



**EKETA**

ΕΘΝΙΚΟ ΚΕΝΤΡΟ  
ΕΡΕΥΝΑΣ & ΤΕΧΝΟΛΟΓΙΚΗΣ  
ΑΝΑΠΤΥΞΗΣ

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**RESEARCH-TECHNOLOGY - INNOVATION  
FOR SUSTAINABLE GROWTH**

**Breaking ground** in Li-ion batteries

Cutting-edge technology about Li-ion batteries surviving cold environments enables future space missions and beats the "cold start" problem

# Newsletter CERTH in English

## Opinions—Dr. Petros Daras



In this column, researchers from CERTH express their opinion regarding the research environment in Greece, make suggestions, express ideas and raise concerns about critical research issues in the country. In this issue, Dr. Maria Panou, researcher at the Hellenic Institute of Transport (HIT/CERTH), is the one who is providing valuable food for thought.

Below, some of the most important points of his utterances:

- Basic and applied research are not sufficiently supported.
- More partnerships with European and American organizations and universities are needed
- The lack of entrepreneurial culture on the researchers' side, the lack of targeted state funding so that the research results become products and the cooperation gap between research centers and the industrial world - these are Greece's main weaknesses.
- Greece should follow the best practices of European calls. There should be direct cooperation between major state organizations and research centers for the provision of services and solutions. Licensing of research centers to grant postgraduate degrees and PhD titles.
- Interdisciplinary research is essential for greater progress, GSRT should give special attention to that.

## Breaking ground in Li-ion batteries

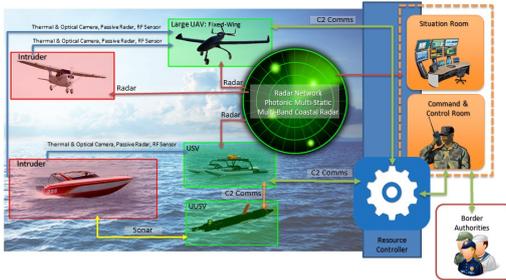


PSDI Laboratory of CPERI/CERTH innovates together with Democritus University of Thrace (DUTH) for lightweight, Li-ion batteries surviving cold environments. The partnership succeeded under previous European Space Agency (ESA) funded Technology Research Programme (TRP) project, in breaking the low temperature barrier for Li-ion cells and delivered a battery that can survive and operate normally at  $-40^{\circ}\text{C}$ , an achievement that led to a joint patent submission with ESA. Now, the core team of CERTH and DUTH has joined forces with Airbus Defence & Space and CIDETEC and on March 1st, 2017 a new contract was signed with ESA. The

aim is to increase the technology readiness lever (TRL), meaning to deliver lightweight, freeze tolerant, pre-commercial pouch cells, a technology enabling future space missions of increased functional payload weight and thus capabilities.

## Digital technologies for secure societies in Europe

One of the main priorities of Europe is the safety of the European citizens both from natural (floods, earthquakes) and human made disasters and threats (crime, terrorism).



As CERTH's researcher Stefanos Vrochidis mentions "In order to deal with these threats in Europe, it is important to develop innovative technologies that will ensure the rights and the freedom of European citizens and at the same time they will increase the competitiveness of the European Industry.

In this context, the Multimedia Knowledge and Social Media Analytics Lab of ITI-CERTH exhibits research and develops technologies to fight terrorism and crime focusing on web and social media analytics,

for crisis management by developing decision support systems, as well as for border monitoring using video analysis technologies. More specifically, CERTH's researcher Ioannis Kompatsiaris mentions that MKLab develops technologies for data mining in surface and dark web and social media in order to identify topics and communities, as well as tools for video and image analysis to detect specific activities. MKLab also develops techniques for semantic fusion of heterogeneous content in order to provide unified access and advanced decision support services based on visual analytics.

MKLab participates in three new European projects (innovation actions): a) TENSOR (<http://tensor-project.eu/>) (2016-2018), which deals with terrorist activity detection in the web; b) BeAware (<http://www.iti.gr/iti/projects/beAWARE.html>) (2017-2019), as coordinator, dealing with the development of a decision support tool for crisis management in climate disasters; and c) ROBORDER (expected starting date May 2017) (2017-2020), which will develop a autonomous border surveillance system with unmanned mobile robots including aerial, water surface, underwater and ground vehicles.

## High efficiency and energy saving in heterogeneous cloud computing infrastructures

**CloudLightning** project brings together eight partners from five countries across Europe in order to effectively address the issue of resource management in cloud computing infrastructures, aiming to reduce energy consumption and costs, mainly in large-scale infrastructures.

Cloud computing infrastructures mainly consist of computing resources of the same type that are managed centrally and made available to the final consumer in one of three forms: Infrastructure-as-a-service: IaaS, Platform-as-a-service: PaaS and Software-as-a-service: SaaS.

The increasing use of cloud computing by small and medium enterprises, has led to the increase of existing cloud services in size and level of complexity. More often, different hardware architectures are added to the infrastructure, such as graphics processing units, many integrated cores and data flow engines, leading to the creation of heterogeneous computing clouds.

In order to manage the complexity of such infrastructures, the **CloudLightning** project proposes a new way of provisioning heterogeneous cloud resources, using self-organization and self-management techniques. This solution will be applied in the fields of genomics, as well as in the oil and gas industry and in ray tracing applications.

The coordinator of the project, Prof. John P. Morrison from University College Cork (UCC) of Ireland points out: "Current cloud resource managers are predominantly centralized and, as such, they have difficulty in identifying optimum resources as the scale of a system increases.

In fact, there is evidence to suggest that resource managers can sometimes be making decisions based on telemetry information that can be in excess of 15 minutes old. As the scale of a system increases, this situation will deteriorate further.

The CloudLightning approach, recognizes this limitation and addresses it by decentralizing resource management decisions in effect creating a number of resource managers, each managing fewer, local, resources. These resources managers communicate with others in their vicinity and self-organize to share the management burden according to some predefined strategies. In this way, better and faster resource management decisions are being made and optimized across the entire cloud infrastructure.”

The project is in its third year and many tools and software components have been built. These components are currently being integrated and deployed on a small-scale test-bed. “Results from executions on this test-bed will then be used to inform a large-scale simulation, thus rooting it in reality. The results of the large-scale simulation are expected to show improved power consumption, improved service delivery and better resource utilization.” as Prof. John P. Morrison (UCC) mentions.

The Information Technologies Institute of CERTH is responsible for evaluating through simulation the performance of the self-organization and self-management techniques in large-scale cloud computing infrastructures and conclude if they achieve better management of resources and reduction of energy consumption and costs.

Dr. Konstantinos Giannoutakis, researcher of ITI/CERTH states that up to this moment “The simulation models and engine have been developed, while next steps include the verification and validation of them, using experimentation data from the project testbed.”

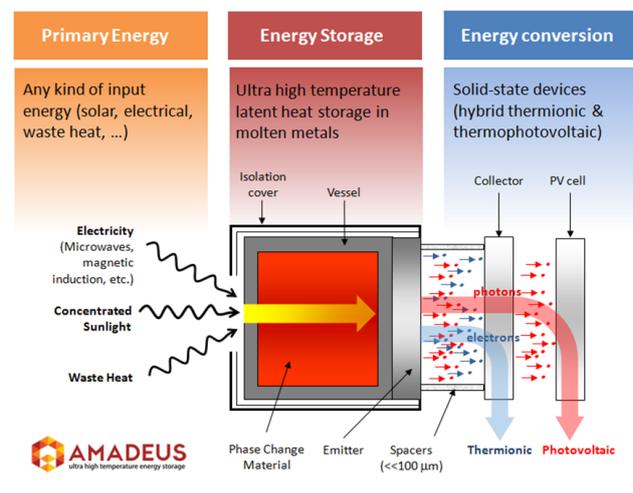
<http://cloudlightning.eu/>

<https://www.iti.gr/iti/projects/CloudLightning.html>

## Breaking the operating temperature limit of 600°C

AMADEUS Project (Next generation Materials and Solid State Devices for Ultra High Temperature Energy Storage and Conversion) pursues the development of a new generation of ultra-compact latent heat energy storage devices operating at temperatures in the range of 1000-2000 °C. The state-of-the-art energy storage devices can hardly break the operating temperature limit of 600°C. Thus, with the proposed technology we can potentially achieve energy storage densities of an order of magnitude greater than the current ones. The operation of the proposed technology is based on Phase Change Materials (PCMs). In the

frame of this project new PCMs will be synthesized, which are Silicon-Boron (SiB) alloys with latent heat in the range of 2-4 MJ/kg (an order of magnitude greater than that of typical salt-based PCMs). Such materials will be stored in a proper casing, which will be thermally insulated in order to minimize thermal losses. This vessel in its one side is connected with a new kind of hybrid thermionic-photovoltaic (TIPV cell) device that has been recently formulated theoretically. The TIPV cell takes advantage of the **thermionic phenomenon** and can convert the thermal energy into electric energy, in conjunction with the conversion of the emitted radiation in the solar cell into electricity. With the thermionic phenomenon the thermal efficiency of the cell **can theoretically surpass the maximum thermal efficiency specified by Carnot theorem.**



The developed system can be used in concentrated solar power (CSP) units, for the exploitation of solar radiation in space applications, for storing energy in dwelling or district level and to assist the electrical grid in terms of stability and flexibility.

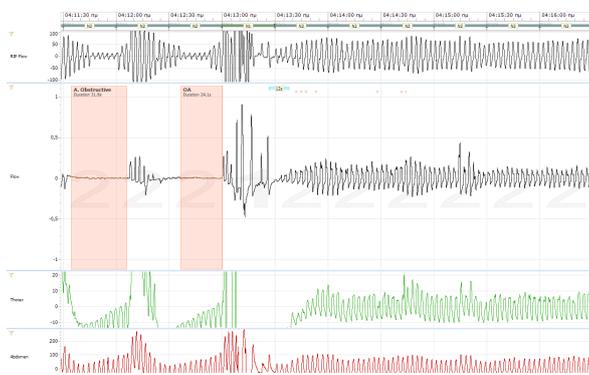
The consortium consists of seven (7) organisations from six (6) different countries. Among these partners, 3 universities (UPM, USTUTT and NTNU), 3 R&D centres (CERTH, CNR and FRI) and 1 SME (IONVAC) are included. The Coordinator of the Project, which started in January 2017, is the Technical University of Madrid (UPM-Universidad Politécnica de Madrid, Spain). The research team on behalf of **CERTH/CPERI**, under the supervision of the Senior Researcher Dr. Nikolaos Nikolopoulos, is constituted by Dr. Aristeidis Nikolopoulos, Dr. Dimitrios Rakopoulos, PhD candidate Myrto Zeneli, PhD candidate Ilias Malgarinos and PhD candidate Panagiotis Drosatos, and will focus on the three-dimensional (3D) simulation of the whole system. At first Computational Fluid Dynamics Tools (CFD) on the basis of ANSYS Fluent commercial program will be implemented. As a further step, a stress-strain analysis of the vessel will be carried out by means on the Finite Element Analysis (FEA) tools, **in order to identify the optimum geometrical configuration that minimizes the mechanical stress in the container** due to continuous expansions-contraction of PCMs (Phase Change Material) during solidification-melting.

AMADEUS project is a FET-Open (Future and Emerging Technologies) Project funded by the European Commission. It should be underlined that the success rate in such a highly competitive call is approximately 4.5%.

For further information, you may contact the Project scientific responsible on behalf of CERTH/CPERI, Dr. Nikolaos Nikolopoulos: [n.nikolopoulos@certh.gr](mailto:n.nikolopoulos@certh.gr)

Or visit the project at: <http://www.amadeus-project.eu/>

## Home Mechanical Ventilation: The importance of data collection

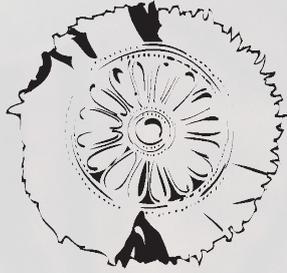


More and more patients with severe respiratory failure are being supported over the past decades by Home Mechanical Ventilation (HMV), a multidimensional and quiet demanding therapeutic method. While it is clear that accurate data concerning HMV patients' population and the derived information are crucial, there are still no related databases.

In the meantime, of increasing concern are the consequences deriving from this kind of data which directly affect the overall estimation of the HMV technology efficiency, the related cost and finally, the Health Policy and Planning.

In this context, INAB/CERTH in collaboration with the Health District of Macedonia started in 2015 the collection of data relevant to the HMV patients. This project runs under the auspices of the Greek Ministry of Health since 2016 and involves 11 of the more active centers. The collaboration process with the Greek National Healthcare Service has started as well.

The process of data collection will not only enable researchers to carry out relative research activities but it will also provide the Greek Ministry of Health and the Greek National Healthcare Service all the necessary information regarding the type of clinics dealing with this kind of therapy, the number, the condition and the distribution of the patients/disease, the type of mechanical support and medical devices used, all the aforementioned being crucial in identifying and adopting the necessary organizational measures.



# ΕΚΕΤΑ

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The Centre for Research and Technology-Hellas (CERTH) founded in 2000 is one of the leading research centres in Greece and listed among the TOP-20 E.U. institutions with the highest participation in competitive research grants.

Today CERTH includes the following five institutes with indicated major fields of research:

- **Chemical Process & Energy Resources Institute (CPERI)** Sustainable & Clean Energy, Environmental Technologies, Chemical & Biochemical Processes, Advanced Functional Materials
- **Information Technologies Institute (ITI)** Informatics, Telematics and Telecommunication Technologies
- **Hellenic Institute of Transport (HIT)** Land, Sea and Air Transportation as well as Sustainable Mobility services
- **Institute of Applied Biosciences (INAB)** Agri-biotechnology, Health Translational Research, Informatics for big bio-data
- **Institute for Research & Technology of Thessaly (IRETETH)** Agrotechnology, Mechatronics, Biomedicine and Kinesiology

CENTRE FOR RESEARCH AND  
TECHNOLOGY HELLAS

6<sup>th</sup> km Charilaou-Thermi Rd  
P.O. Box 60361

GR 57001 Thermi, Thessaloniki  
Greece

Tel: +30 2310 498210

Fax: +30 2310 498110

Extroversion and Networking Services

Tel: 2310 498205, Fax: 2310 498280

email: [liaison@certh.gr](mailto:liaison@certh.gr)

Press and media enquiries

Tel: 2310 498214, Fax: 2310 498110

email: [amelidr@certh.gr](mailto:amelidr@certh.gr)

