



Enhancing Aluminum Scrap Sorting with Handheld XRF

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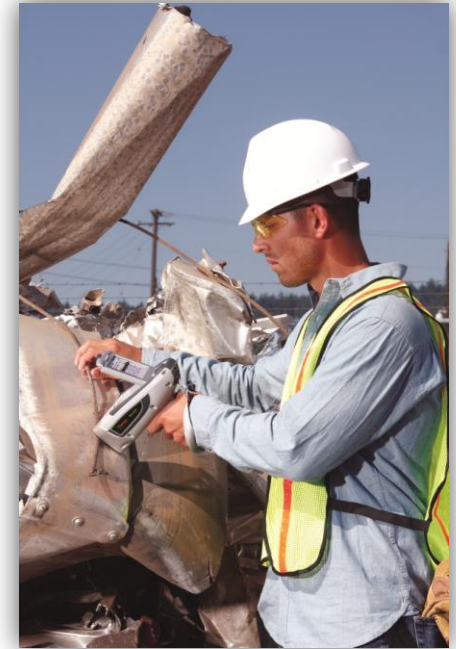
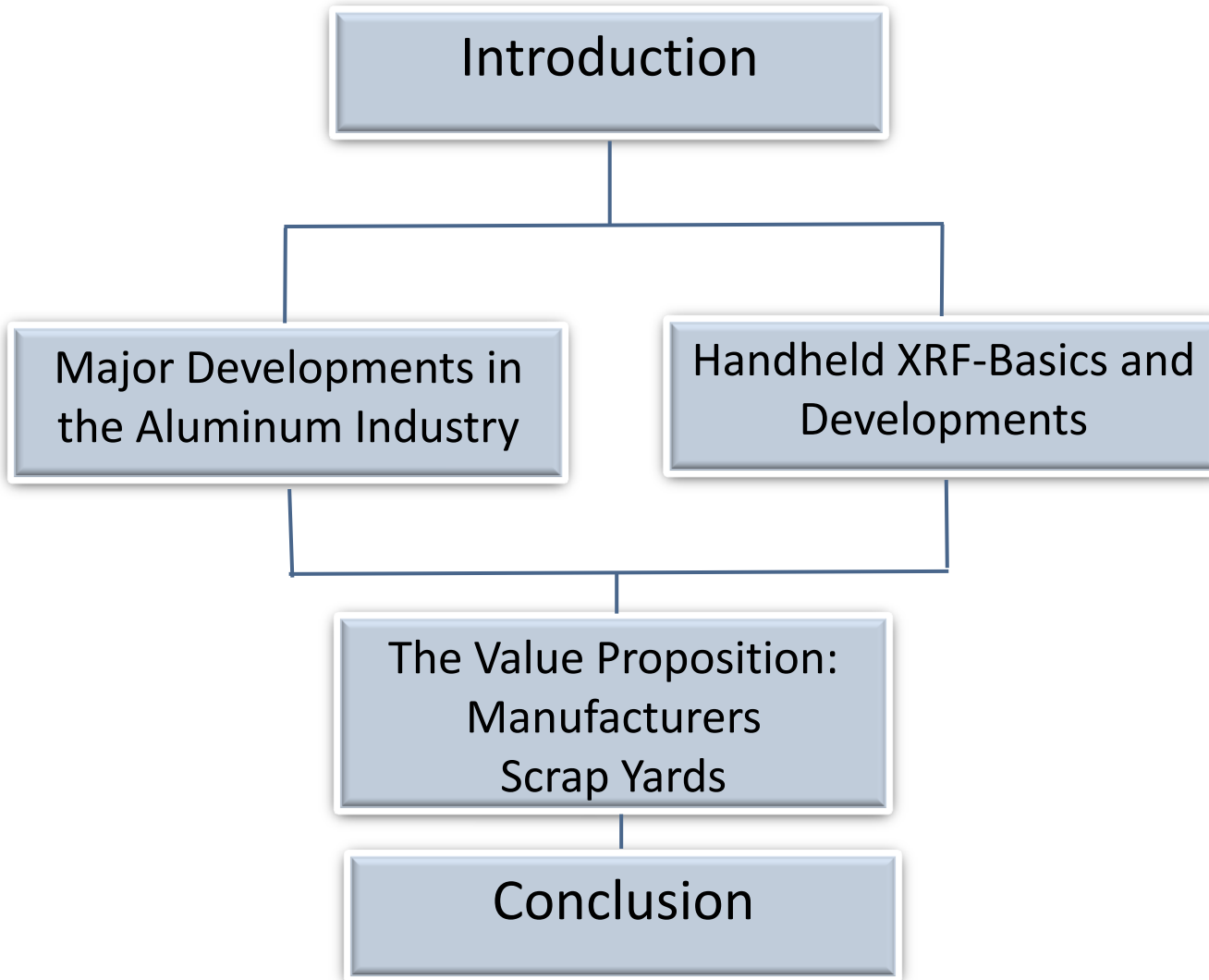
Thermo Scientific Portable Analytical Instruments

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Presentation Outline



Did You Know That...

- Aluminum was classified as a precious metal during the mid 19th century.
- Napoleon III gave aluminum cutlery to his most distinguished guests, the rest had to eat with gold cutlery...
- *Once the Hall-Hèroult process was commercialized the price of aluminum plummeted from \$500/lbs → 0.25\$/lbs.*



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Stats:

- More than 400 employees worldwide
- Headquartered near Boston, USA
- Analyzer excellence recognized globally
 - Molecular – More than 6,000 instruments deployed since 2005
 - Elemental – More than 35,000 analyzers deployed since 1994

Key Developments in The Aluminum Industry

1) Increased demand for aluminum

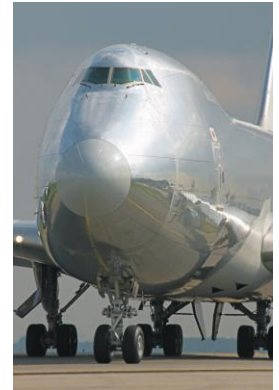
- Industrialization in emerging markets
- Automotive: increased build rates and increasing light content (energy efficiency)
- Consumption forecasted to grow by 6% worldwide, propelled by strong growth in China

2) Primary production constraints

- Growing demand \neq growing profits \rightarrow 25-30% of current production \leq breakeven point
- Oversupply (5 mill. t stockpiled \equiv 75,000 Boeing 747s^{**})
- Lower output (example: Rusal lowering output by 7% this year^{**})

3) Strong push to incorporate scrap as a raw material

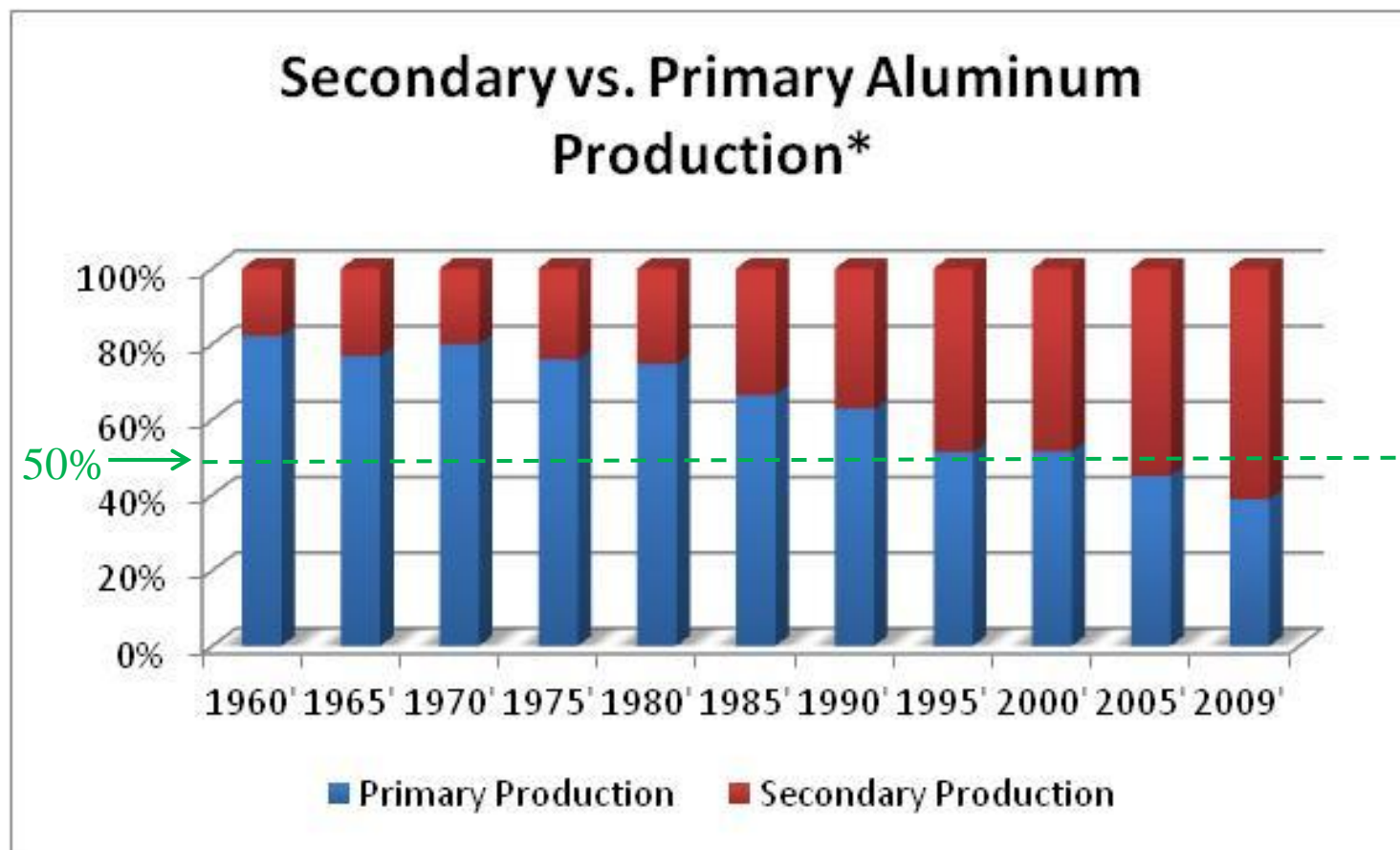
- Financial: 95% energy savings
- Environmental: 95% green house emissions reduction
- Regulatory compliance (*LEED*, *CAFE*)
- Growing environmental awareness
- Aluminum is 100% recyclable with no loss of quality



* Shipments of aluminum extruded products, The Aluminum Association

** <http://blogs.wsj.com/moneybeat/2013/05/14/aluminum-struggles-with-oversupply/>

3: Increased Demand for Secondary Aluminum



Since 2001 the production of secondary aluminum has exceeded that of primary aluminum.

* Source: "Aluminum Statistics – U.S. Geological Survey", October 2010

Novelis: An Example for Higher Scrap Integration

As largest global purchaser, Novelis has a leadership role

Launched global Sustainability Commitment

- ▶ Will have major industry impact: suppliers, customers
- ▶ Reduces carbon intensity of our customers' products
- ▶ Fundamental evolution of business model

By 2020 
We aim to have **80%** of our products
produced made from recycled materials

10

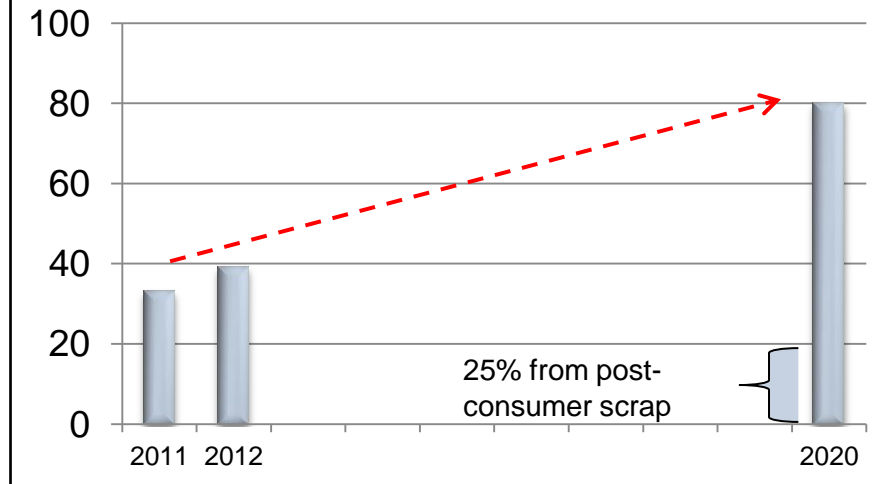
NOVELIS

From Novelis website, red arrow added by author

Benefits to Aluminum Manufacturers:

- Reduce dependence on mining and primary production
- Reduce carbon footprint
- Increase profitability

Content of Recycled Materials



Scrap Trends:

- Higher recycling content
- Higher post-consumer scrap content
- Cross sector competition for scrap

4: The Role of Secondary Aluminum is Shifting





- The usage of secondary aluminum is shifting:
 - “Primary and remelted billet are completely interchangeable”*
 - *“..as long as the proper raw materials are used to achieve the necessary chemistry and specifications”*
 - “Secondary aluminum could be used not just for castings, but also for painted automotive sheet”**
 - *“..if the aluminum scrap is properly segregated”****

*According to US billet remelter, quoted from Metal Bulletin, November 2012/Number 9178

** According to Charles Bradford, Bradford Research, quoted from Metal Bulletin, November 2012/Number 9178

*** According to Kay Meggers, Alcoa, quoted from Metal Bulletin, November 2012/Number 9178

Where's the Problem? Replacing Alumina with Scrap

Feed Material:	 <small>© Norsk Hydro</small>		
<i>Information availability about:</i>			<i>With XRF</i>
Manufacturer	<input checked="" type="checkbox"/>		?
Composition	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Lot Information	<input checked="" type="checkbox"/>		?
Country of Origin	<input checked="" type="checkbox"/>		?
Knowledge of Hazardous Materials	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>

Handheld XRF Technology Overview

1. Primary x-ray ejects K-shell electron

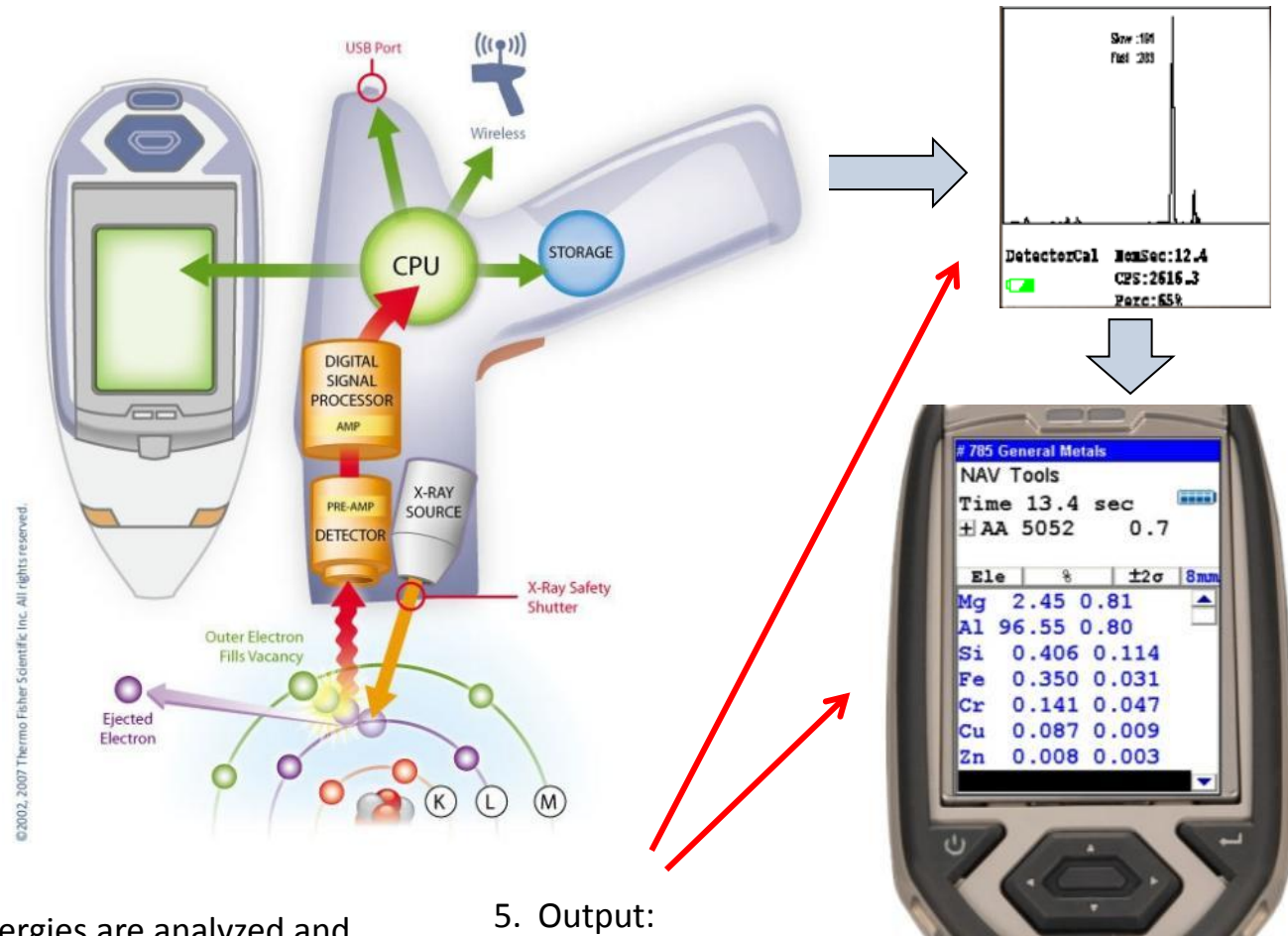
2. Electrons from higher shells fill in the gaps

3. Differential energy state is released as fluorescence x-rays (element-specific)

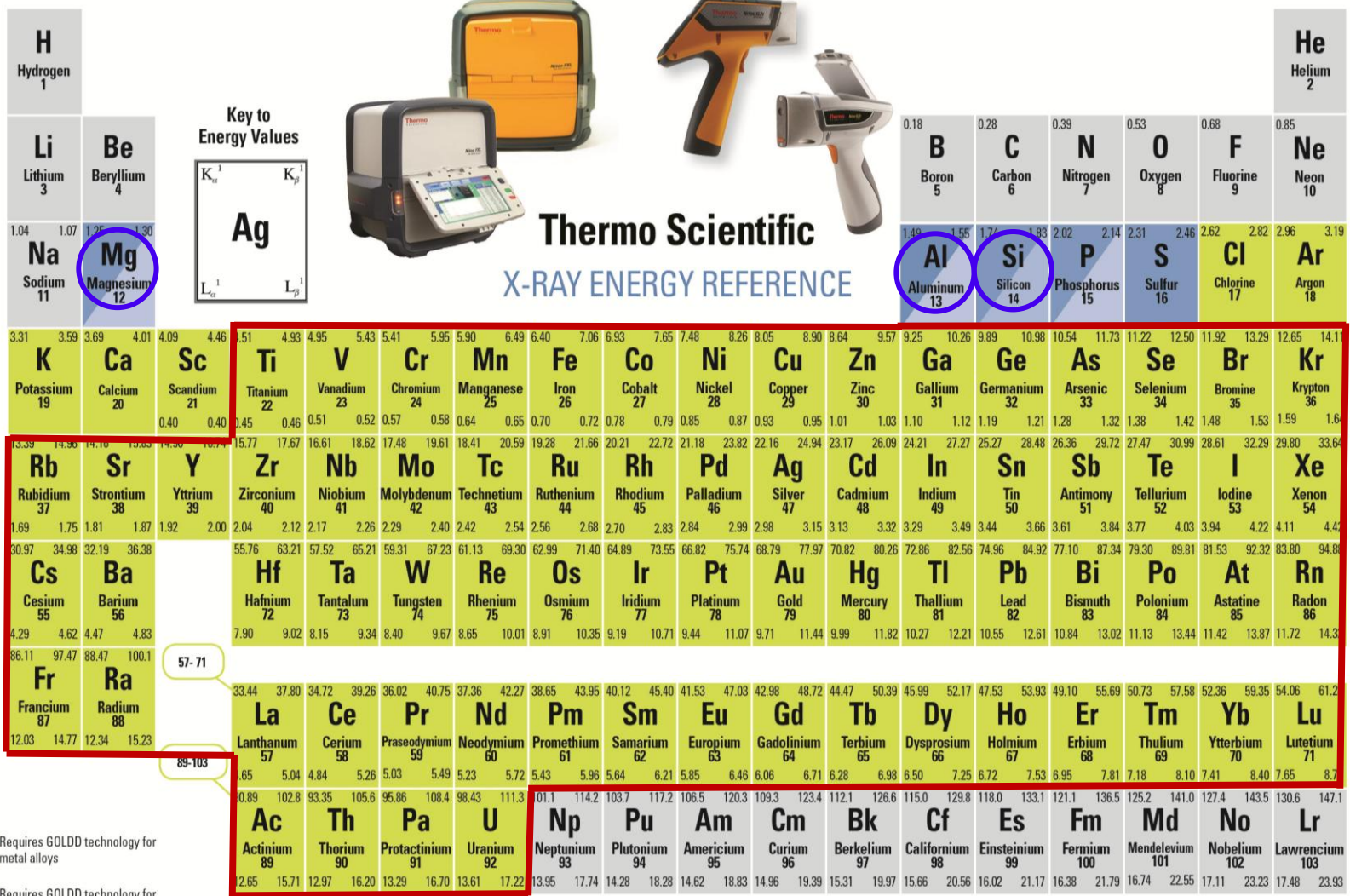
4. The x-ray energies are analyzed and compared with a built-in alloy library

5. Output:

- Spectra
- Positive grade identification
- Elemental composition
- Match level (0-4)

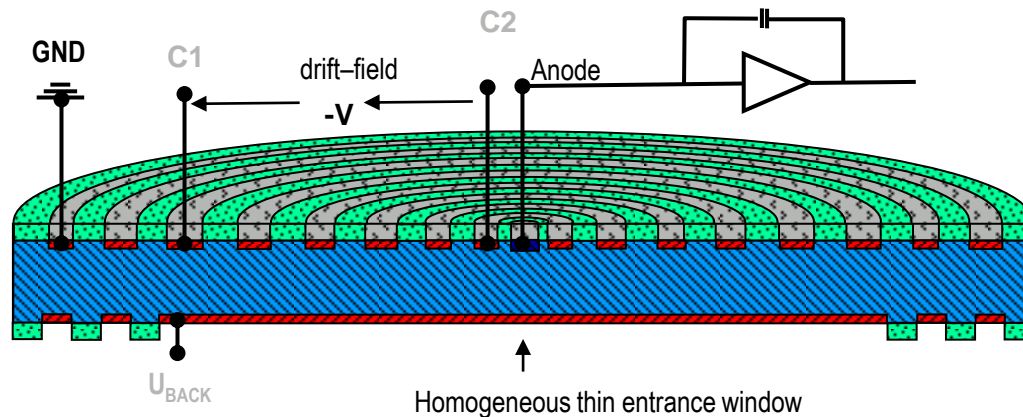


Detectable Elements Using Handheld XRF – Then

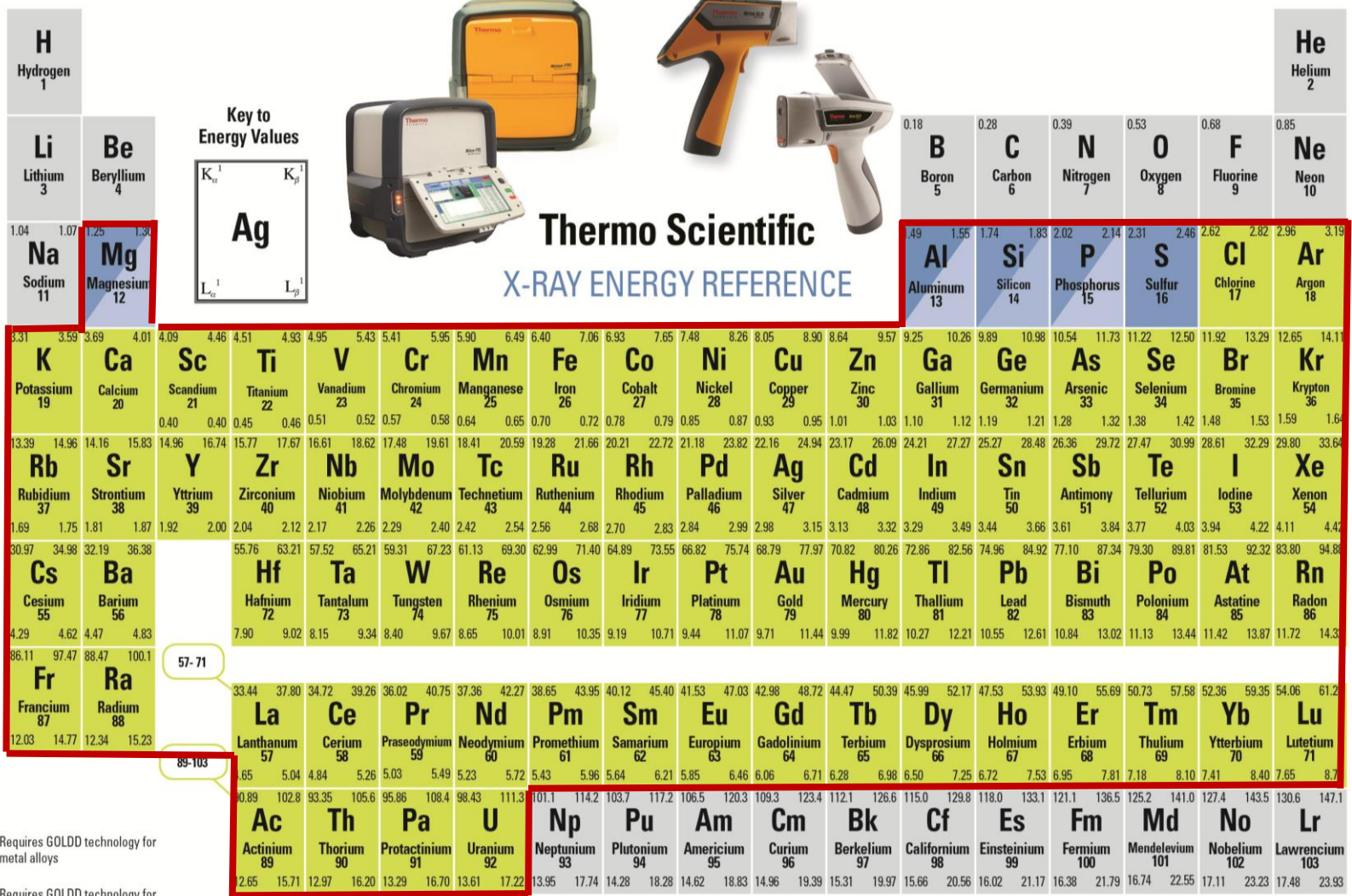


Latest Detector Technology: the Silicon Drift Detector

- Similar to Si PIN, but larger surface area, higher quality Si, low leakage current, small anode capacitance, and unique electrode array
- *This means that the detector has:*
 - *Higher count rate*
 - *No detector dead-time*
 - *Higher resolution*
 - *Improved signal-to-noise ratio*
 - *Better efficiency, sensitivity, precision*



Detectable Elements Using Handheld XRF – Now



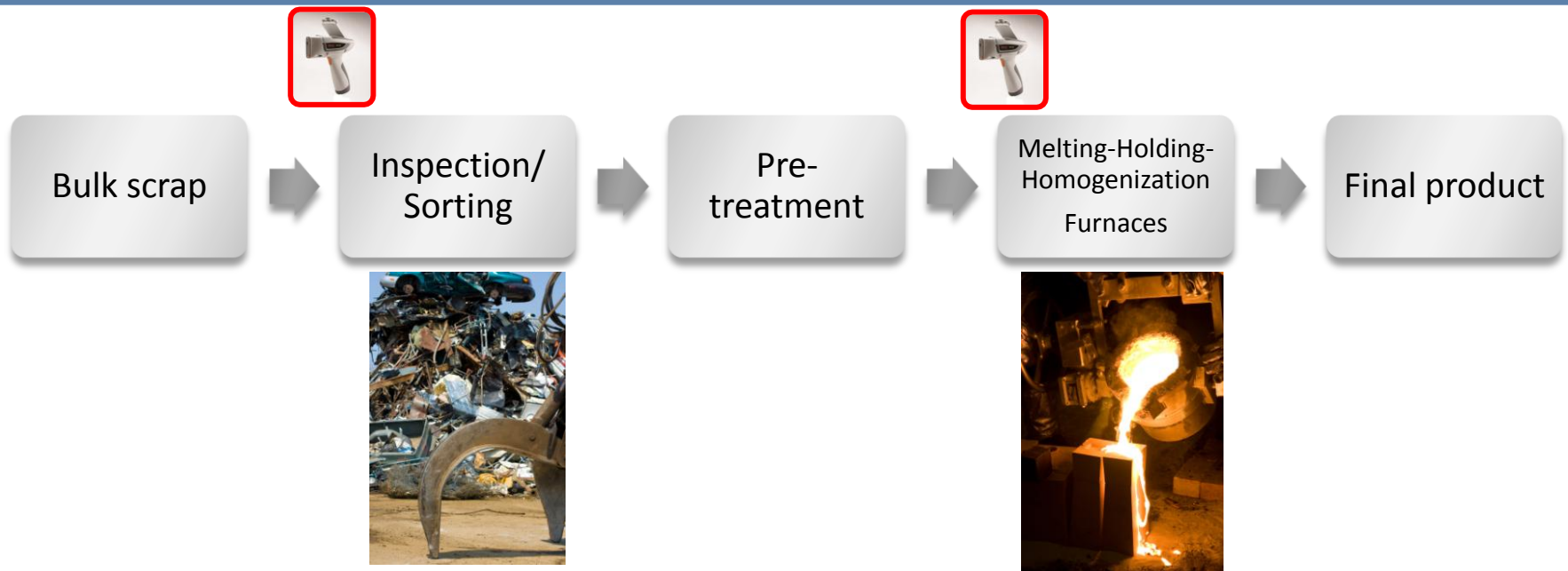
The Result: In-Family Grade Separation Capabilities:

	Si		Fe		Cu		Mn		Mg	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2014	0.5	1.2	0	0.7	3.9	5	0.4	1.2	0.2	0.8
2024	0	0	0	0.5	3.8	4.9	0.3	0.9	1.2	1.8
3003	0	0.6	0	0.7	0.05	0.2	1.0	1.5	0	0
3004	0	0.3	0	0.7	0	0.25	1.0	1.5	0.8	1.3

Faster separation based on light element content - in air

*Not all elements shown

Early Stage Material Qualification

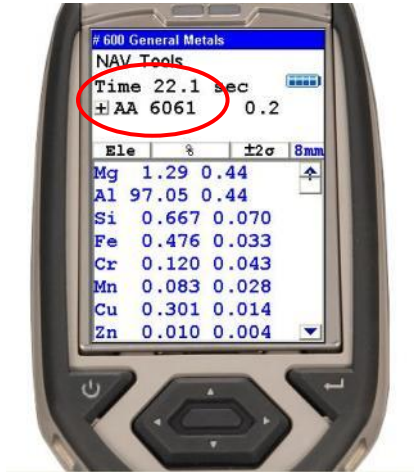


- *End-product specs*
- *Equipment integrity*
- *Contaminant prevention*
- *Regulatory compliance*
- *Melt feedstock optimization*

Advantages:

1. Quick transactions with scrap dealers
2. Portability: bring the analyzer to the scrap
3. No specialized technical skills required
4. Save on lab turnaround time

Maximizing Savings and Profitability



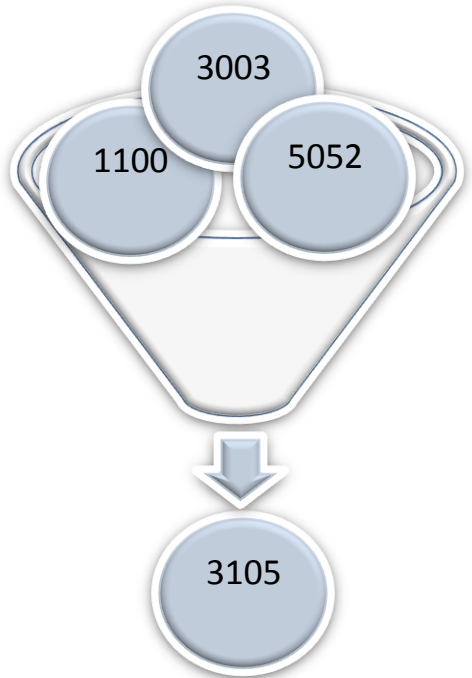
*6061 or 6063?
What a difference
a grade makes*

Potential Cost Savings as a Result from Correct Grade Identification			
	Price Difference (6063-6061) USD/lb		
Annual Turnover ('000 tons)	\$0.05	\$0.07	\$0.10
24	\$2.6 M	\$3.7 M	\$5.2 M
12	\$1.3 M	\$1.8 M	\$2.6M
6	\$0.6 M	\$0.9 M	\$1.2M

Application Example: Melt Feedstock Optimization

3105 can be made by using various alloy combinations:

	A	B	C	...n
1100	70%	37%	30%	
3003	20%	37%	51%	
5052	10%	26%	19%	
Within 3105 Spec?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	



Most Cost-Effective Combination

Conclusion

- Aluminum scrap is becoming a strategic raw material.
- The portion and role of post-consumer scrap are shifting.
- There is a growing need to characterize this new “raw material”.
- Thanks to technological advancements in handheld XRF, light element measurement capabilities (Mg, Al, Si, P, S) have improved significantly.
- Handheld XRF is a value-added tool, currently used by aluminum manufacturers and scrap yards operators to determine alloy grade and chemical composition.

Thank You – Q&A



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