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PROJECT NEWSLETTER

Development of an innovative low-cost and highly efficient Energy Storage system
Grant Agreement n° ENTERPRISES/ENERGY/1123/0027

Contents

DIAS Project

The DIAS project is developing an innovative Thermal Energy Storage (TES) system using geopolymer materials derived from Construction and Demolition Waste (CDW) such as clay bricks and ceramic tiles.

These geopolymer-based materials are optimized for high thermal stability, withstanding temperatures up to 700 °C. The TES units are modular in design and can be produced via casting or 3D printing, enabling scalable and cost-effective manufacturing. This system stores excess thermal energy and releases it when needed, enhancing energy efficiency and supporting grid flexibility.

The DIAS Project is developing a sustainable, high-temperature Thermal Energy Storage (TES) system using recycled construction waste like bricks and tiles. By turning waste into energy storage materials, the project supports renewable energy use, promotes the circular economy, and helps balance the energy grid more efficiently. DIAS project is progressing steadily and according to plan.

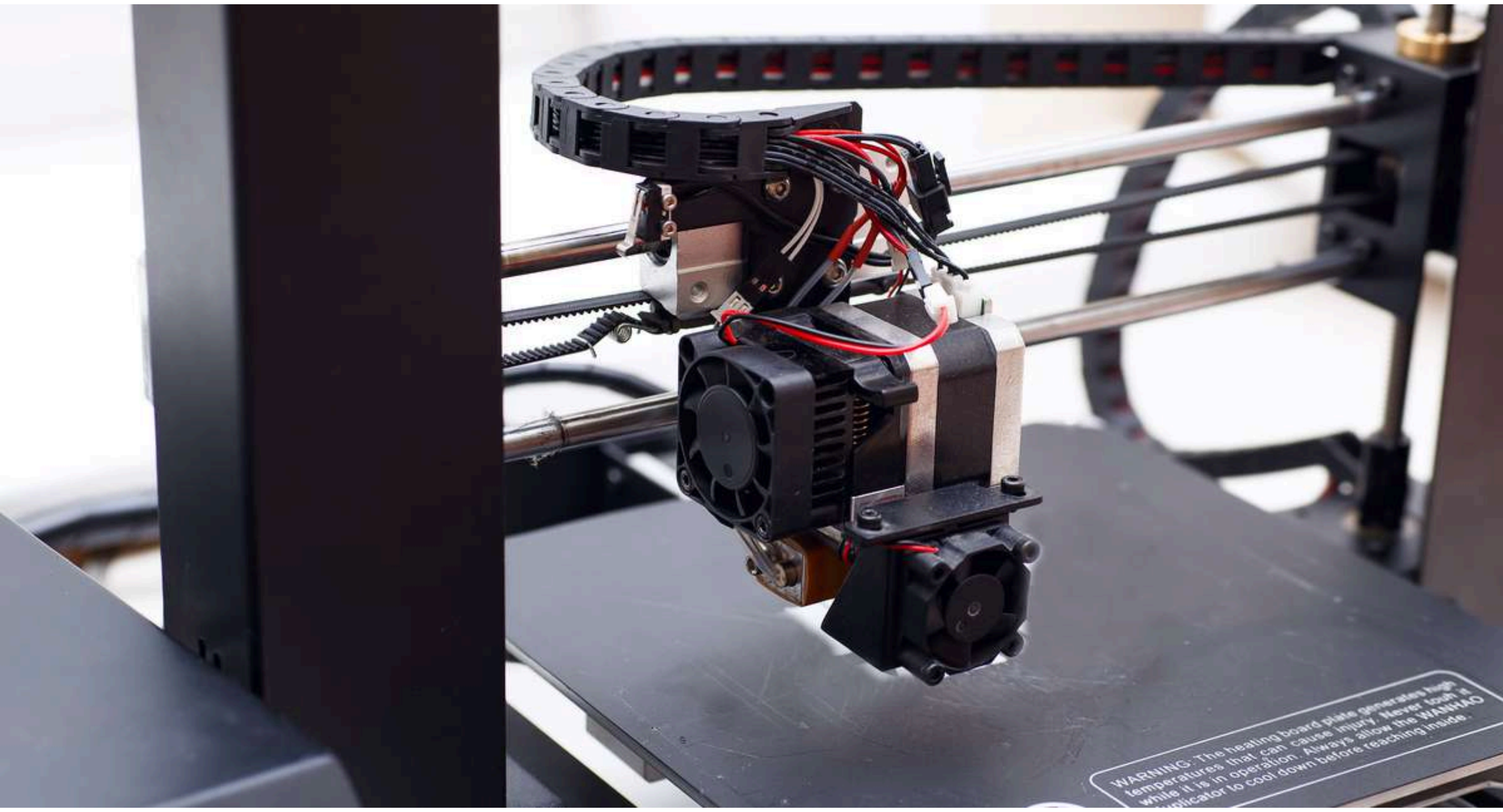
Over the past months, significant milestones have been achieved across all technical and scientific work packages. From material optimization and TES module design and dissemination activities. The consortium is working collaboratively to bring the vision of a sustainable, efficient, and scalable TES system to life.

Progress Update: Geopolymer Materials Ready for TES Production

The DIAS project has reached a major milestone with the successful selection and optimization of two innovative geopolymer materials for use in its TES system. These materials are made using recycled waste bricks, offering a sustainable and cost-effective alternative to traditional storage media. Two geopolymer compositions were developed, one activated with sodium and the other with potassium. After extensive testing, both materials demonstrated excellent performance at high temperatures, making them ideal candidates for storing and releasing thermal energy.

TES Unit Production Begins: Casting & 3D Printing

To bring these materials into real-world applications, the project has designed and launched two production processes for building the TES system: direct casting and 3D printing.



Casting Method

This traditional manufacturing process was used to produce modular, prismatic storage units with a total volume of 1 cubic meter. The method includes controlled mixing, molding, curing, and quality assurance steps. Energy and material balances were calculated to ensure the process is scalable and efficient for future deployment.

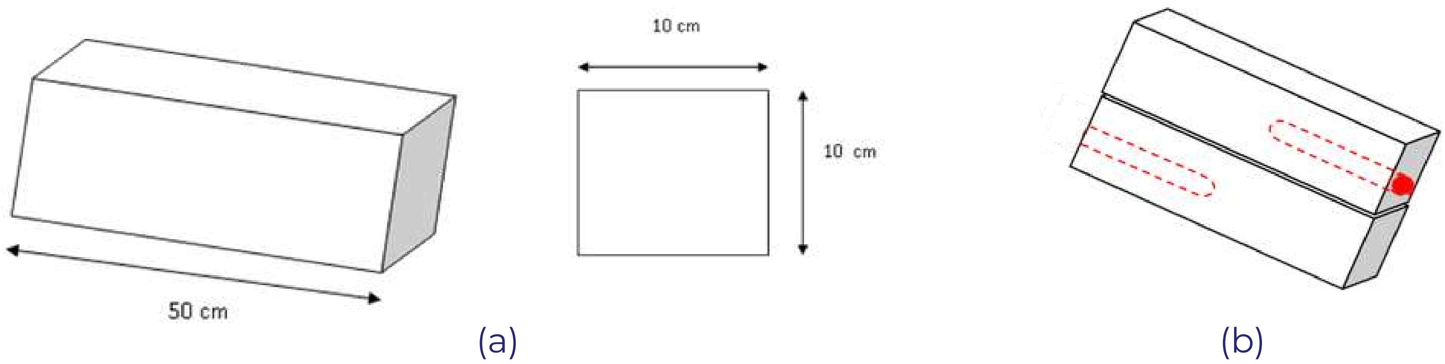


Figure1. (a) basic TES unit and (b) arrangement of TES units for lab-scale testing and evaluation

3D Printing Method

As an innovative alternative, 3D printing has also been applied to manufacture TES components. Using advanced CAD modeling and digital toolpath planning, geopolymer pastes were successfully printed into customized shapes. Key printing parameters—such as nozzle size, layer height, and paste flow—were fine-tuned to achieve strong, thermally stable components. The 3D-printed designs offer significant advantages in flexibility, modularity, and ease of integration into different systems.

Life Cycle Assessment (LCA)

An initial Life Cycle Assessment LCAhas been launched to evaluate the environmental impact of the newly developed TES materials. In this phase, the project team identified relevant datasets and methodological tools to compare the geopolymer-based TES to traditional cement-based systems and other sensible heat storage materials. Using reputable databases such as ecoinvent, the assessment focuses on key sustainability indicators like carbon footprint, energy consumption, and resource use. This early analysis confirms the potential of the DIAS materials to offer a significantly lower environmental impact, supporting both climate goals and the principles of the circular economy.

Consortium

DIAS consortium consists of two partners from Cyprus - the development organisation of RTD Talos and FREDERICK RESEARCH CENTER (FRC).

About FRC

FRC engages highly qualified research staff with long experience in implementing independent and high caliber research and a large number of publications record in peer-reviewed scientific journals. Through its participation in national and European R&I projects (about 130 externally funded national and EU projects and approx. €12 million in funding) FRC enables the transfer of knowledge and knowhow from academia/research community to enterprises, and at the same time, it gains new knowledge that is used to strengthen its research and innovation activities. FRC involvement in research projects is located in the areas of Applied Sciences and Engineering, Environment, Education, Management & Economics and Social Sciences. To facilitate that, FRC has contemporary facilities and access to Frederick University's infrastructure, equipment and software tools, through a specific collaboration agreement. The laboratory is equipped with a variety of special machines suitable for the testing of materials' properties (i.e. physical, thermal and mechanical properties and durability) and manufacturing of ceramics and cement-based materials. In addition, FRC has recently established in its labs a 3D printer suitable for printing ceramic and cement-based materials.

Interview with Dr Demetris Nicolaides

FREDERICK RESEARCH CENTER

Dr Demetris Nicolaides (FRC) holds Diploma in Civil Engineering from the National Technical University of Athens (NTUA), as well as MSc in Structural Engineering from the Cardiff University, UK. From the same school he received his PhD in Civil Engineering in 2004, in the research area of fracture and fatigue of Ultra High-Performance Fiber Reinforced Cementitious Composites (UHPFRCCs). He is currently an Associate Professor of Civil Engineering at Frederick University in Cyprus. Dr Nicolaides' research focuses on (1) Geopolymer concretes with particular interest in the valorisation of solid wastes to produce innovative, sustainable and smart inorganic polymer / geopolymer building materials. (2) Concrete technology with particular interest in (a) use of construction and demolition wastes as aggregates in concrete and (b) cement replacement materials. (3) Safety of structures with particular interest in: (a) protection against fire, blast and impact and (b) retrofitting techniques of structures. He has coordinated and/or been involved in several European projects related to the above topics.

Dr Demetris Nicolaides

FREDERICK RESEARCH CENTER

What are the major challenges in Renewable Energy Storage Systems?

One of the biggest challenges is the mismatch between renewable energy generation and energy demand. In sunny regions like Cyprus, we often produce more energy than we can use or store—particularly during peak sunlight hours. Without efficient storage, that surplus energy is wasted. Moreover, current technologies like OPC-based concrete in TES (Thermal Energy Storage) systems can't handle the high temperatures needed for concentrated solar power (CSP) applications, often degrading at temperatures above 400°C. This limits their effectiveness and longevity. Finally, scalability and cost-efficiency remain major hurdles, especially for smaller enterprises that can't afford complex systems.

What is the Value Proposition of the DIAS project to overcome current challenges?

The DIAS project proposes a breakthrough in both material science and energy storage design. We're developing high-performance, low-cost TES materials derived from locally sourced construction and demolition waste (CDW), which aligns with circular economy principles. By converting this waste into alkali-activated geopolymers, we not only reduce environmental impact but also create a material that can withstand temperatures up to 700°C—a major leap from current options. Furthermore, we're designing a modular and scalable TES system, adaptable for both large and small-scale applications, making it commercially viable for a wide range of industries.

How will DIAS technology revolutionize the TES industry?

DIAS is setting a new benchmark. We're not just offering a new material—we're proposing a fully engineered, pilot-tested TES system. The integration of 3D printing technology allows for tailored designs and improved system efficiency. Our TES modules are designed to operate efficiently in CSP plants and other high-temperature applications, while also being adaptable to grid infrastructure. This combination of cutting-edge material, flexible design, and sustainable sourcing is something the TES industry hasn't seen before. It could transform how industries manage thermal energy, from breweries to hospitals.

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Why is it important and urgent to come up with new materials for TES systems?

The urgency comes from two fronts. First, climate change: we must transition rapidly to renewable energy, but without efficient storage, that transition is limited. Second, resource sustainability: existing materials are either too costly, not environmentally friendly, or unsuitable for high temperatures. Our novel geopolymers meet all the critical requirements—thermal resistance, mechanical stability, and low environmental footprint. By using recycled CDW, we also tackle waste management. It's a win-win approach that meets both energy and environmental needs.

What are the next steps of the DIAS project?

We are currently progressing from lab validation to pilot-scale demonstration. This includes scaling up the TES modules, testing under real industrial conditions, and fine-tuning the techno-economic model. We're also preparing a comprehensive business and commercialization plan, targeting industrial sectors in Cyprus and beyond. The final prototype will demonstrate daily operation in actual working environments, paving the way for commercial adoption and eventual market deployment. Notably, some of these activities will either implemented or continue beyond the official conclusion of the project, underscoring the consortium's commitment to this innovative and socially beneficial solution.

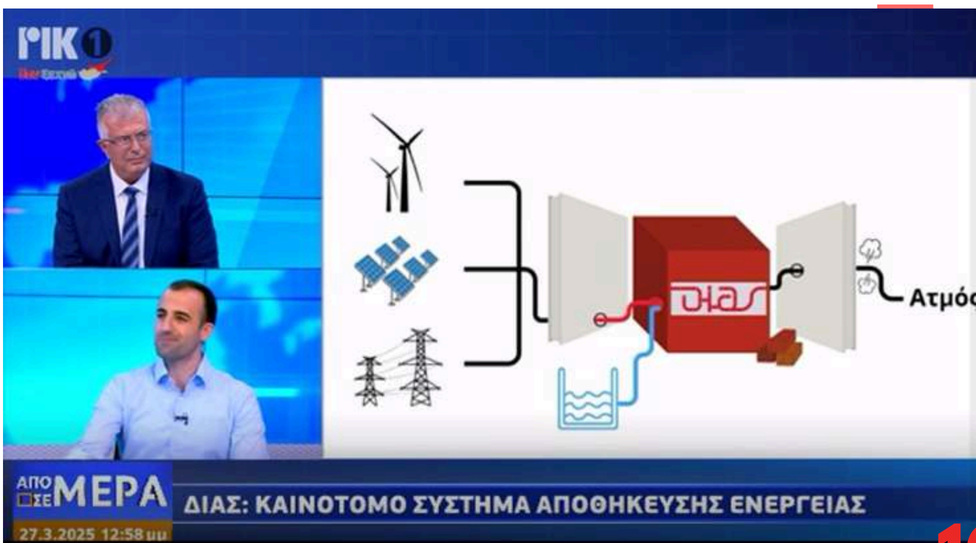
News & Activities

2nd Consortium meeting

The DIAS consortium held its first progress meeting in January 2025 to review achievements and plan next steps. Discussions focused on material development, system design, prototype preparation, and sustainability evaluation. The team also advanced dissemination activities and initiated Life Cycle Assessment efforts.

DIAS live on RIK1 TV show

On March 27th Loizos Georgiou of RTD Talos presented our DIAS project live on RIK1 TV show, "Απο μέρα σε μέρα"!



Find Out More

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DIAS Project

www.talos-rtd.com/dias-project/#

ΤΑΛΩΣ

FREDERICK RESEARCH CENTER

Designed by RTD Talos

Funded by the European Union NextGenerationEU

Republic of Cyprus

Cyprus tomorrow RECOVERY AND RESILIENCE PLAN

RESEARCH & INNOVATION FOUNDATION

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