



# Collaboration on ML & AI

Bespoken and Vertical Solutions, using Big Data, Advanced Data Analytics, Machine Learning (ML) and Artificial Intelligence (AI), across **Industry 4.0** Value Chains

by **Metallurgy4**

**Athens, July 2021**



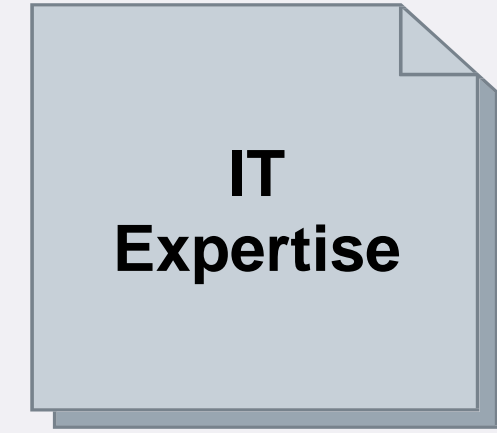
**Confidential**

# Metallurgy4

- **Metallurgy4** ≡ Development of customized products/services to the **Mining and Metallurgy** Sector across the globe, in the field of **Industry 4.0**
- **Domain-Experts** - Expertise of a multidisciplinary team, deeply covering: All aspects of Minerals and Metals Value Chain (e.g. Mining, Mineral Processing, and Metallurgical Processes) + IT/AI + Advanced Analytics/Machine Learning
- Analyzes existing production activities, processes and value chains
- Applies all modern tools of AI: Machine Learning, Predictive Analytics, Process Automation, Digital Twins, Natural Language Processing, Data Mining, Image & Signal Analysis and Classification, Recommendation systems, etc.
- Identifies hot spots and PIP's (Probable Improvement Points) at a daily or strategic time horizon
- Installs **AI & IIoT** environment, offering absolute control of the manufacturing facilities and their performance

# What is Metallurgy4

2 Think-Tanks + 1 Vision  Metallurgy4



# PMI: Prof. Dimitris Panias

- Prof. Panias is the Principal Scientific Advisor on Metallurgical processes of **Metallurgy4**
- 35 years experience in extractive metallurgy, the last 20 years as Professor in Analysis and Design of Metallurgical Processes at the Laboratory of Metallurgy of National Technical University of Athens (NTUA)
- Expertise in aluminium, copper and precious metals extractive metallurgy
- Close cooperation with Greek and European metallurgical industry
- Intensive research work in the field of extractive metallurgy, especially for primary alumina and aluminium production
- Leader of the research group “Technologies for Sustainable Metallurgy - TeSMet” with researchers originating from metallurgical and chemical engineering, as well as geology
- Owner and Inventor of two patents

## PMI: Anastasios Kladis

- Anastasios (Tassos) Kladis has more than 25 years of managerial experience in the Raw Materials Industry
- Consultancy services for Business Development, M&A's, Joint Ventures, Sourcing Analysis and Project Development in Minerals, Metallurgy, Bio-based and Materials Industries
- Consulting mining, biobased and nanomaterials companies, and world-class research institutes at VP and/or CEO level
- Participating in take-offs, capital raising and other funding efforts for junior miners and metallurgists
- Active in trading of raw materials to and from Europe
- Active in five Continents



- Active research and experience in the field of DA & AI
- Awarded International Expertise
- Certified and Highly Qualified Engineers (120+)
- Verified Consistency, Reliability and Quality Results
- Approach Targeted to fulfil Specific Customer Needs
- Innovation, in cooperation with the Customer
- Presence in North America (Canada)

### Some of our customers



### Patents, Awards & certifications



# Our high-level approach to the DA/AI journey



**Modernize:** Make data ready for an AI and hybrid cloud world

# Our steps to the DA/AI journey

## Collect

- Data virtualization
- Provision of SQL and NoSQL DBs
- Event ingestion
- Streaming Analytics

## Organize

- Data transformation
- Data quality and classification
- Policies and Rules
- Data cataloguing
- Flowsheet adjustment

## Analyze & Infuse

- Business reporting
- Data science & visualization
- DA/AI lifecycle automation
- DA/AI apps

## Funding

- EU Programs
- National Programs
- “Market” Funding

Proved experience in Data management, Analytics, ML/AI and app. development



# Operationalizing DA/AI with Trust & Transparency

## Prepare

- Data Profiling
- Quality & Lineage
- Data Governance

Data Ops



**Organize Data for AI**  
Data Engineer

## Build

- Data Exploration
- Data Preparation
- Model Development

Train at Scale



**Build AI**  
Data Scientist

## Run

- Model Management
- Model Deployment
- Model Re-training

ML Ops



**Run AI**  
App Developer

## Manage

- Accuracy
- Fairness & Explainability
- Automated Anomaly & Drift Detection

Trust &  
Explainability

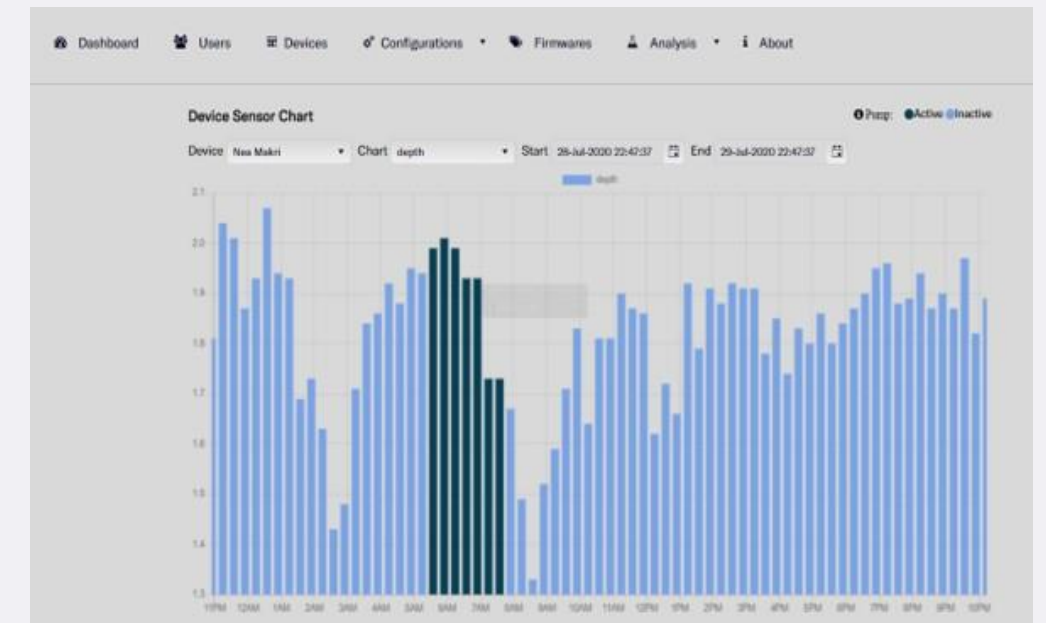
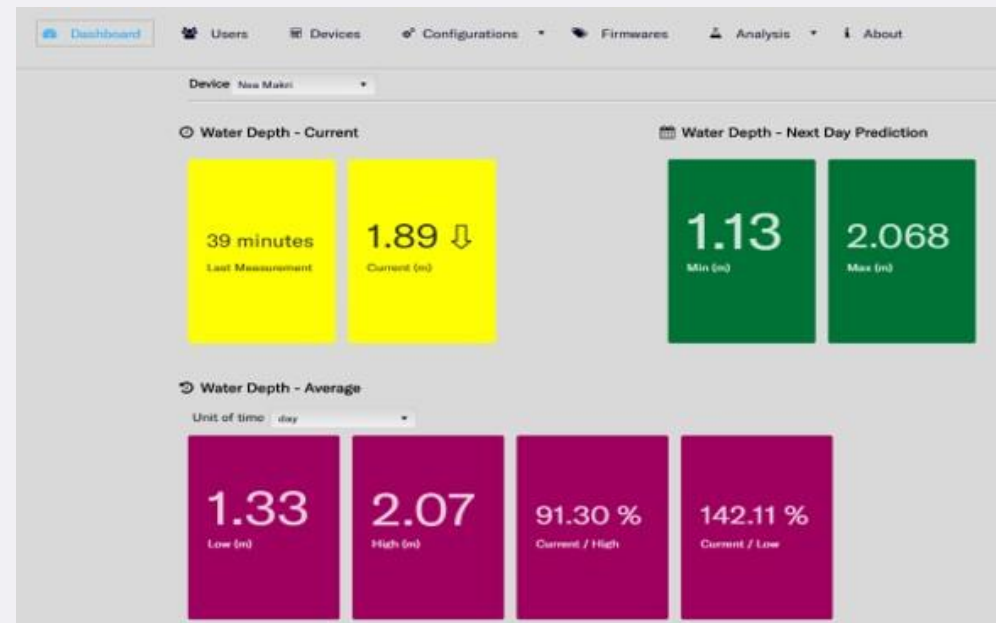
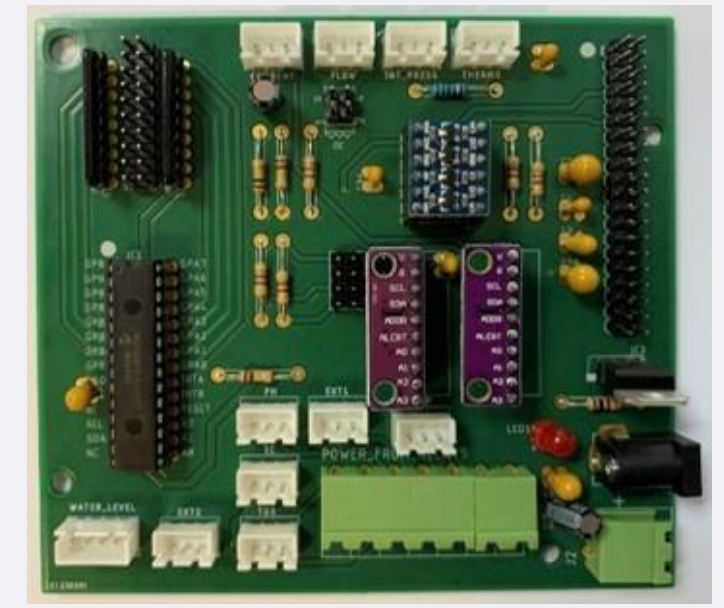
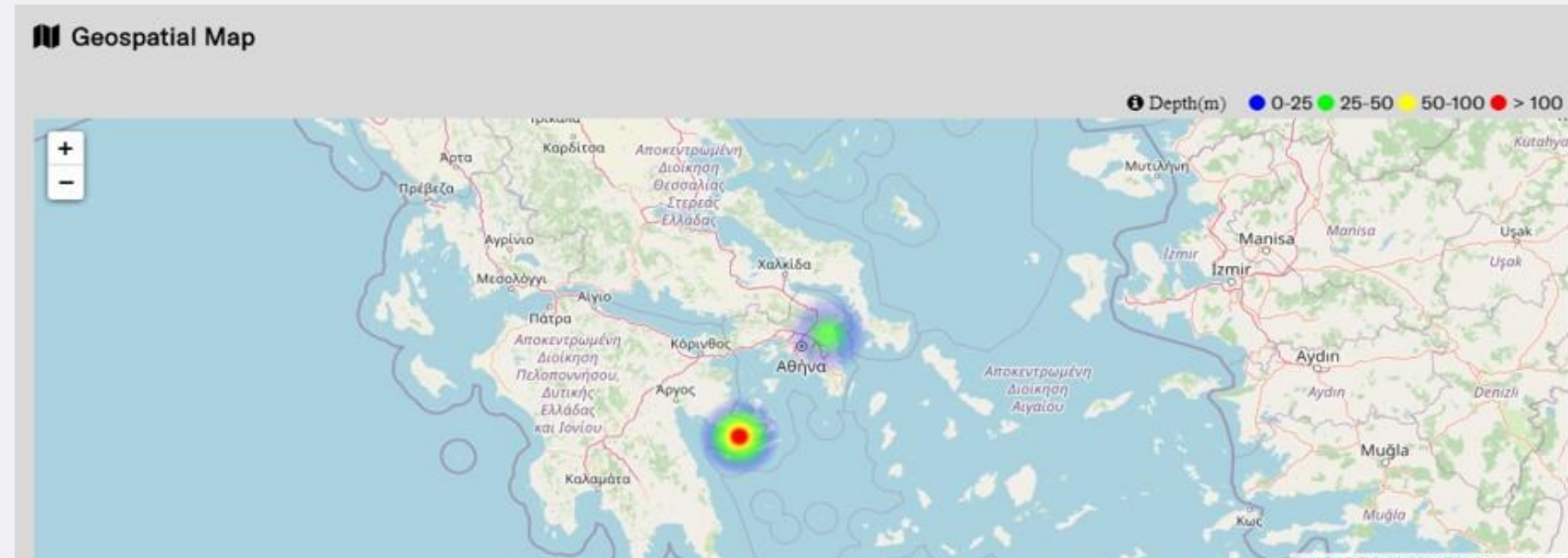
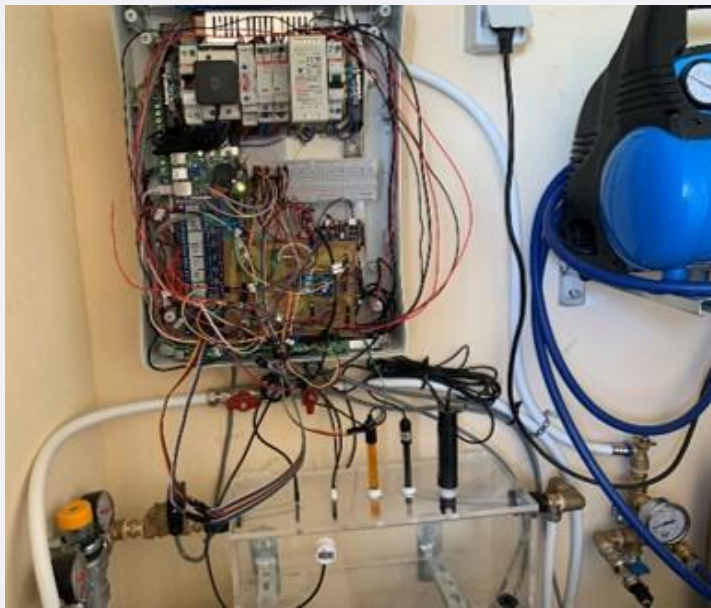


**Consume AI**  
Business User



# Case Study: "Water Underground"

Water Underground = IoT + Cloud + Big Data + Advanced Analytics + ML/AI

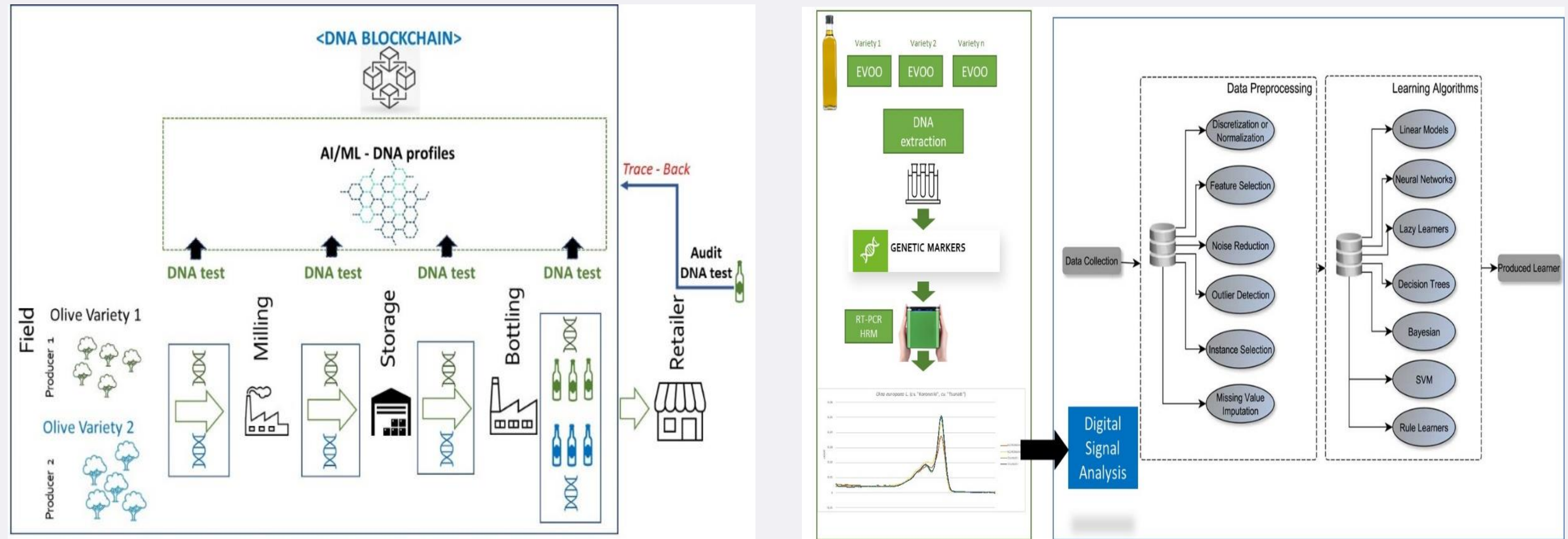


Become for underground water what is meteorological stations, maps and models for weather



# Case Study: "DNAblockchain"

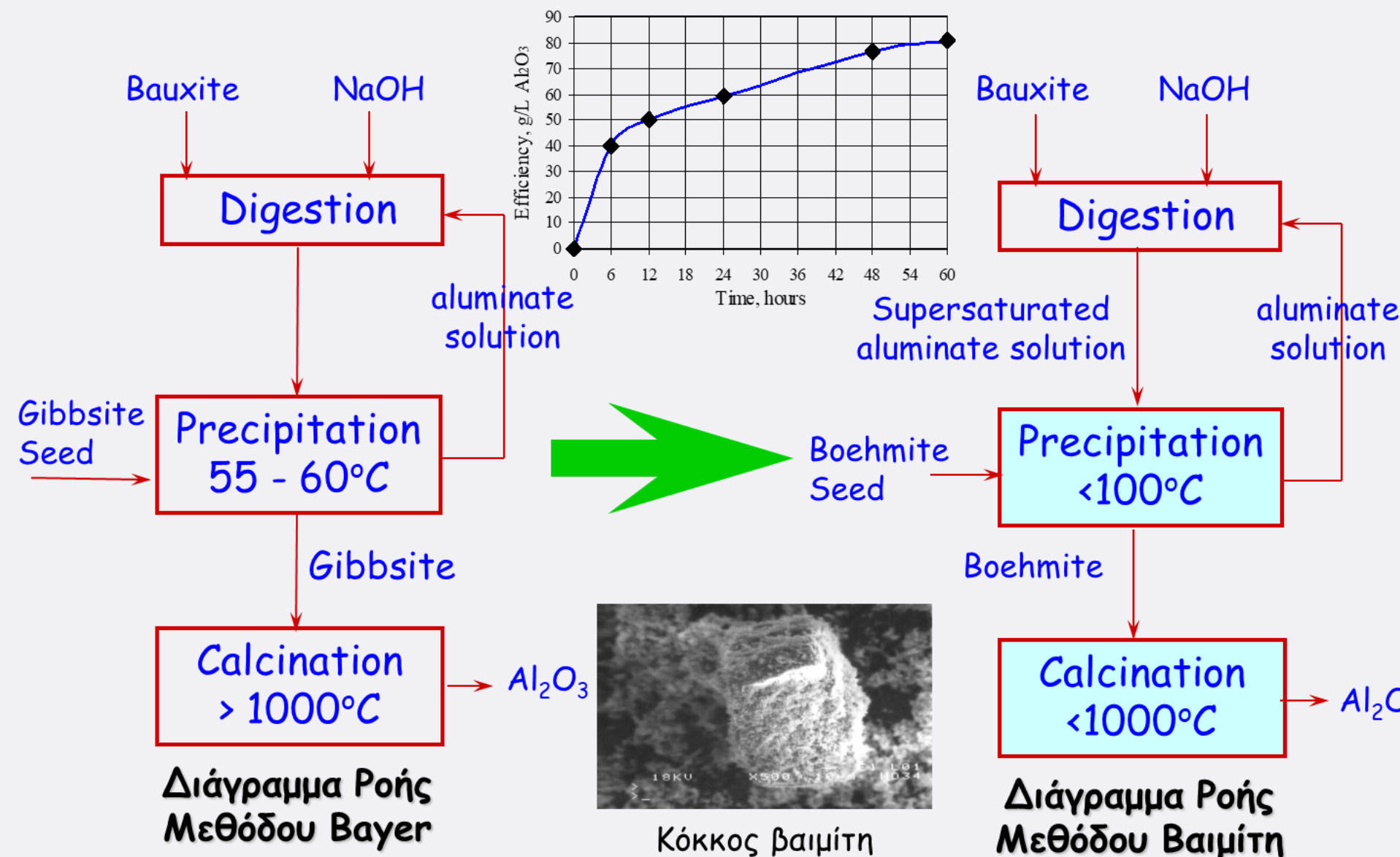
DNAblockchain = DNA HR-PCR + Signal Analysis + DA/AI + Blockchain





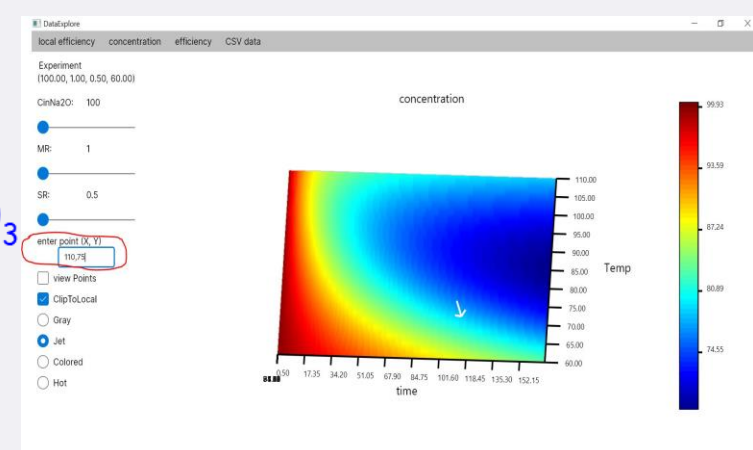
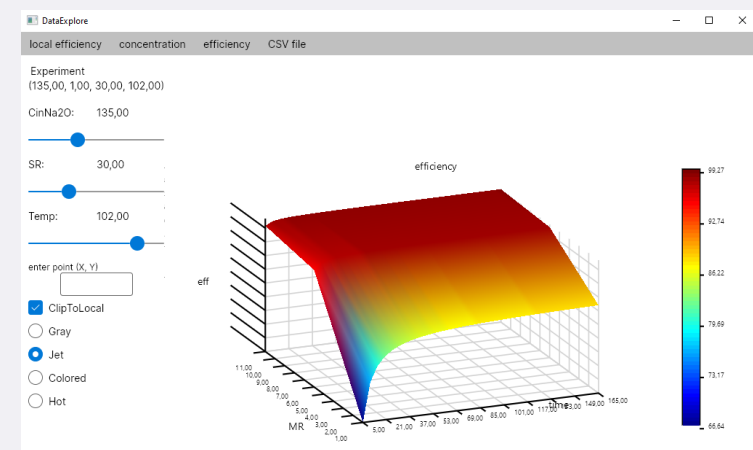
# Case Study: "Al4Al – Boehmite precipitation"

Boehmite precipitation = Energy consumption optimization of Bayer Process

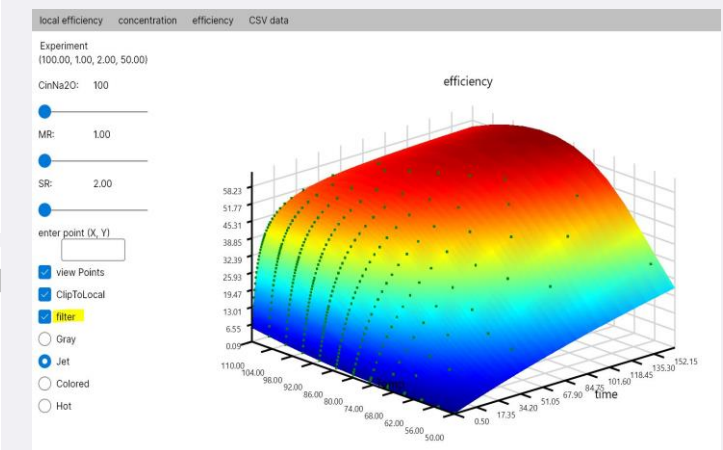


## Analytic Digital Twin

$$\frac{dC_{pr}}{dt} = 2.29 \times 10^{13} (C_{Na_2O})^{-1.8} \times (SR)^{0.54} e^{-\frac{10,750}{T}} (C - C_e^{app})^2$$



## AI Digital Twin



## Advantages

- Analytical model not required (e.g., complex/unknown processes)
- Relies only on observed data
- Fast and responsive (analytical model often time consuming)
- Low resources' consumption
- Graceful to errors/deviations from abstract/ideal processes

Result: Energy consumption reduction by 1.8 GJ/ton Al<sub>2</sub>O<sub>3</sub> – ML process optimization simulation

# Metallurgy4 Advantages

## Minimum “lead time” needed

- Overall, minimization of time required for **customer** team involvement
- “Local voice” from people who understand daily and long-term challenges and priorities of the plant

## Dedication, flexibility and agility

- Confidentiality and, especially, deep understanding of what is confidential, securing **customer** know-how
- Deep understanding of **customer** value chain => Minimizes time to collect, compile and understand data and come up with solutions
- Proven top-notch expertise in EU funded project development

# Metallurgy4

## Possible candidate fields/applications

- Process optimization – Process-based ML
- Production optimization
- Architecture optimization
- Resource(s) – Energy optimization
- Predictive wastes - Decarbonization
- Predictive maintenance
- Predictive Quality Analytics
- Automated Root-Cause-Analysis (RCA)
- Anomaly/fault detection
- IIoT
- Edge computing
- Analytic & AI-based Digital Twins
- Data visualization & Interaction
- Safety (vision)
- Cybersecurity
- Compliance

## Beyond that...

- Develop and/or deploy IIoT solutions, smart sensors etc. to improve monitoring and control
- Incorporate other AI technologies, e.g., Digital Twins, Digital Agents, VR etc. to improve human machine interaction
- Integrate AI technologies to provide a holistic, smart, real-time (remote) view of the plant's operation and efficiency
- Incorporate Machine Vision for manufacturing monitoring and safety compliance
- Supply-chain optimization
- Extend AI platform to other facilities
- Study, propose and prepare Horizon Europe funding

**Thank you for your attention**



**Any questions?**