



# Unlocking the value of AI in the exploration of lithium-rich geothermal fluids

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and the CRM-GEOTHERMAL team



Funded by  
the European Union

# INLECOM INNOVATION (Greece)

- **INNOVATION:**

- Enhancing innovation capacity through digital ecosystems
- Research & Innovation Consultants.
- Strong participation in Research Projects. Bringing innovation to industry.

- **EC RESEARCH PROJECTS**

- Strong R&D Participation (25 running today)
- Active proposal writing/networking
- Technical Roles (see right)
- Coordination (coordinating 3 today)
- Dissemination, exploitation, innovation management

- **RESEARCH & DEVELOPMENT**

## **AI/ML, NLP, Digital Twins and Computer Vision**

- Digital Twin Simulations
- Decision Support Systems
- Predictive modelling
- Semantic and Textual Analysis
- Machine Vision Processing

## **Distributed Ledgers, Smart Contracts and Encryption**

- Material Tracking Solutions (blockchain)
- Smart Contracts for data/material/processes, NFTs
- Data Safety
- Advanced Security Mechanisms and Identity/Trust Management

## **ICT Solution Design, Integration and Proof of Concept**

- ICT Platforms, Edge Processing, Big Data Processing
- Data and System Integration
- Data Fusion
- Smart Visualization and User Interface

# INLECOM INNOVATION

## • APPLICATIONS

- Applied ICT and Internet of Things
- Transport & Logistics
- Food & Circular economy
- Security
- Energy
- Raw Materials
- Green buildings & Smart Cities
- Health
- Manufacturing



## Technology Application per Cluster

### Cluster 1 – Health

- Air Quality Monitoring Networks and ML predictions
- Large-scale Data Modelling and Simulations
- Chemical Process Predictive Models, Analytics, Simulations
- High-Performance Simulations and Efficiency



### Cluster 2 - Culture, creativity and inclusive society

- Predictive Modelling and Heritage Effects Simulations
- Defect Detection and Surface Level Analysis
- Digital Twins Physical Assets Simulations
- 3D Laser Scanning and Modelling at mm Accuracy
- Wireless Sensor Network, Data for Physical Monitoring



### Cluster 3 - Civil Security for Society

- Industrial Data Security, Privacy and Safety
- DLT-based Digital Identity and Trust Management
- Edge computing and Distributed AI
- Natural Language Processing for governments/LEA docum.
- Decision Support, Risk Modelling and Simulations
- Critical Infrastructure Protection
- Predictive Modelling and Cascading Effects Simulations



### Cluster 4 - Digital, Industry and Space

- Digital Tools/Platforms and Complex Supply Chain
- AI/ML Predictive Modelling, Process Analytics
- Computer Vision for Inspection and Maintenance
- Blockchain/DLTs for Raw Material Tracking/Marketplaces
- Edge Platforms and Decentralized Intelligence
- Digital Twins Physical Assets Simulations



### Cluster 5 - Climate, Energy and Mobility

- Digital Tools for Critical Situations Resilience
- AI/ML for Logistics, Planning and Transport Operations
- Digital Twins Network Simulations and Global Sustainability
- AI/ML-based Decision Support, Modelling and Simulations
- Energy System Modelling, Optimization and Planning Tools
- Distributed Ledgers, Digital Communications, Encryption



### Cluster 6 - Food, Bioeconomy, Natural Resources, Agriculture and Environment

- Deep Learning Algorithms for Food Waste reduction
- Predictive Modelling, Analytics and Simulations
- Digital Twins Physical Assets Simulations
- Wireless Sensor Network for Physical Monitoring



# CRM-geothermal: Project facts and challenge

- **The challenge:** Large amounts of Critical Raw Materials (CRM) are needed for the energy and digital transition
- Europe needs a **resilient and domestic CRM supply chain** that reduces imports exposed to market and political risks

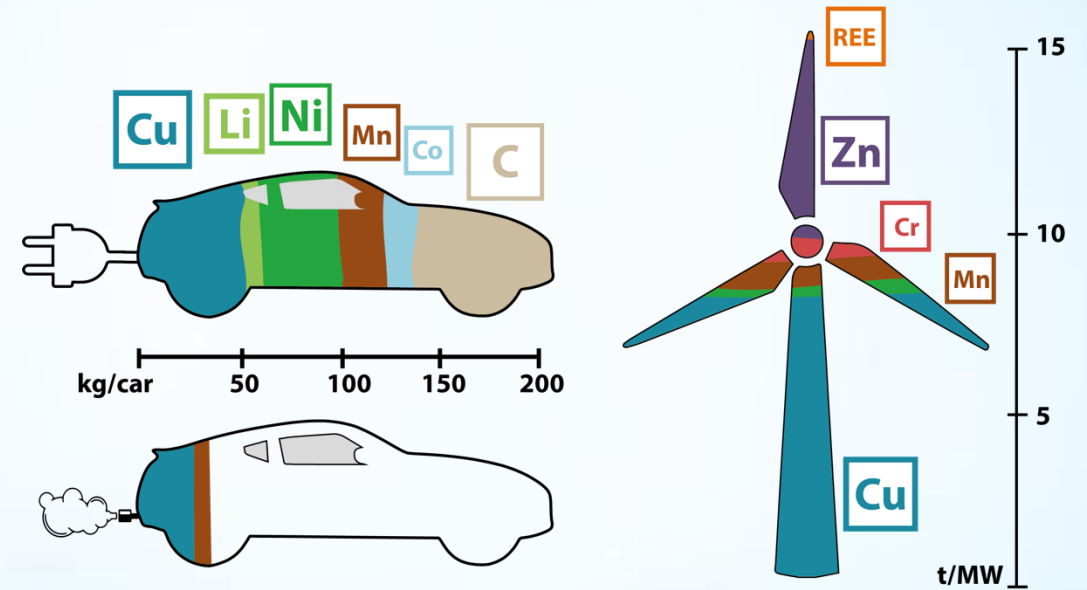
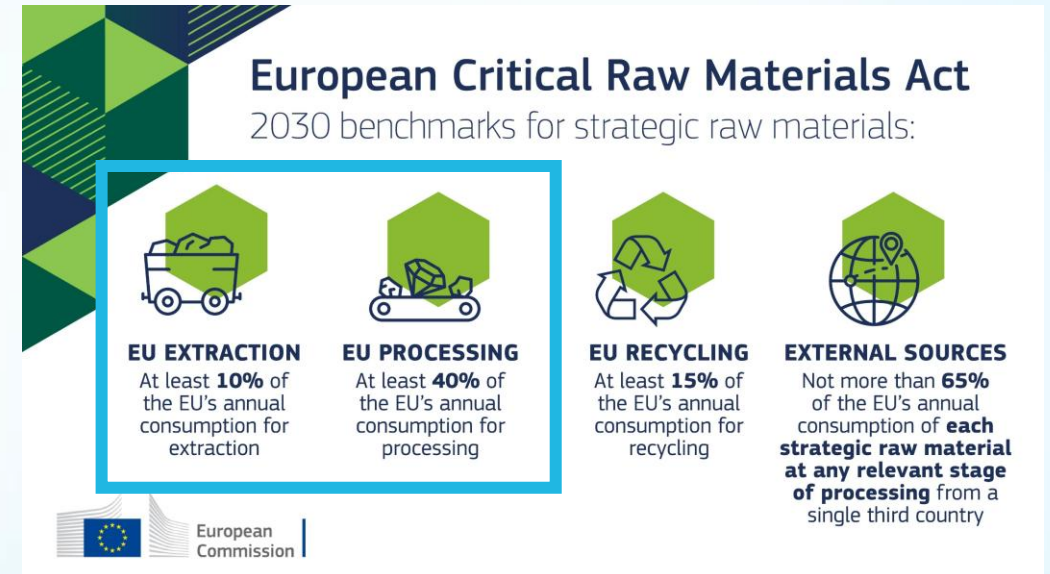


Illustration of the increasing need for critical materials that comes with the transition to renewable energies and the transition to electric cars. Data from <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>. (Source: Ch. Kusebauch, GFZ)

# CRM-geothermal: Project facts and challenge

- **The challenge:** Large amounts of Critical Raw Materials (CRM) are needed for the energy and digital transition
- Europe needs a **resilient and domestic CRM supply chain** that reduces imports exposed to market and political risks
- CRM extraction from geothermal fluids has the potential to **cover a significant percentage of current and future needs of certain CRM** to the EU





# Concept

CRM-geothermal proposes to combine the **extraction of heat/electricity** and the **extraction of valuable elements from geothermal fluids**.

Advantages are:

- ✓ Maximising returns on investment
- ✓ Avoiding additional land use
- ✓ Minimising environmental impact of mining. Make mining invisible!



# Project facts

- **Horizon Europe** call „HORIZON-CL4-2021-RESILIENCE-01-06 - Innovation for responsible EU sourcing of primary raw materials”
- **20 partners**, 19 Affiliated Entities
- 48 month project duration (**May 2022 – April 2026**)





# Activities

- Establishing an **overview of the potential for raw materials** in geothermal fluids
- **Determining the source of selected CRM**, their mobility and potential for sustained extraction from geothermal brines;
- Developing and optimising **innovative extraction technologies** for selected CRM;
- Assessing the **environmental-social-economic viability** and foster ethical sourcing of CRM;
- **Demonstrating at a pilot site** the extraction technology at the scale of a mini-plant and evaluate the system's sustainability



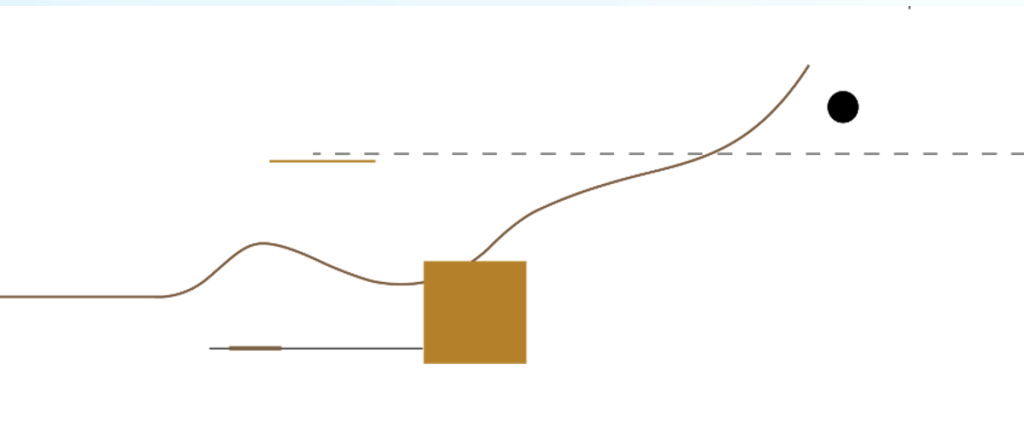


# AI Tool for Lithium Exploration

## Goal

*-plain----->* fuse geothermal and data science to decipher the complex interplay between elemental features, fluid characteristics and Lithium concentrations

*-technically->* develop a tool delivering accurate **estimations** of lithium content that is **interpretable**



# Feature Importance & Interpretability of Tool's Decision Making



# AI Tool for Lithium Exploration

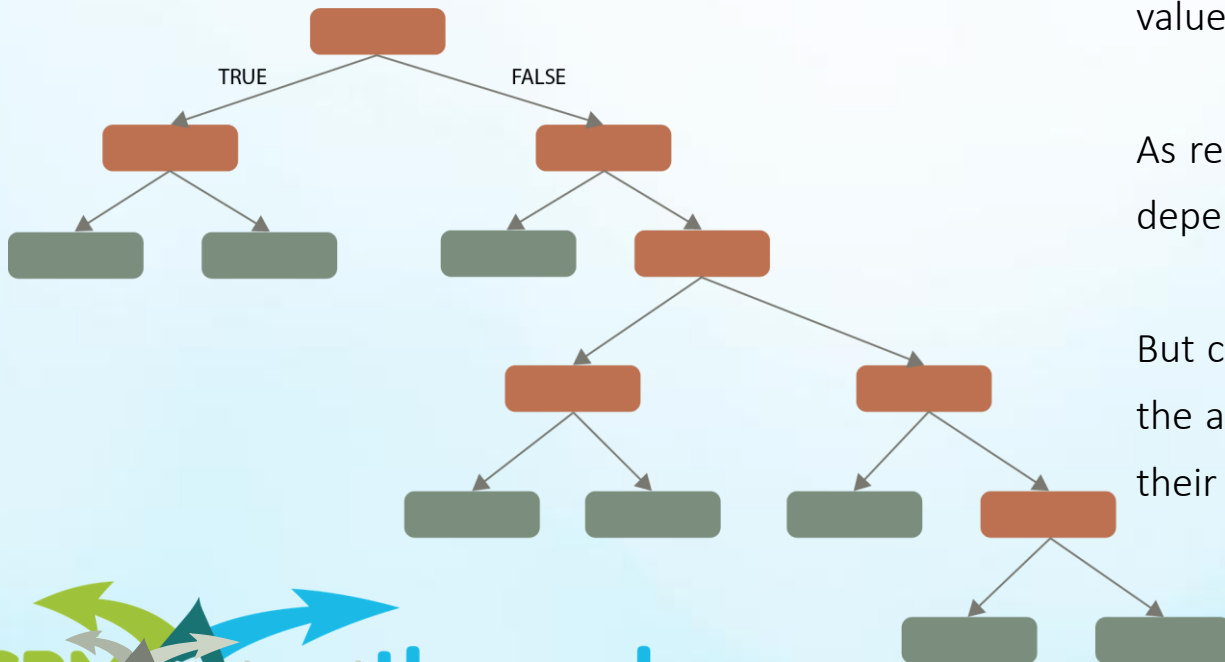
## An ML model with explainable output

The tool uses decision trees: data traverses a series of **nodes**, undergoing splits based on specific features until reaching a final prediction at **terminal nodes** (leaves)

The splitting aims at creating tightly clustered values, i.e two subset of values with lower weighted variance than the original variance

As regression models, decision trees are capable of uncovering non-linear dependencies between the factors influencing Lithium formation.

But compared to other regression models such as NN, decision trees have the advantage of giving you the datapoints based on which they averaged their result



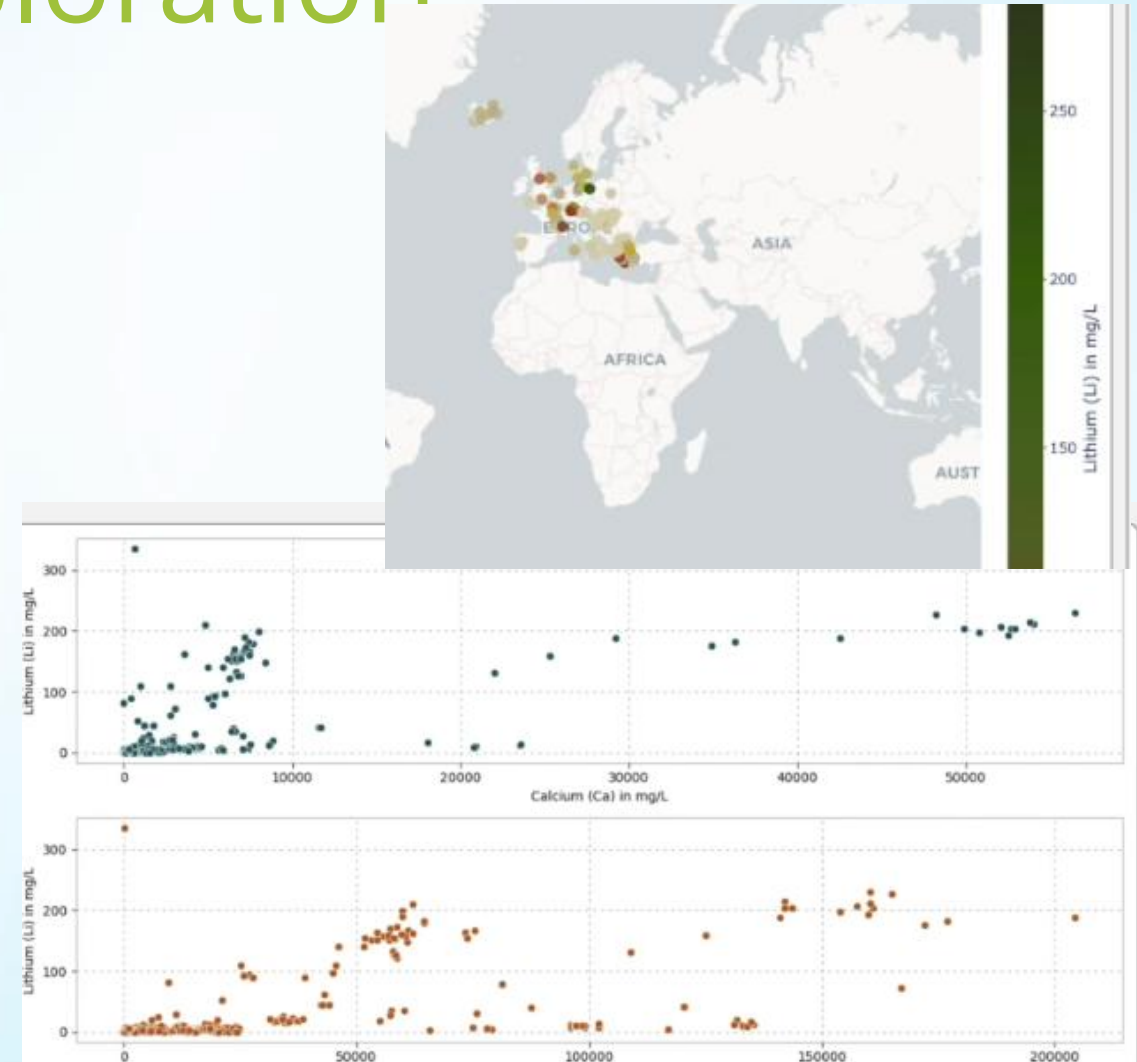


# AI Tool for Lithium Exploration

These are different ways of answering the question of "why we have this prediction?"

→ because the model took the avg of these datapoints [*decision tree*]

→ because each features contributed in this way [*Shapley values*]

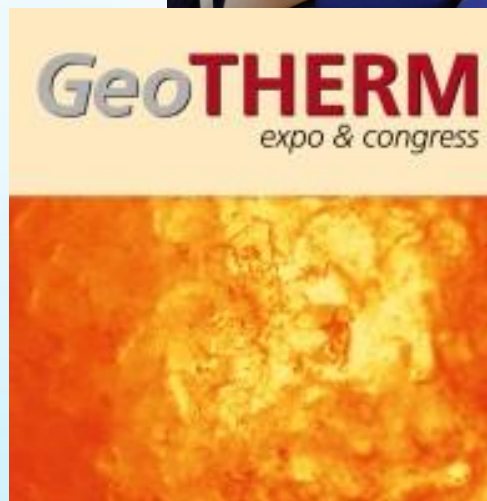


# Save the Date: CRM-geothermal conference

**25 February 2026**, Offenburg, Germany

Half-day event prior to the GeoTHERM 2026

Get insight into **results from CRM-geothermal** and  
**interact with our researchers and innovators**



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Thank you for your attention!

**Check our tool online!**

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