Advancing Integration of Machine Learning for Optimized MOF Production, Enhanced Slurry Formation, and Novel Adsorption based AWH Technology in Geothermal Power Plants

Abstract:

The AI-POTENT project aims to scale MOF production, improve MOF integration, and demonstrate MOF-based atmospheric water generation (AWG) technology using geothermal waste heat. By combining NovNat's MOF technology with AI-driven slurry optimisation, improved condenser design, and enhanced materials, the project will advance the system from TRL 5 to TRL 7. A 200 L/day AWG system will be demonstrated at the Kizildere-II geothermal power plant in Turkey, supporting wider deployment across geothermal facilities in Turkey and the EU.



Countries involved

Application sectors
Water Industry

Research and innovation domains
Advanced manufacturing processes, Smart & adaptative manufacturing systems

Total cost in M€ (millions)
1.38 M€

Starting date
01/05/2026

Duration (in months)
26 months

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RATIONALE OF THE PROJECT

The AI-POTENT project addresses the growing global challenge of water scarcity by advancing metal-organic framework (MOF) technology for sustainable atmospheric water generation (AWG). Although MOFs offer exceptional water adsorption performance, their widespread adoption is limited by high production costs, scalability challenges, and difficulties integrating them into commercial systems. At the same time, many geothermal power plants, particularly in water-stressed regions, rely on less efficient air-cooling because of limited water availability for wet cooling.

AI-POTENT overcomes these barriers by combining scalable green MOF production, AI-assisted slurry optimisation, advanced coating technologies, and improved AWG system design. The project will demonstrate an integrated MOF-based AWG system powered by geothermal waste heat, producing water for cooling while reducing energy use, carbon emissions, and operational costs. By validating the technology at the Kizildere-II geothermal power plant in Turkey, the project will establish a commercially viable pathway for deploying AWG across geothermal facilities in Turkey, Europe, and other water-scarce regions, supporting both water security and the transition to more sustainable energy systems.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

The AI-POTENT project has advanced MOF-based atmospheric water generation (AWG) by developing an integrated solution combining sustainable MOF production, AI-enabled optimisation, advanced coating technologies, and geothermal energy integration. The project addresses key challenges in current AWG systems, including high material costs, limited MOF scalability, inefficient coating processes, and system integration barriers.

Across the project work packages, significant progress has been achieved. NovNat successfully validated the cyclic performance of its MOF technology, optimised material formulations, and produced 120 kg of high-performance NOV-4 MOF. The AWG system has been advanced through modelling, optimisation, manufacturing, assembly, and successful MOF coating integration, resulting in a complete AWH demonstrator.

The project has also developed cost-effective MOF slurry application methods through rheological testing, formulation optimisation, and thickener ratio evaluation. In parallel, hydrophobic condenser coating solutions have been investigated to improve condensation efficiency and durability.

These achievements provide the foundation for scaling the technology towards a 200 L/day AWG demonstrator integrated with geothermal waste heat, enabling reduced energy consumption, improved water productivity, and progression from TRL 5 to TRL 7 for future commercial deployment in water-stressed regions.

MARKET POTENTIAL

AI-POTENT targets the growing Atmospheric Water Generation (AWG), geothermal energy, and MOF markets by addressing the increasing need for sustainable water and energy solutions. The project's MOF-based AWG technology uses low-grade geothermal waste heat to produce water efficiently in water-stressed regions, overcoming the high energy consumption and scalability limitations of current AWG systems. This creates a strong commercial opportunity within geothermal power plants and other industrial sectors requiring sustainable water supply. The consortium provides direct access to the market through NovNat's patented MOF and AWG technologies, Zorlu Enerji's geothermal operations, Betek Boya's coating expertise, and Durit Coatings' advanced surface technologies, ensuring a clear route from technology development to industrial deployment and commercialisation.

IMPACT POTENTIAL

AI-POTENT will demonstrate a scalable, AI-enabled MOF-based AWG system integrated with geothermal power plants, increasing technology readiness from TRL 5 to TRL 7. The project is expected to reduce water scarcity constraints for geothermal operators, improve plant efficiency, lower CO emissions, and enable sustainable use of waste heat. By advancing green MOF manufacturing, smart slurry formulation, and PFAS-free hydrophobic coatings, the project strengthens Europe's leadership in sustainable manufacturing and clean technologies. Its results will support commercialisation of next-generation water generation systems and create opportunities across energy, water, and industrial sectors.

