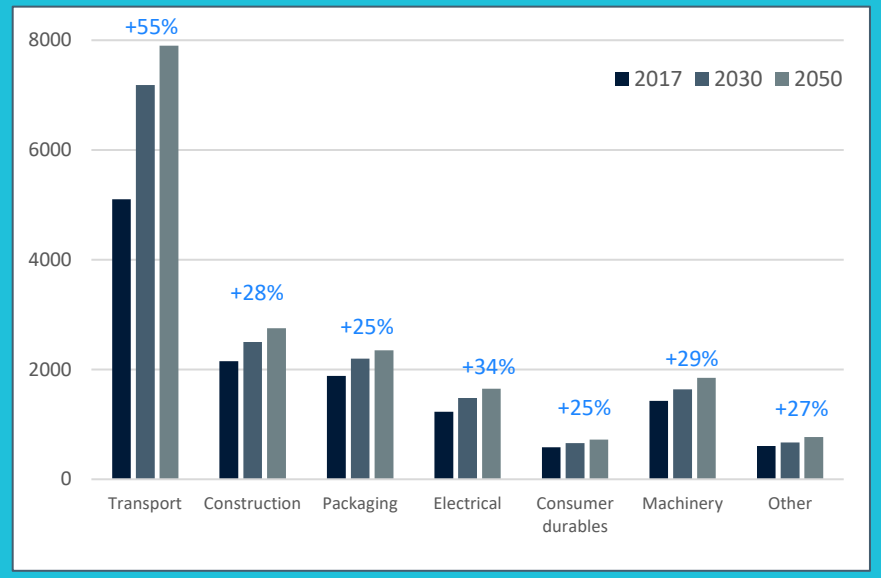
MATERIAL RECOVERY

RECYCLING

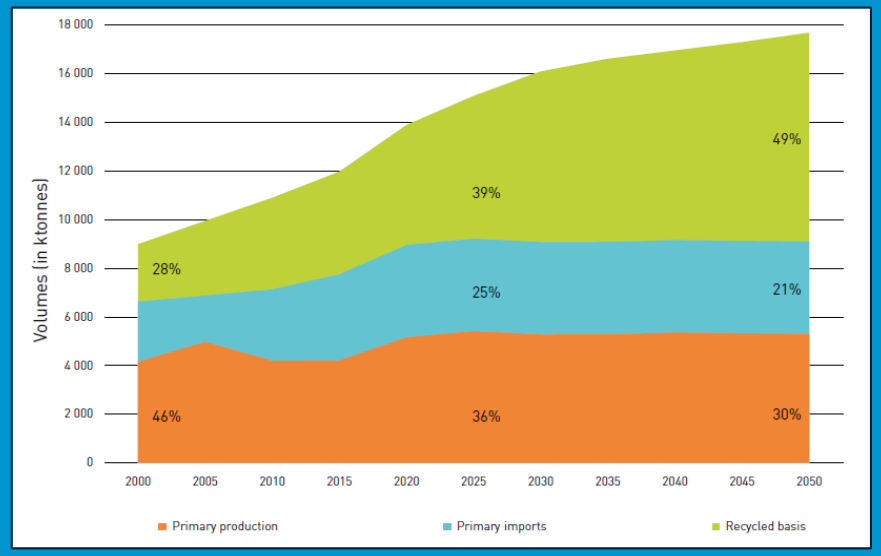
MINING

PROCESSED FOOD

FRESH FOOD



3 EU demand for semi-finished aluminum per sector for 2017-2030-2050 in Mton/yr[2].



EU demand for aluminum ingots from 2000 to 2050 showing a growth scenario for aluminum on recycled basis[1].

Market drivers & trends in the Aluminum industry (EU perspective)

- EU demand for aluminum to grow +40% from 2018-2050

- Growth driven by
  - Transportation sector (lightweighting, EV's)
  - Building & Construction sector (EU Green Deal focus on energy efficiency)
  - Packaging sector (increased pressure on plastics from EU Single Use Plastic Directive, increased collection & recycling targets)

- Growth predominantly covered by recycled aluminum
  - Limited primary production capacity
  - Circular economy pushing legislations for CO_2 reduction and incentivizing recycled content

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Sources:

1. *European Aluminum Vision 2050; 2. European Aluminum Circular Economy Action Plan, 2020*

Producers introducing ‘Green’ aluminum alloys

CREAL™
CIRCULAR RECYCLED ALUMINIUM

recall

X-Ray Transmission (XRT) technology

- Sorting based on a difference in atomic density
- XRT technology allows sorting into different products

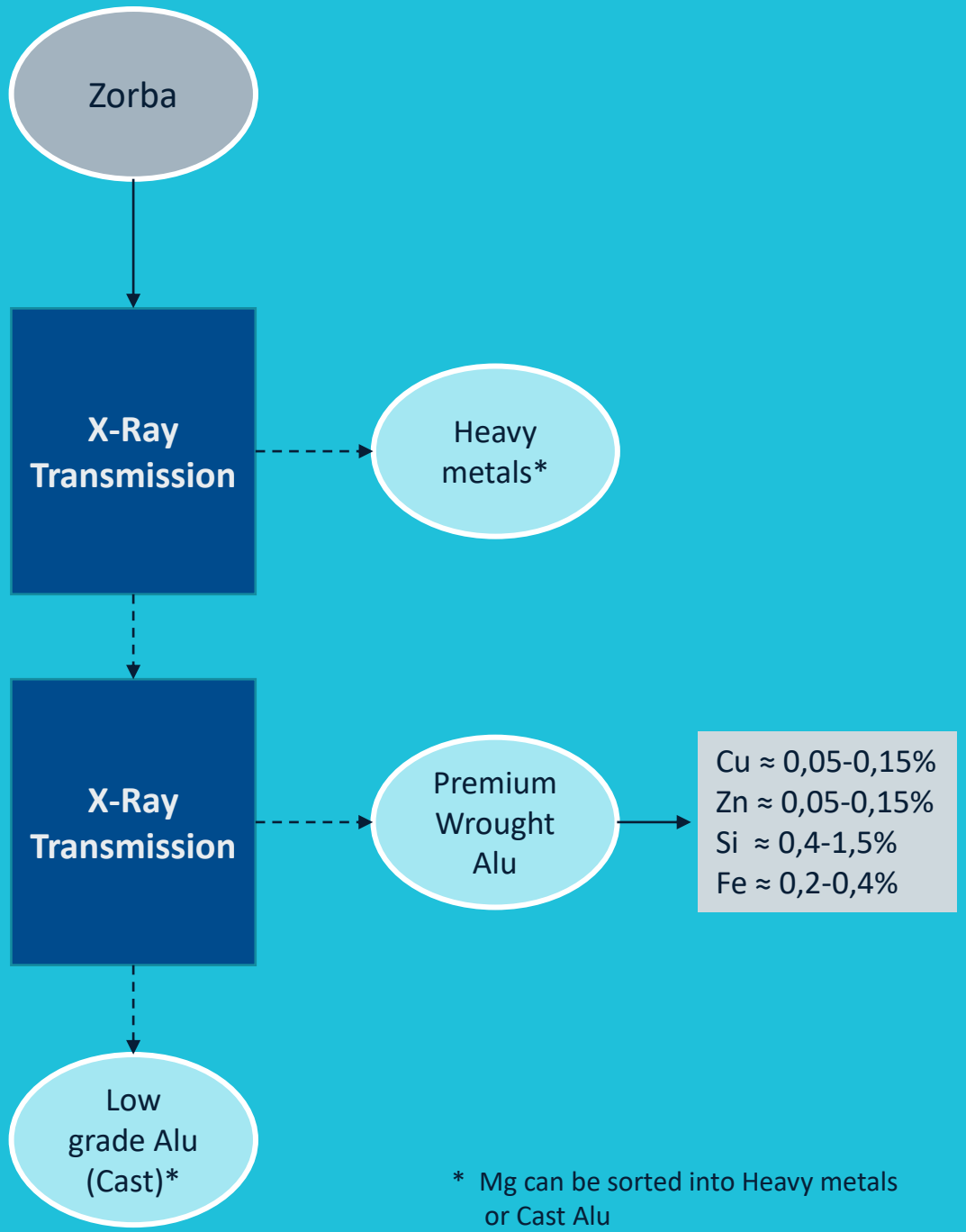
Low density → High density

Magnesium

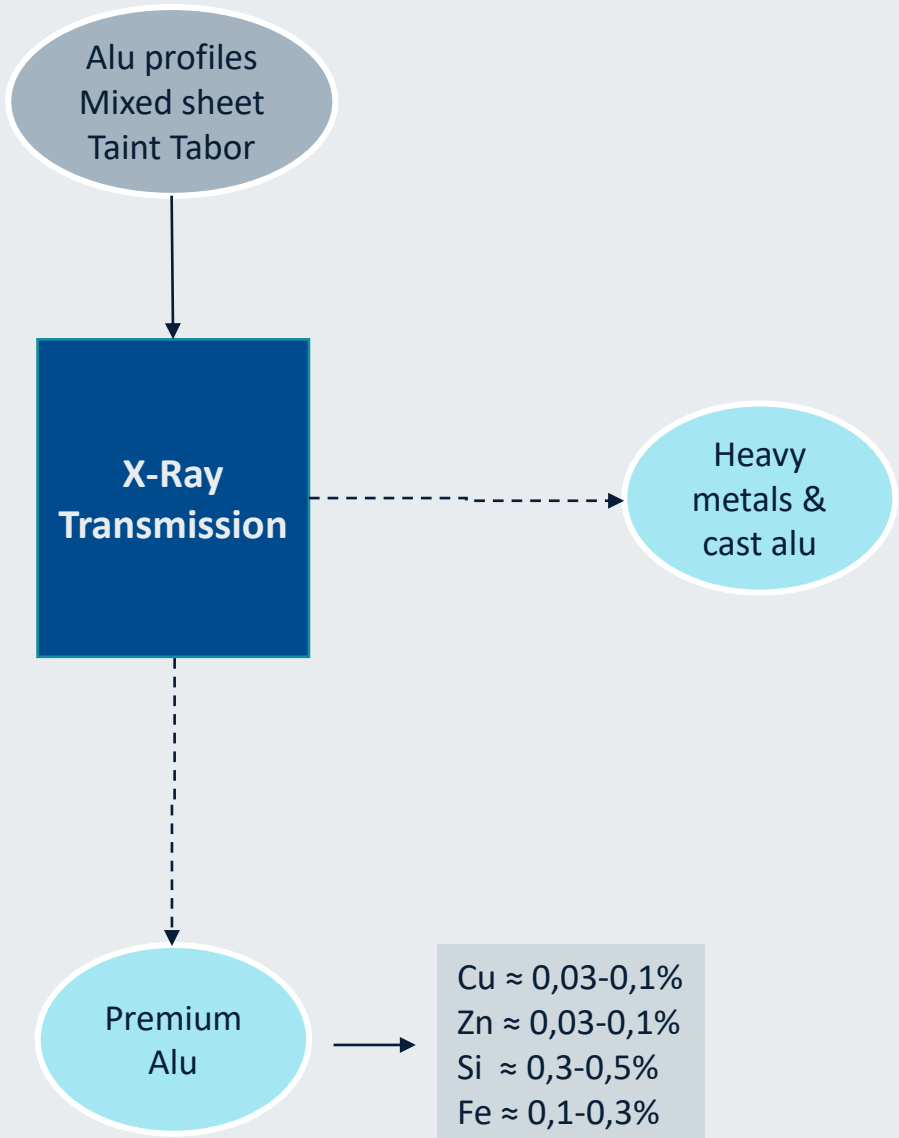
Wrought aluminum

Cast aluminum

Heavy metals



* Mg can be sorted into Heavy metals or Cast Alu



CASE STUDY Aluminum recycler in Italy:

Input material:

Aluminium profiles & sheet
Taint/Tabor

Contaminations:
Zinc, brass attachments or inclusions
Some free heavy metals
Very little castings, Zamac (zinc alloy)
Plastics, non-metals

Contamination level only few %

Input content of zinc ~0,5-1% Zn

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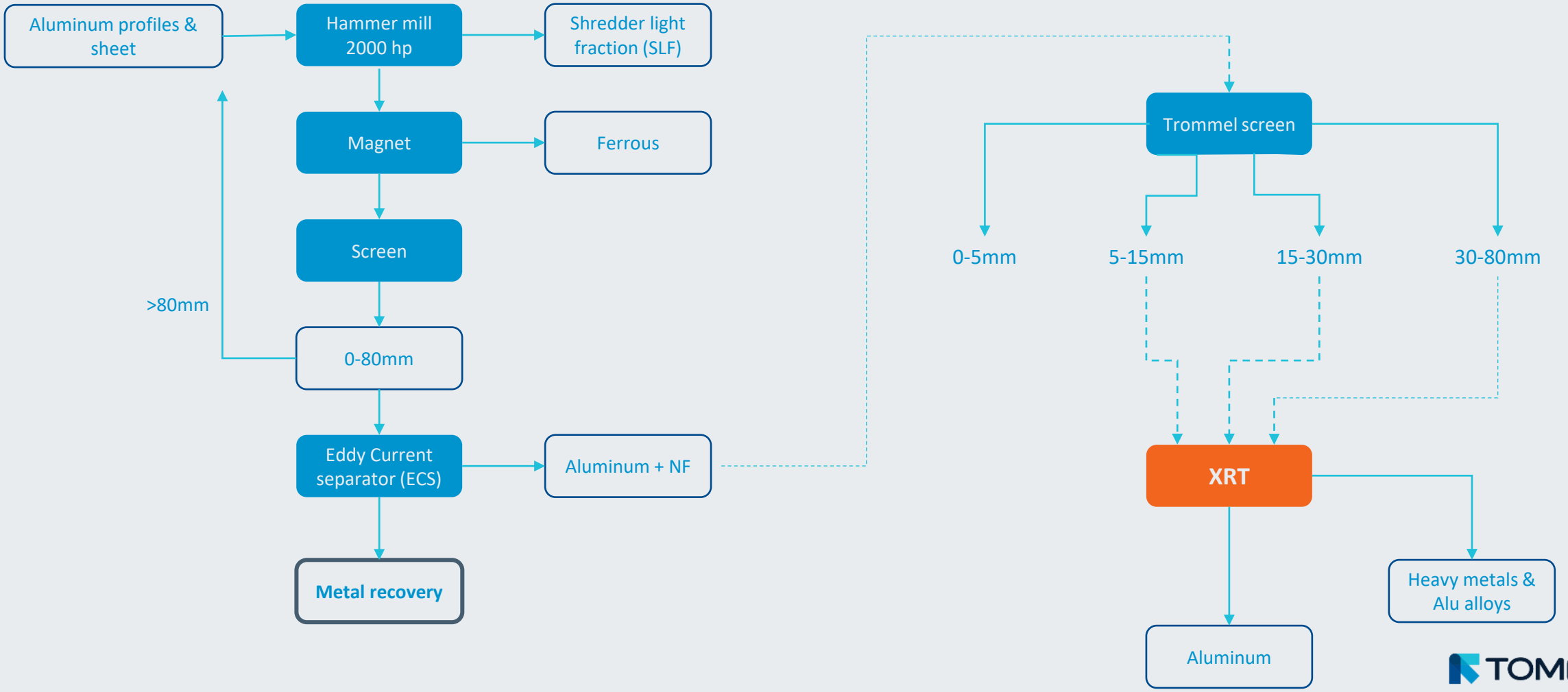
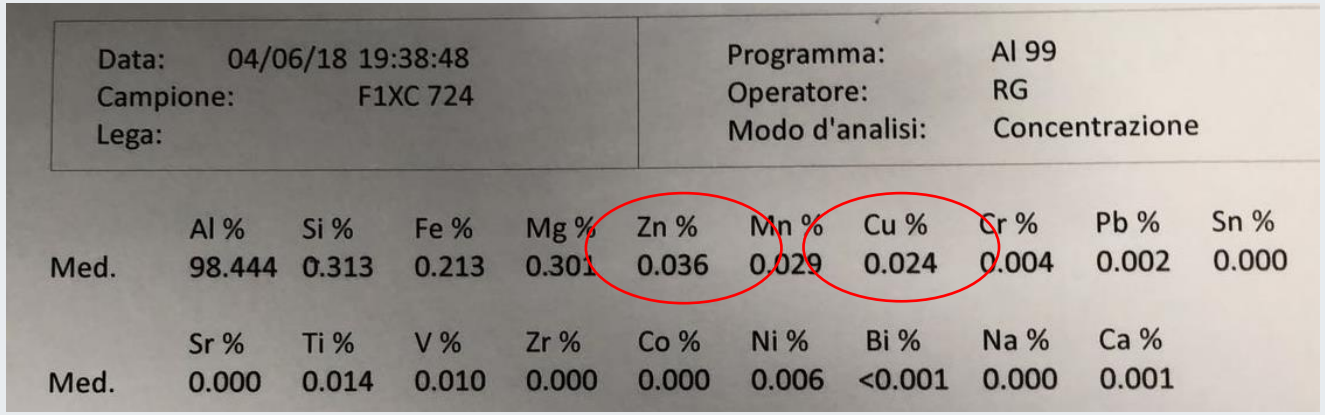
CASE STUDY - Shredder Downstream Process



CASE STUDY - Product quality

- **Zinc** < 0.04 – 0.05%
- **Copper** < 0.04 – 0.05%



Data:	04/06/18 19:38:48					Programma:	Al 99			
Campione:	F1XC 724					Operatore:	RG			
Lega:						Modo d'analisi:	Concentrazione			
	Al %	Si %	Fe %	Mg %	Zn %	Mn %	Cu %	Cr %	Pb %	Sn %
Med.	98.444	0.313	0.213	0.301	0.036	0.029	0.024	0.004	0.002	0.000
	Sr %	Ti %	V %	Zr %	Co %	Ni %	Bi %	Na %	Ca %	
Med.	0.000	0.014	0.010	0.000	0.000	0.006	<0.001	0.000	0.001	

Added value:

- Sell at 95% of LME
- For example: Price-Delta = **€ 300 / ton**
  (depends on actual market conditions)
- Aluminum scrap used for remelting; production of extrusion billets.

Losses:

- Fines 0-5mm (3-5%) – sold as dross/slag to slag recycler
- 8-10% in waste, ferrous, stainless etc.
- 1-2% aluminum into ejected contaminants

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CASE STUDY - Aluminum remelter Italy

INDINVEST

Aluminum Foundry & extrusion plant

- Two tilting furnaces, double chamber
- 5 presses
- 48.000 tons per year of produced extrusion profiles

Mainly 6060 alloy:

- Similar to primary quality
- Fe < 0.24%
- Zn < 0.045%
- Mn < 0.04%
- Cu < 0.03%

CASE STUDY - Benefits for Indinvest

Prior to using sorted scrap produced by Centro Rottami XRT:

- Secondary scrap **~ 20%** of total
- Primary ingots **~45%** of total
  - Price + € 250 > secondary scrap

Since using secondary scrap produced by Centro Rottami XRT

- Secondary scrap **~ 45%** of total
- Primary ingots **~30%** of total

+ € 1.5M

- Energy / gas consumption: **65 m^3/ton**

- 6%

- Energy / gas consumption: **60 m^3/ton**

- Cleaning of furnaces due to 'dirty scrap'

+ € 1.0M

- Furnace doesn't need cleaning as a result of using clean scrap
  - **Increased production by 2%**

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Opportunities for recyclers by sorting aluminum scrap

Increase margins

Produce higher quality from low grade scrap

Quality is King

Secure outlets with higher qualities

Stay local

Avoid transportation costs/issues

Benefits for remelters using secondary scrap instead of primary aluminum

Secondary scrap price vs. primary

Case study example:
+€1.5M /yr by doubling scrap content

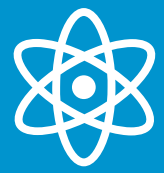
Reduce energy consumption

Case study example:
-6% energy consumption by reduced holding time etc.

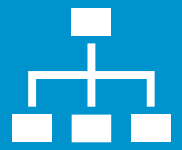
Increase production capacity by reducing dross

Case study example:
+€1M /yr by increasing capacity by 2%

Laser-Induced Breakdown Spectroscopy – The next step in aluminum sorting



Detection of elemental composition (incl. Si, Mg, ..)



Further sort scrap into different alloys / alloy groups
(Eg. 6xxx out of mixed sheet)

Increase scrap quality by further reducing alloying elements

Demand for (recycled) aluminum will continue to grow

Focus on carbon footprint & recycled content

Higher scrap qualities are needed

Proven technologies such as X-Ray Transmission are capable of upgrading aluminum scrap

New technologies will provide more opportunities

Thank you