



SENSMET

Real-time Metal Analysis at Point-of-Need

Empowers Industrial Processes and Environmental Monitoring

Toni Laurila, CEO

Executive Summary

Innovation Overview

SENSMET has, for the first time, developed a groundbreaking portable μ DOES[®] analyser technology, offering unprecedented mobility and precision in on-site elemental analysis with minimal use of consumables.

Significance

SENSMET's technology reduces operational costs and environmental impact, aligning perfectly with mega trends such as the green transition and digitalisation of industries.

Market Opportunity

With the next-generation portable μ DOES[®] analyser SENSMET can capture 30% of the multi-billion US\$ ICP-OES market, tapping into industries and applications requiring rapid and accurate on-site elemental analysis.



Unique Value Proposition

SENSMET empowers companies driving circular economy and green transition by providing real-time, multi-metal analysis of hydrometallurgical and wastewater processes. μ DOES® technology enhances product quality and process efficiency through precise concentration data of strategic metals such as battery metals, catalyst materials and rare earth elements. The unique combination of key advantages of Sensmet's μ DOES® technology reshapes the industries' efficient and sustainable landscape:

Real-Time Monitoring

Continuous, automated analysis reveals trend variations enabling immediate process adjustments. Detecting and understanding previously unknown phenomena in real time accelerate R&D and enhances problem-solving.

Comprehensive Analysis

Simultaneous measurement of up to 35 metals, including challenging, high-impact metals like lithium and rare earth metals.

Enhanced Measurement Performance

Capability to simultaneously measure both the concentrations of major metals and their precise ratios, as well as the exact values of the smallest trace concentrations of impurity metals.

Cost Efficiency

Eliminates the need for expensive carrier gases or chemical reagents, reducing operational costs. Our user-friendly instrument simplifies staff training and enhances productivity.

Environmental Sustainability

Employs green chemistry principles supporting sustainable industrial practices.



Shaping the Future

Green Transition and Critical Metals

SENSMET's game-changing technology allows for optimising the production and recycling of lithium battery metals and rare earth elements (REE). The efficient recovery, circular economy and quality control of the critical metals is in the core of the green transition: lithium batteries, electric motors, wind turbines, and LED lighting.

Water Stewardship

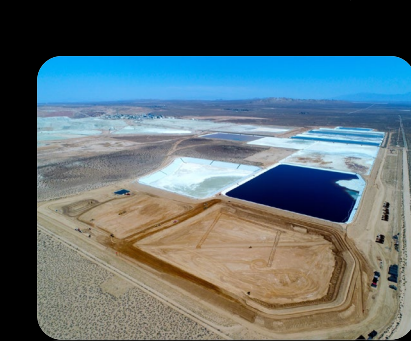
SENSMET empowers industries to adopt efficient treatment, reuse, and conservation of industrial raw, process and wastewater. SENSMET real-time water analyser ensures regulatory compliance and reduces environmental impact.

Environmental Water Quality Control

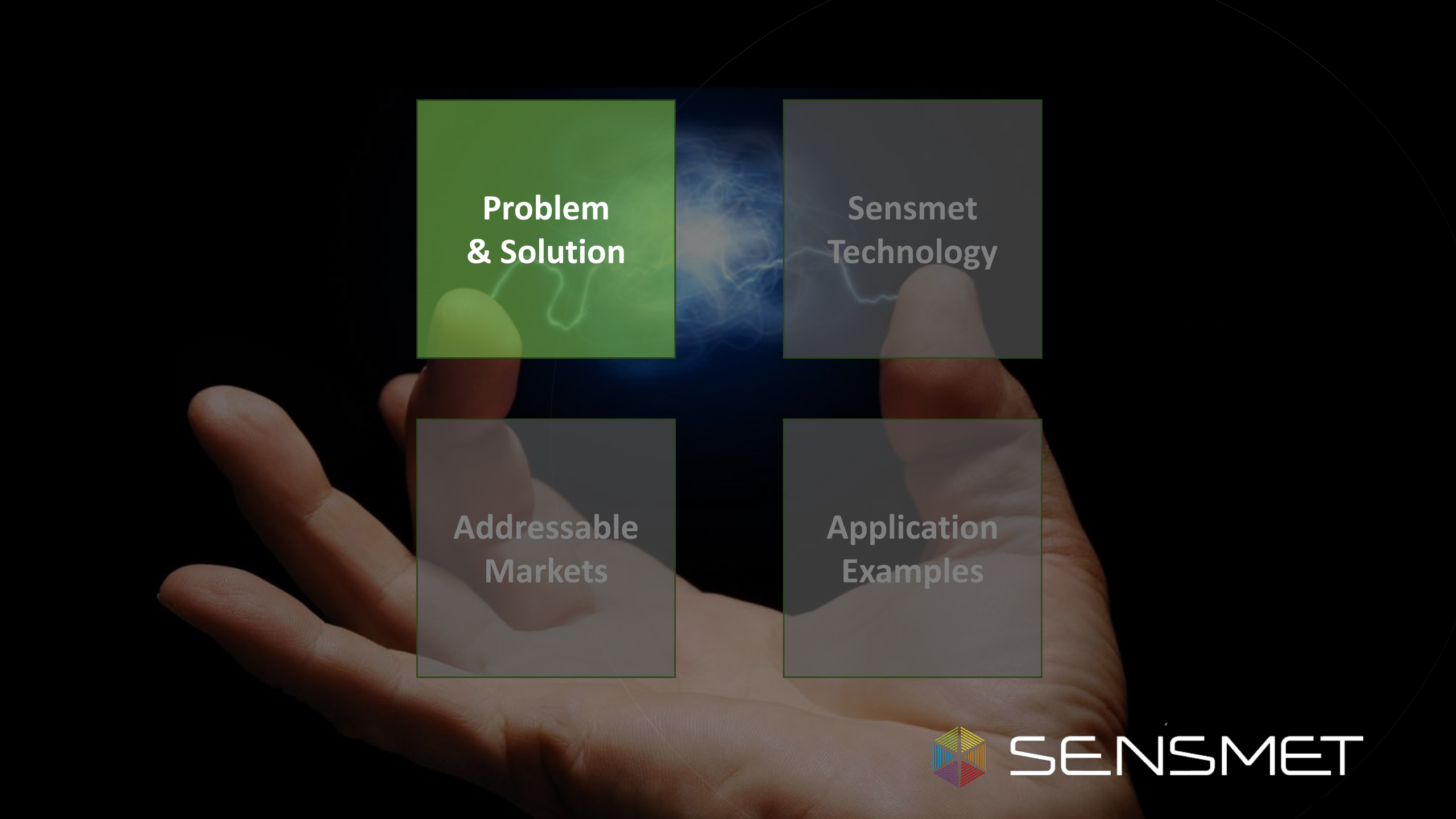
With climate change intensifying water pollution and scarcity, SENSMET's water quality monitoring technology fills a critical gap. It provides real-time data on pollutants and the status of environmental health to protect ecosystems and ensure clean water resources.

Industry Trajectory Towards Automated, Real-Time, and Portable Measurement Systems

The industry needs smarter, automated solutions that provide real-time insights with minimal CAPEX/OPEX. SENSMET's cutting-edge technology not only offers unprecedented analytical performance but also reduces operational costs and environmental impact, making it a future-proof investment in industrial digitalisation.



SENSMET



**Problem
& Solution**

**Sensmet
Technology**

**Addressable
Markets**

**Application
Examples**



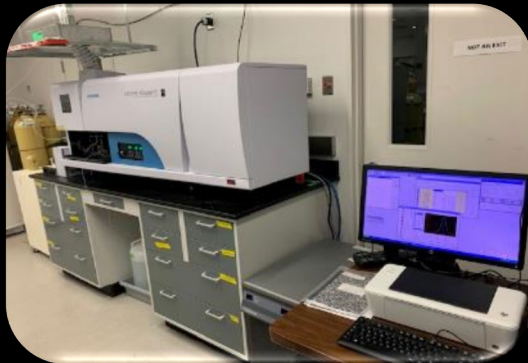
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Industry and Environment Need Better Measurements

SENSMET Has Revolutionised Metal Analysis by Producing Lab-grade Data at Point-of-Need

Problem in Liquid Analysis

- laboratory results are always late
- 24/7 lab operation is expensive
- difficult to find skilled personnel



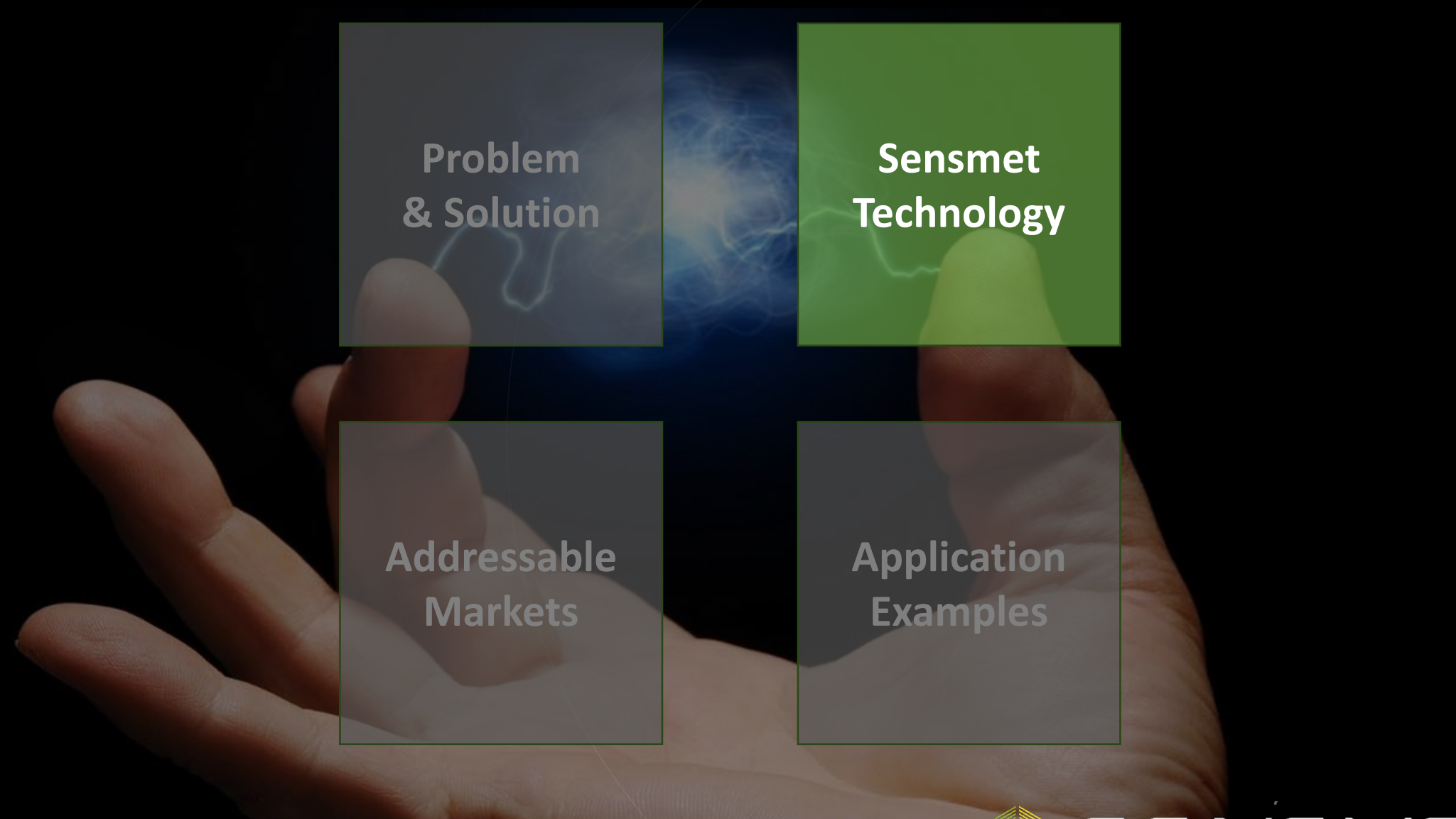
ICP-OES – the laboratory workhorse

Solution

- 100% automated and online
- real-time quantitative data on metal concentrations
- low need on consumables and maintenance



SENSMET online analyser

A hand is shown holding four colored squares arranged in a 2x2 grid. The top-left square is grey and contains the text 'Problem & Solution'. The top-right square is green and contains the text 'Sensmet Technology'. The bottom-left square is grey and contains the text 'Addressable Markets'. The bottom-right square is grey and contains the text 'Application Examples'. The background is dark with a faint blue and white energy-like pattern.

**Problem
& Solution**

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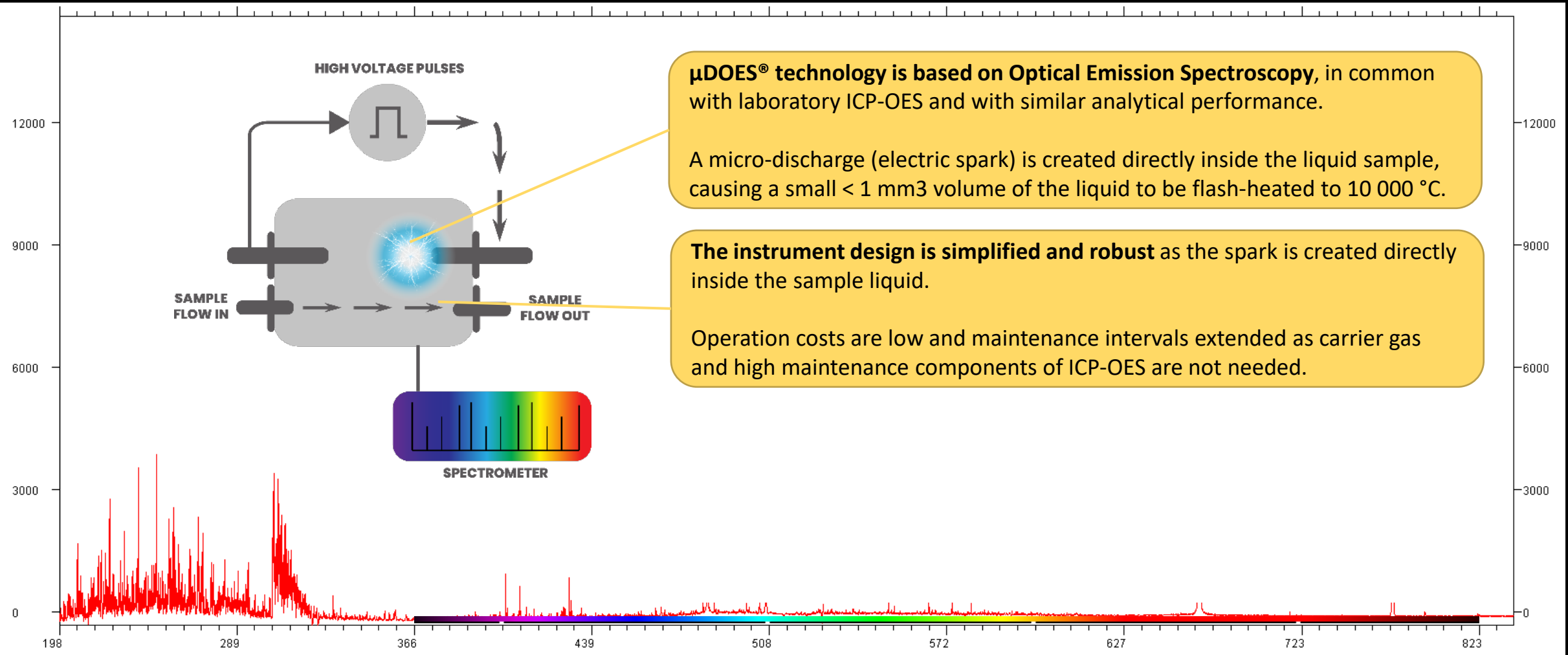
**Application
Examples**



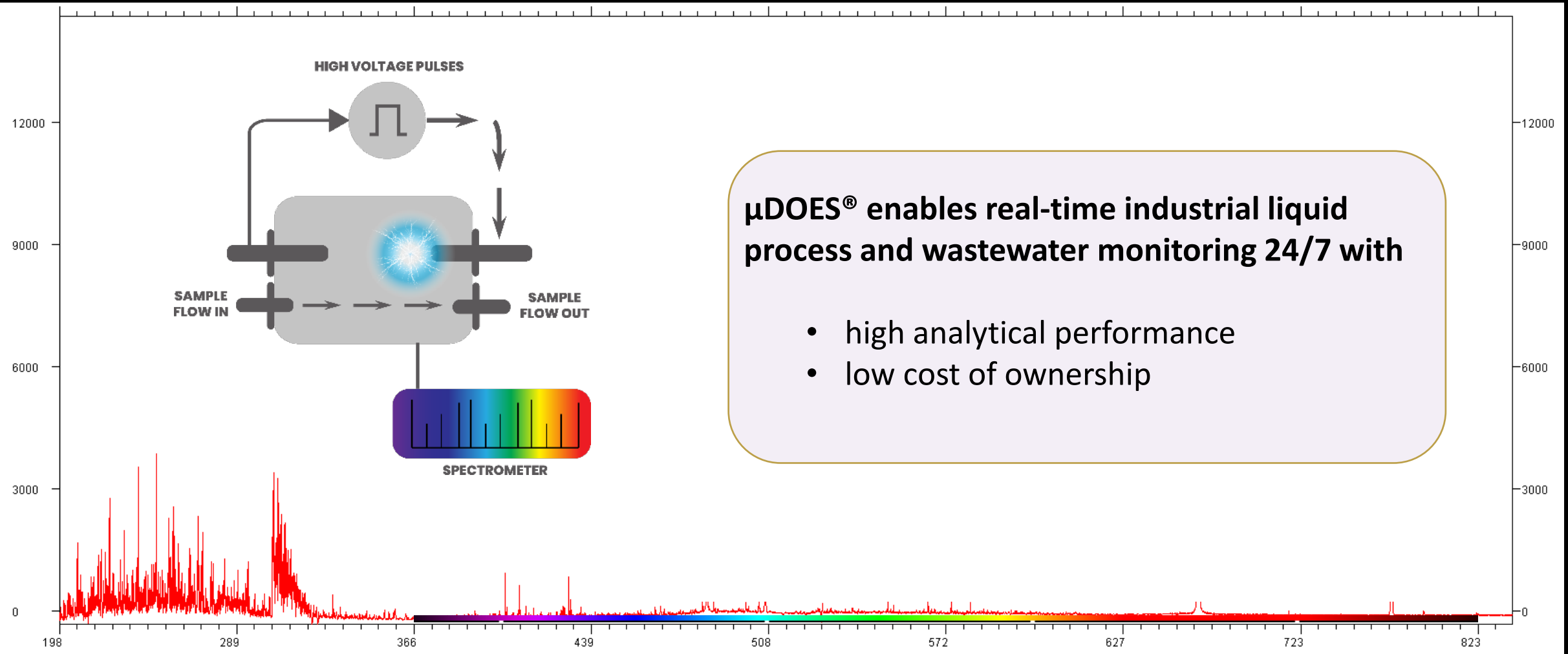
SENSMET

μDOES® Technology – Sparks Inside Liquid

Patented μDOES® (Micro-discharge Optical Emission Spectroscopy)



μ DOES[®]. Simple and Robust.



Unique Properties of μ DOES[®] Technology

RECORD MULTI-METAL COVERAGE

Over 35 metals starting from the lightest weight lithium

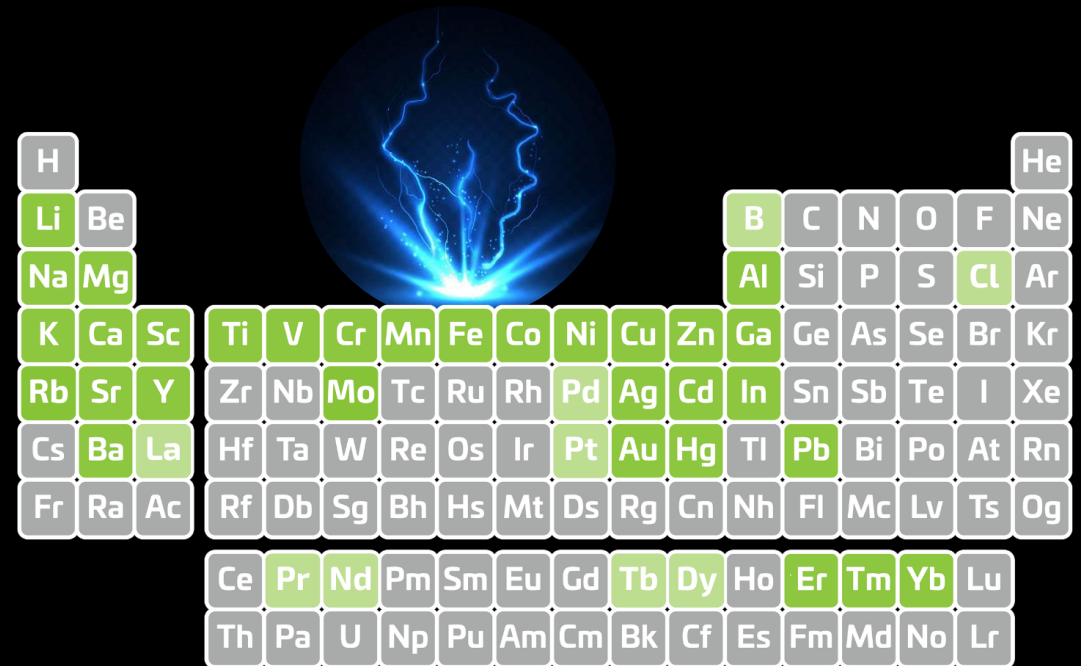
SENSITIVE

ppb to ppm analysis range, that is, $\mu\text{g/L}$ to mg/L ;
with online dilution unit analysis range extended
to high concentrations of 10s of g/L

AUTOMATED AND EASY

From sampling to reports, including clean-up
and calibration, it's 100 % automated:

- no carrier gas, no hazardous chemical reagents
- 3-month maintenance intervals
- multiple sampling lines per analyser are optional
- Modbus data and command flow

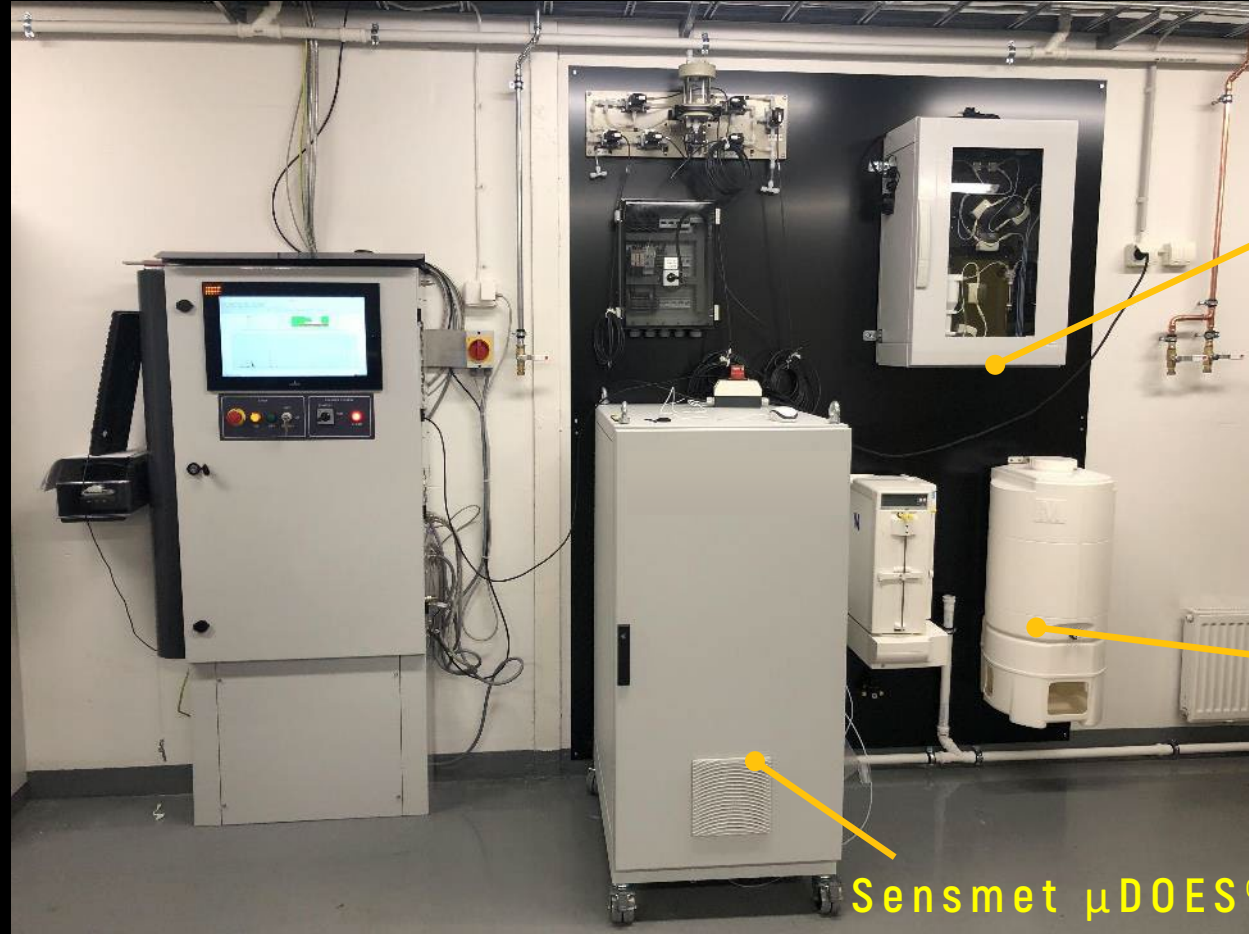


Superior Alternative to Competing Solutions

Criteria	μDOES [*]	ICP-OES	Ion chromatography	Benchtop NMR	TXRF	Titration
Simultaneous analysis of a wide range of elements*	✓	✓	✗	✗	✗	✗
Low detection limits (≤ μg/L)	✓	✓	✗	✗	✓	✗
Fast measurement time (≤1 min)	✓	✓	✗	✗	✗	✗
No gases required (Ar, He, N ₂)	✓	✗	✓	✓	✓	✓
Low energy consumption	✓	✗	✓	✓	✓	✓
No chemicals	✓	✓	✗	✓	✓	✗
On-site	✓	✗	✓	✓	✓	✓
On-line	✓	✗	✓	✓	✗	✗
Fully automated (sampling, data analysis, QC)	✓	✗	✓	✓	✗	✗
Low maintenance	✓	✗	✗	✓	✓	✗

*including light elements (Li, Na) and heavier elements (Mn, Co, Ni, In, Au, ...)

A Customer Installation



Automatic Sensmet
Dilution Unit

Online Demineralised
MilliQ® Water System
by Merck

Sensmet μ DOES®
Analyser



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SENSMET

Empowering Efficiency and Sustainability

Automated Metals Monitoring System (AMMS)

- First AMMS for liquids producing quantitative real-time data on metal concentrations, backed by AI, matching laboratory performance.
- Precise AMMS allows for greater process efficiency, better product quality and sustainability.

Product Roadmap



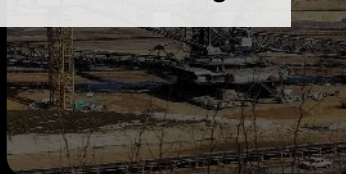
Spark



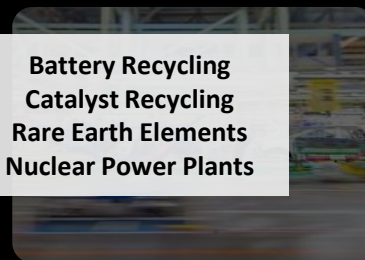
2nd generation product

Addressable Markets

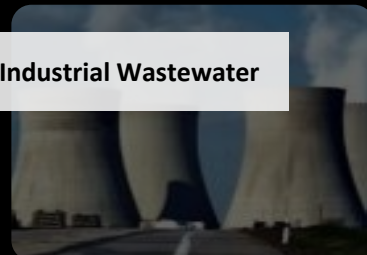
Metals & Mining



Battery Recycling
Catalyst Recycling
Rare Earth Elements
Nuclear Power Plants



Industrial Wastewater



Environmental Monitoring



Select Customers

Customers	Industry
Metso	Mining process technology
Sibanye Stillwater KELIBER	Mining and metals processing
outokumpu	Stainless steel and mining
RioTinto	Mining and metals
Terrafame	Mining company
WEEE FINER	Metals recovery company
Helsinki	Municipal wastewater monitoring

Necessary Attributes by Industrial Markets

Application Market / USP Attribute	Battery Metals	Rare Earth Elements	Nuclear Power	Catalyst Recycling	Electronics Recycling	Metal Plating	Other
High-precision Metal Ratio Measurement in Real Time	✓	✓					
High Dynamic Ratio Between Main and Impurity Metals	✓	✓		✓	✓		✓
Speed of Measurement: (faster processes and R&D)	✓	✓	✓	✓	✓	✓	✓
Multi-component Analysis	✓	✓	✓	✓	✓	✓	✓
Low Cost of Operation (consumables, maintenance)	✓	✓		✓	✓	✓	✓
Robust Field Operation	✓	✓	✓	✓	✓	✓	✓
Minimal Sample Preparation	✓	✓	✓	✓	✓	✓	✓
Environmentally Friendly Operation	✓	✓		✓	✓	✓	✓

Key Value Proposition for Lithium Producers

Precise and simultaneous monitoring of Li, Ni, Co and Mg as well as impurities such as Cu, Al, Ca and Mg enables efficient battery metals production and efficient high-purity recovery of critical materials from end-of-life batteries.

Battery Metal Production
from Ores and Brines



Battery Metal Recycling
from Black Mass

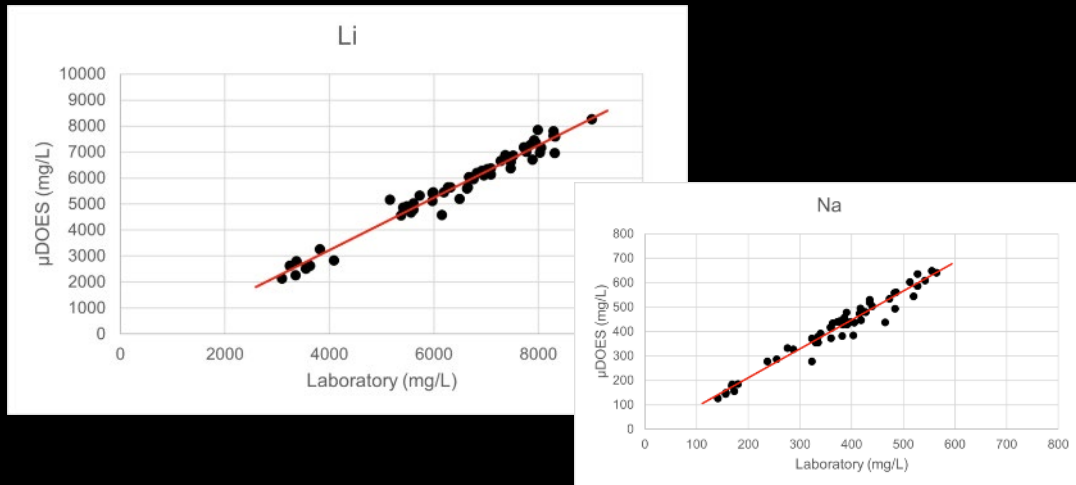


Customer Testimonials

Metso Oyj – 5 billion EUR OEM partner

*“We were impressed by the outcomes of the measurement campaign, conducted in a challenging environment replicating real-life conditions. Despite the rigor, the μ DOES® and ICP-OES delivered congruent results. **This is significant — we anticipate that the μ DOES® technology will bring substantial value to the realms of battery metal production and recycling processes when integrated to Metso Courier® HX system.**”*

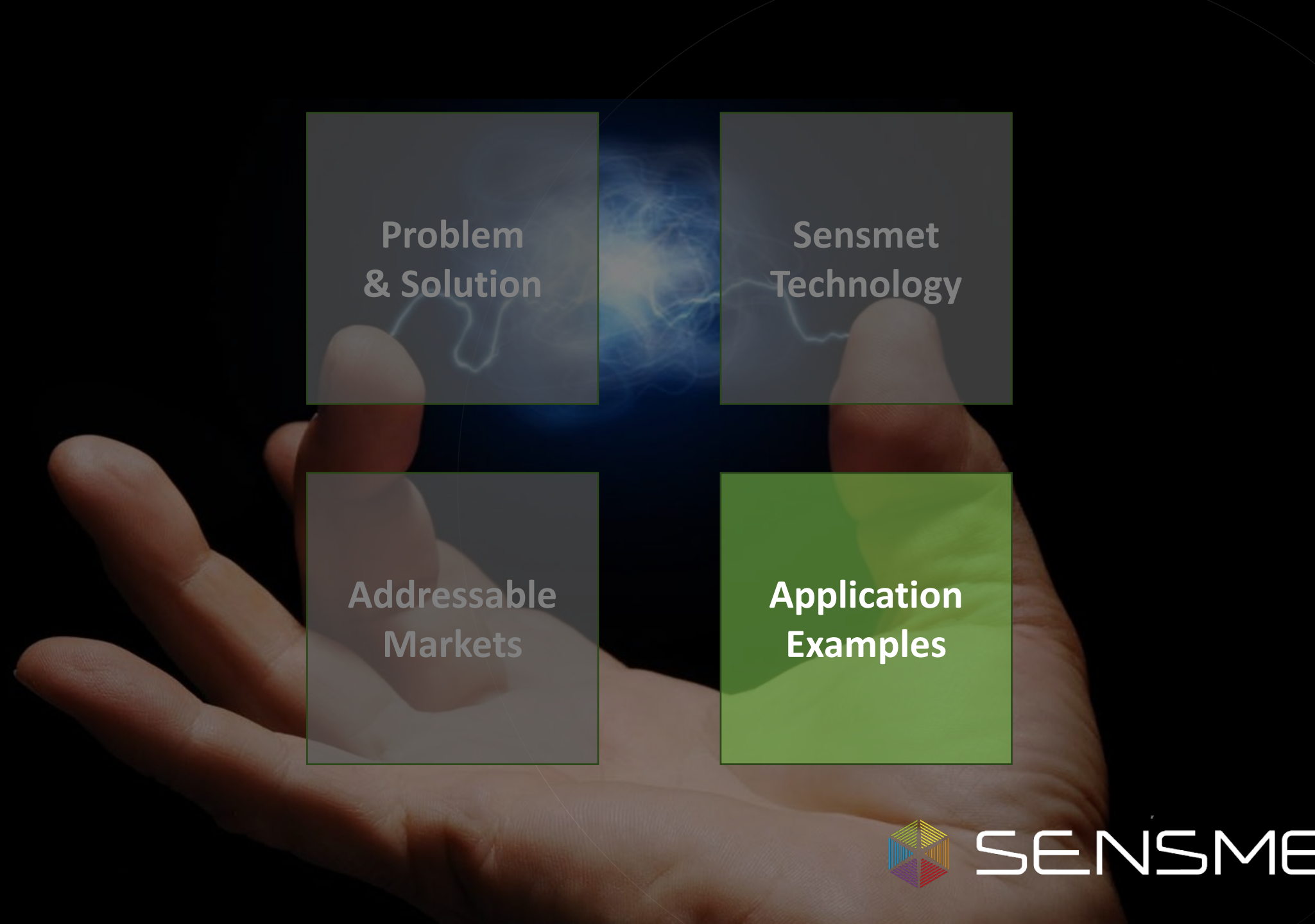
Veli-Matti Järvinen, Vice President, Automation Product Group, 2023



Keliber Oy – Sibanye-Stillwater company

*“When sodium carbonate is added to slurry containing beta spodumene at high pressure and temperature, lithium carbonate and analcime solids are formed. If insufficient sodium carbonate is dosed, all lithium will not react to lithium carbonate, and unreacted lithium will be lost in the side product analcime sand. **This is extremely undesirable because it represents a loss of revenue. Overdosing would also result in a waste of process chemicals.**”*

Sami Heikkinen, Site Manager, 2022



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SenSpec® Software

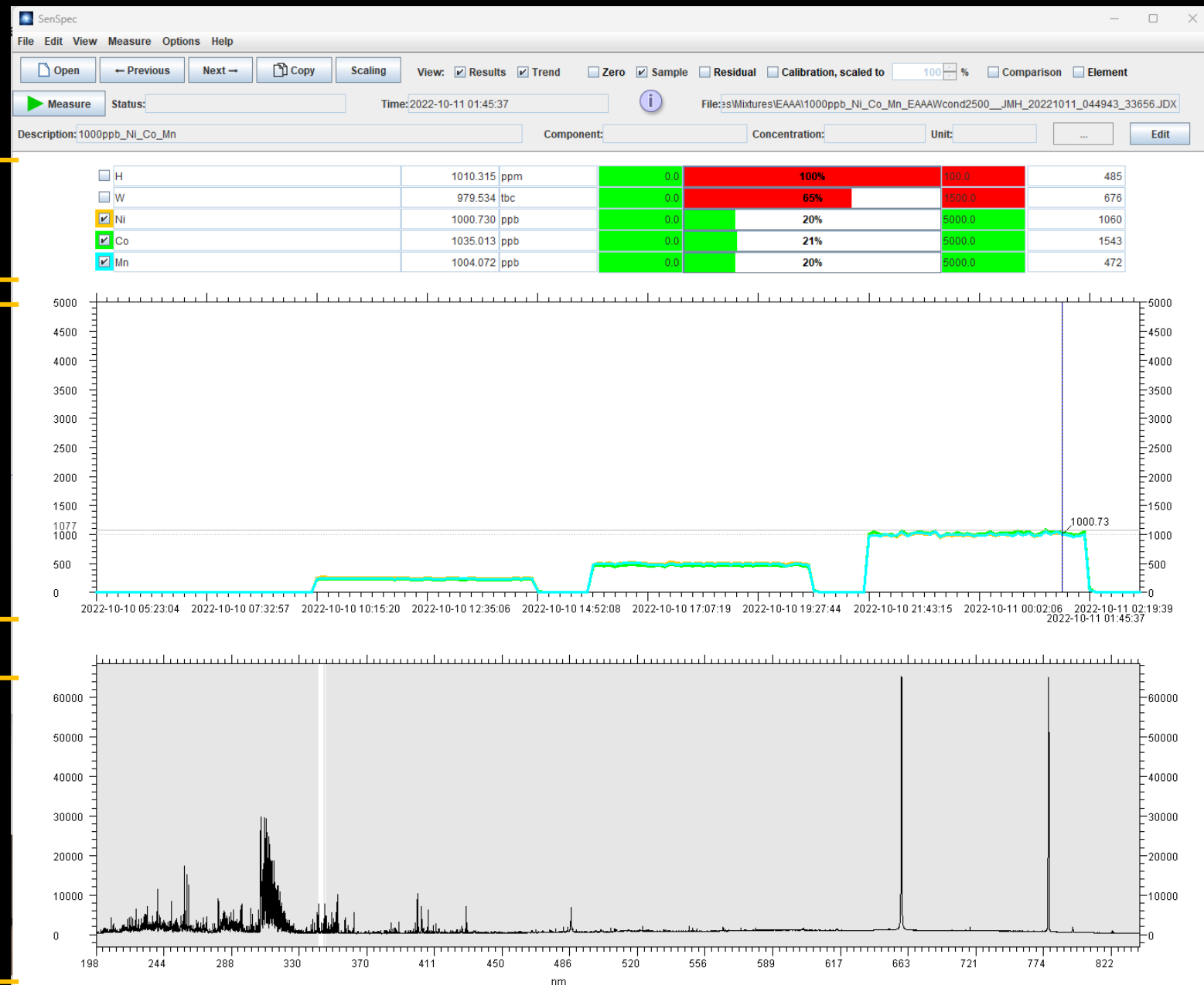


SenSpec® Software

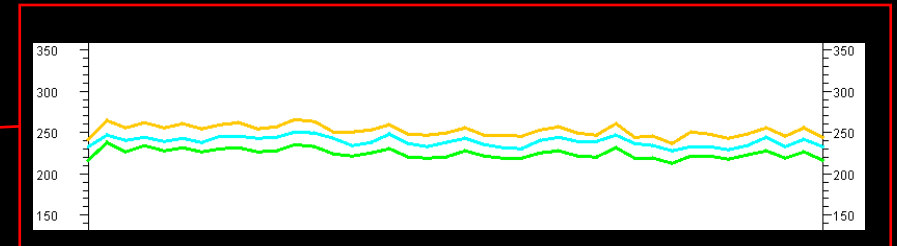
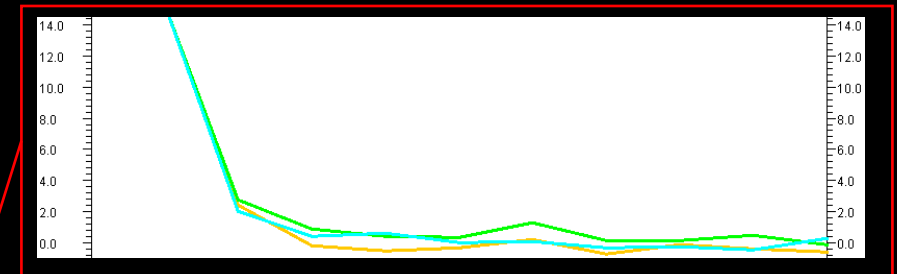
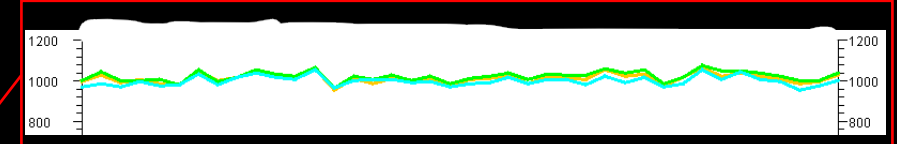
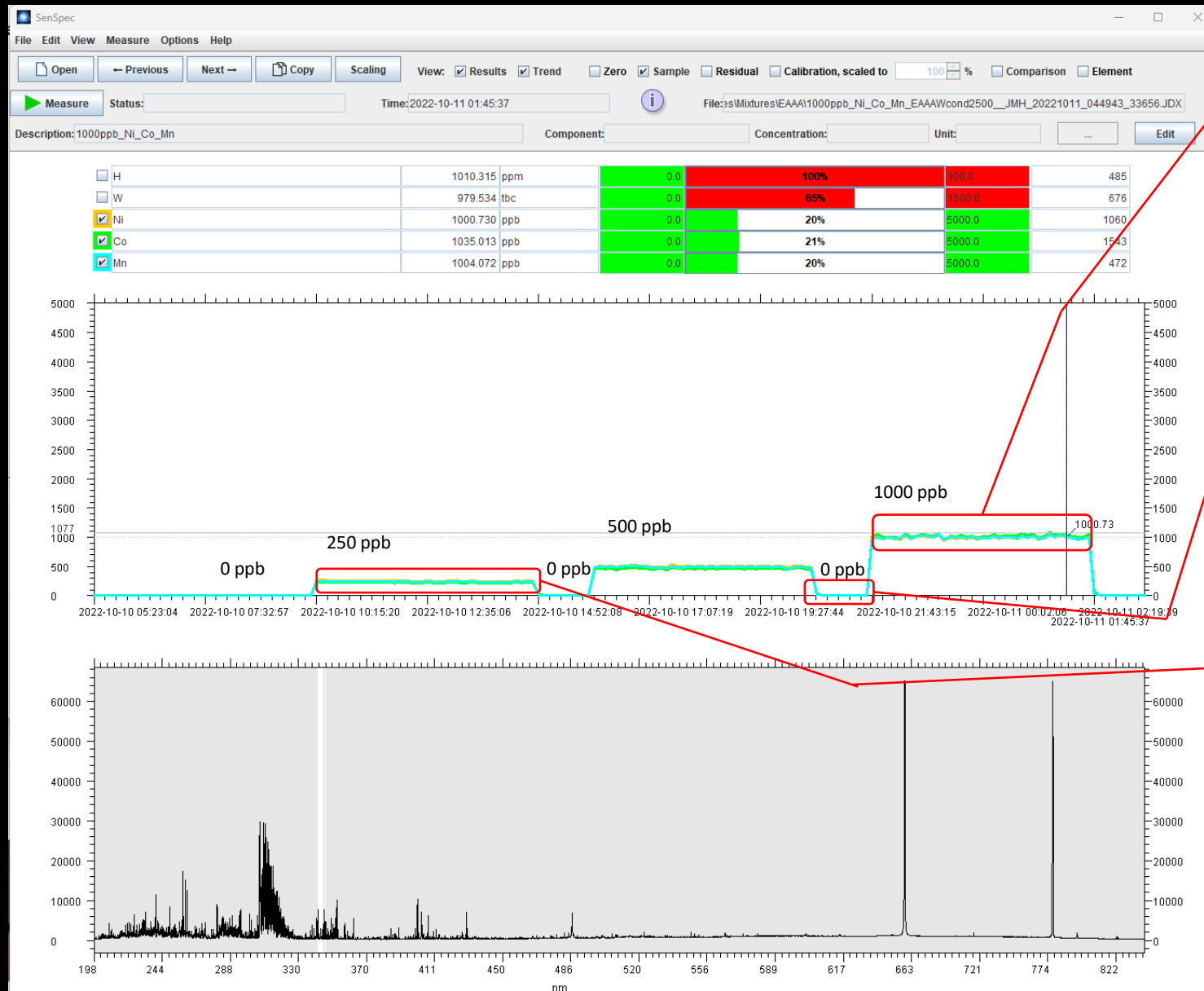
Analytical Results
in Real Time

Concentration
Trends

Optical Emission
Spectra

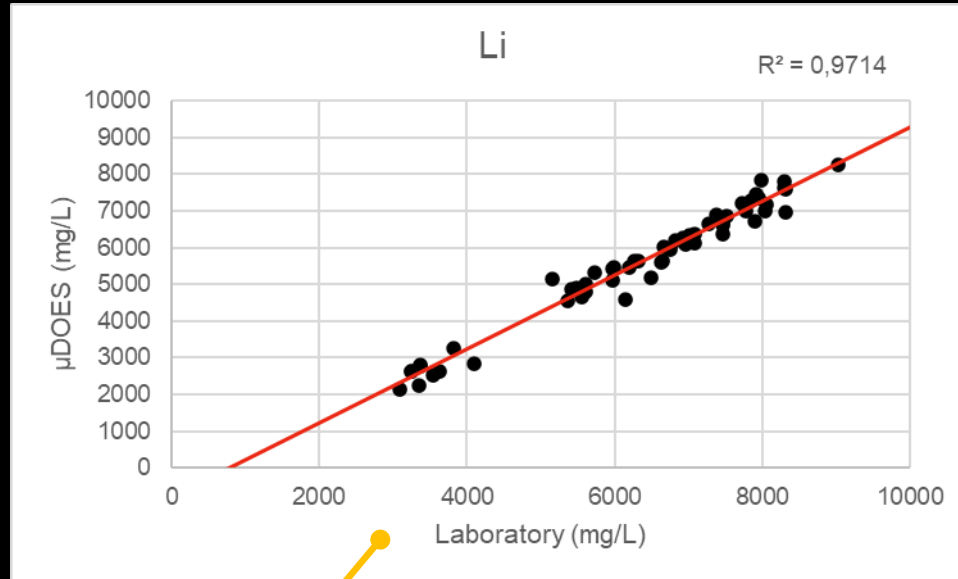


I Performance Example on Battery Metals

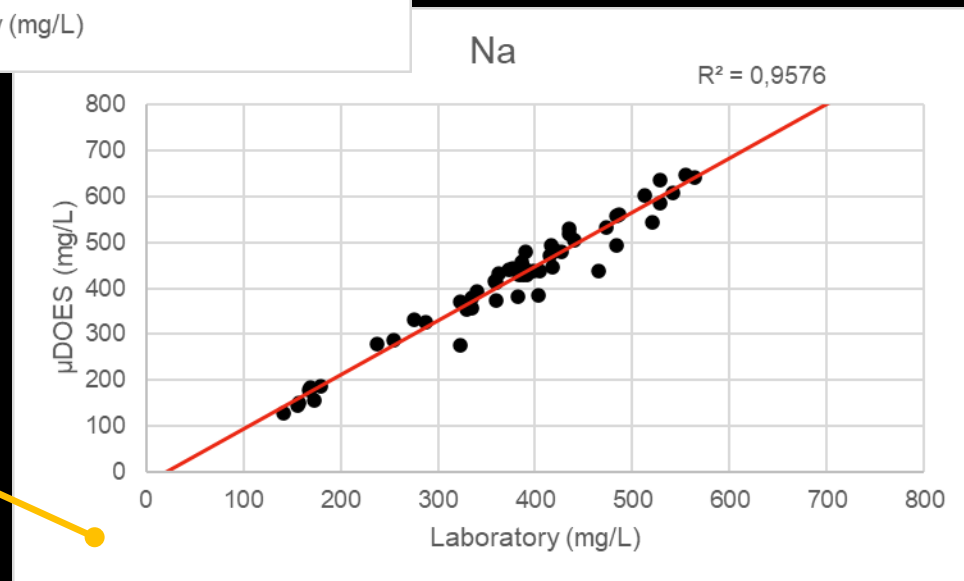


7 min measurement interval
total 46 hours
no internal standard

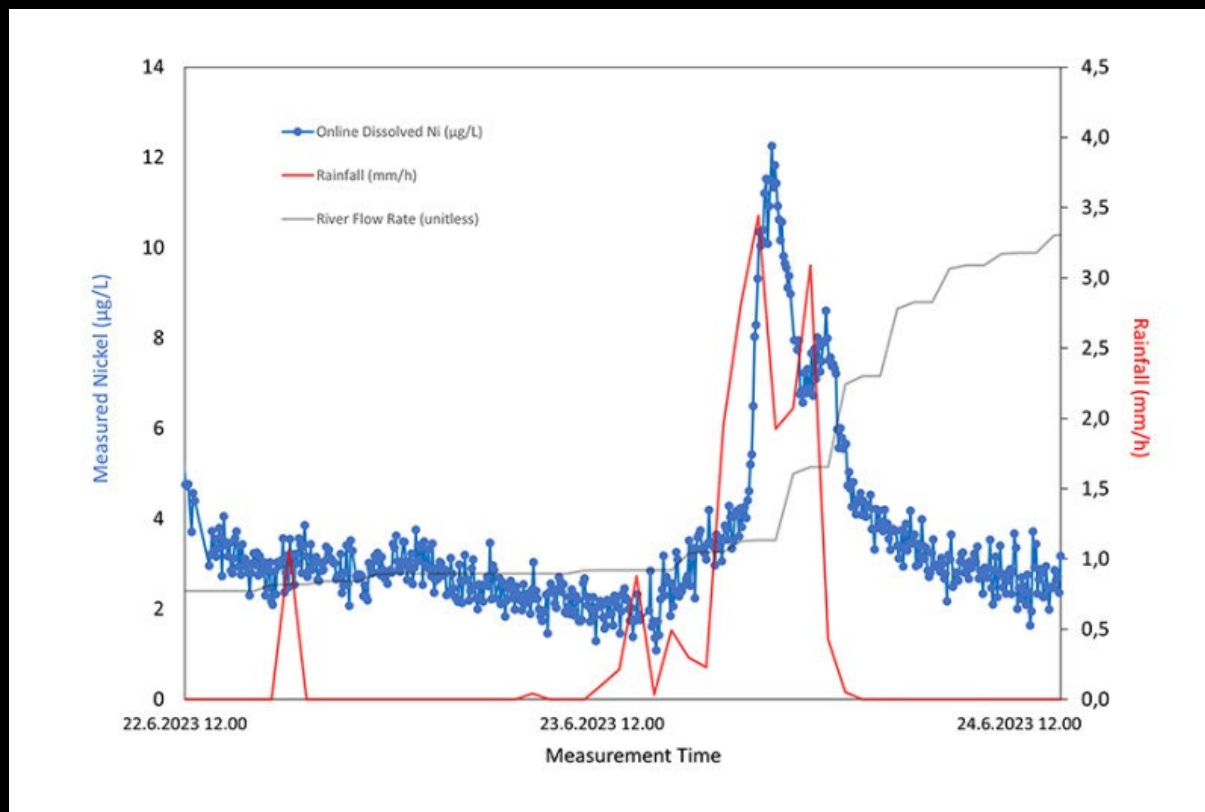
II Lithium Carbonate Precipitation



μDOES® vs. ICP-OES comparison
performed by a customer
using 80 real process samples.



III Environmental River Water Monitoring for Nickel



Full story available at <https://www.envirotech-online.com/news/water-wastewater/9/sensmet-oy>

Thank You



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