KU LEUVEN



MEERDAAGSE OPLEIDING

Micro-credential Battery Systems

From 14/01/2027 to 15/04/2027 (11 sessions)

from 18.00 to 21.30

Genk, Gent, Ninove, Olen, Temse

PUC | CONTINUE

Applications, safety and (grid) flexibility | Profiteer van de Early Bird Korting!

Battery systems are rapidly becoming central to how we organise and balance our energy systems. This programme offers **an integrated perspective** on their role across the energy transition, combining academic insights, applied research, practical use cases from industry and site visits to various companies across Flanders.

This programme focuses on both the theoretical and practical aspects of battery systems, with a special emphasis on two key application domains: **mobile applications**, such as electric vehicles, and **stationary applications**, including grid-connected electrical energy storage systems.

Starting from the role of batteries in the broader energy transition (module 1), the programme introduces essential technological concepts, including battery management systems and state-of-health estimation (module 2).

While focusing on electric vehicles and stationary storage as key application domains, the programme also explores the state of the art in more emerging and demanding contexts, including construction, maritime and agricultural applications (module 3).

Beyond applications, the programme addresses the regulatory and safety frameworks shaping the battery landscape, with specific attention to European legislation, international standardisation, and operational safety in industrial environments (modules 4 & 5).

Finally, the programme shifts towards the role of batteries as enablers of flexibility, highlighting how battery systems can support grid stability and help tackle congestion across different system levels (module 6).

Programma

SCOPE AND OVERVIEW

This programme focuses on both the theoretical and practical aspects of battery systems, with a special emphasis on two key application domains: **mobile applications**, such as electric vehicles, and **stationary applications**, including grid-connected electrical energy storage systems.

The programme's primary focus thus lies in the later stages of the battery value chain, specifically on battery packs, applications, and reuse, including battery management systems. While we do incorporate fundamental knowledge about materials and electrochemical properties, it is presented in the context of **practical and industrial applications**.

This overview course is structured into **six modules.**

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Finally, the programme shifts towards the role of batteries as enablers of **flexibility,** highlighting how battery systems can support grid stability and help tackle congestion across different system levels (module 6).

The programme's format provides a blend of lectures by experts and **use cases from industry**, combined with **visits** to various companies across Flanders.

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Detailed description of each module and session

MODULE 1: Setting the scene

1.1: The bigger picture (KU Leuven Gent)

Role of batteries in energy transition

In this foundational session, we delve into the pivotal role that batteries play in the ongoing energy transition. We take an interdisciplinary approach, examining their position within the broader context of the 'trias energetica', energy technologies and electrical energy storage. Additionally, we discuss their connections with emerging technologies like hydrogen.

- Lecturer: Jan Cappelle (professor, KU Leuven)

Industrial-technological overview

This session offers a perspective on the role of the technology industry in the energy transition and delves deeper into European and Belgian companies operating within the strategic value chain of battery technology. We discuss several key challenges for further developing and strengthening this strategically important technology. We provide an overview of the expected market developments in Europe for battery cells, the evolution of production capacity, as well as recycling capacity. We also explore the associated challenges and opportunities for our region, including the need for the right skills to successfully combine the energy transition with a local and circular economy.

- Lecturer: Jean-Marc Timmermans (Group Leader Manufacturing and Process Systems, Agoria)

1.2: Visit EnergyVille (Genk)

EnergyVille unites the Belgian research partners KU Leuven, VITO, imec and UHasselt for research on sustainable energy and intelligent energy systems. This visit offers us a unique opportunity to explore cutting-edge infrastructure related to battery R&D, smart grids, intelligent EV charging and vehicle-to-grid technologies.

- Lecturer: TBD (EnergyVille)

MODULE 2: Battery Management

2.1: Monitoring and Managing Battery Health: Methods and Systems (KU Leuven Gent)

State of health estimation techniques

State of health is a critical parameter that provides insights into the current condition of a battery. It is an essential factor for ensuring the battery's well-being and safe usage. During

this session, we provide an overview of various techniques for assessing state of health, categorising their pros and cons based on the specific requirements of the algorithm. Battery degradation results from a multitude of factors, which are also discussed during the session. We place special emphasis on key research activities such as fast charging and the utilization of smart functionalities. Additionally, we describe ongoing research projects on state of health estimation for second-life applications conducted at the Battery Innovation Centre within MOBI-VUB.

- Lecturer: Maitane Berecibar (professor, VUB-MOBI)

Battery Management Systems

Battery Management Systems (BMS) are crucial for maximising the performance of batteries while ensuring their safe operation. We explore the various topologies of BMS solutions for various applications, different types of cell balancing techniques and their benefits, delve into sensors at the cell and module levels. We also discuss current and future BMS functions, their integration into battery systems and interaction with other system components.

- Lecturer: TBD (EnergyVille)

2.2: Visit ABEE (Ninove)

During this visit, we provide a brief overview of the BMS concepts used in stationary and automotive applications. In addition, we showcase thermal management solutions for various applications. You have the opportunity to explore the battery pack production line (0.5 GWh/year) and view the BMS validation hardware (up to 1000V), both of which are instrumental for development purposes.

- Lecturer: Noshin Omar (CEO, ABEE)

MODULE 3: Applications

3.1: From stationary to mobile electrification: state-of-the-art in applications and boundary conditions (KU Leuven Gent)

In this session, we analyse the extent to which electrification is already underway and define the boundary conditions for different applications. The scope goes beyond the battery pack, encompassing power electronics and associated subsystems. We also examine which battery technologies are most suitable for specific applications.

We also touch upon more challenging domains of electrification, such as:

- construction sites: electrification of machinery (e.g. cranes, excavators, and temporary installations)
- dredging and maritime applications: integration with onboard and shore-based power systems
- agriculture: electrification of tractors, irrigation systems, and processing equipment
- other heavy-duty or off-road environments, such as events and temporary infrastructure

…

- Lecturer: Simon Ravyts (professor, KU Leuven)

3.2: Visit Volvo Trucks (Volvo Trucks Gent)

During the visit, we provide a brief overview of Volvo's long-term vision for sustainable transportation. You will gain insight into the achievements that Volvo has already realised, including the production of battery packs and fully electric trucks. You also have the opportunity to visit these facilities, including a tour of the module factory if it is operational by then.

- Lecturer: Nico Van den Broeke (Group Leader Training and Competence Center, Volvo Trucks)

MODULE 4: Recycling and regulations

4.1: Legislation and standardisation (KU Leuven Gent)

International Battery Standardisation for a safer and innovative future

The growing prevalence of lithium batteries for mobile and stationary applications has underscored the vital need for international standardization. In the realm of lithium mobile batteries, the standardization efforts are divided between the International Electrotechnical Commission (IEC), which focuses on individual battery cells and modules, and the International Organization for Standardization (ISO), which considers the battery pack as a system within the vehicle. In this session, we explore how international standards act as a driving force, facilitating the adoption of cutting-edge technological solutions by manufacturers, users, and regulatory authorities, resulting in benefits for all stakeholders.

- Lecturer: Peter Van Den Bossche (professor, VUB-MOBI)

Challenges and progress in implementing the new European legislation

On August 17, 2023, the new European Battery Regulation came into effect, encompassing the entire battery life cycle, from raw material procurement and production to battery specifications, second-life considerations, and collection and recycling. This session addresses aspects of the Regulation that battery producers, while required to comply with, often do not have full control over themselves. These aspects include responsible sourcing of raw materials and the carbon footprint of production, as well as concepts such as reuse and remanufacturing for second-life applications, and end-of-life targets and responsibilities. The Regulation frequently references delegated or implementing acts (which are yet to be drafted) to provide detailed technical specifications. In this session, we offer an update on the progress of these acts.

- Lecturer: Jan Tytgat (Director Government Affairs EU, Umicore)

4.2: Visit Umicore (Olen)

This session includes an on-site visit to the battery laboratories of Umicore, a major industrial player in materials recycling and battery technology.

Engie, as a key actor in the energy sector, will also contribute to the programme by presenting its activities and zooming in on a concrete second-life battery project located on

the Umicore site. This system consists of repurposed electric vehicle batteries. While a first industrial deployment in 2021 demonstrated its technical potential for grid balancing and circular use, subsequent experience has shown that the economic viability of such reuse models is difficult to sustain in practice...

- Lecturers: Geert Defieuw (Site Manager Olen, Umicore) and Seth Spoelders (Energy Solutions Manager, Engie)

MODULE 5: Safety

5.1: Electrical safety and fire safety (KU Leuven Gent)

In this session on battery safety, we will take a closer look on two crucial aspects, i.e. electrical safety of battery systems and fire safety of battery systems. Batteries, as 'always-on' electrical sources, pose unique challenges, including significant risks for installers due to the different behavior of DC systems during fault conditions such as short circuits, earth faults, and arc flashes, compared to traditional AC installations. This requires careful consideration in the choice of protection equipment and fault current calculations. Fire risks are generally mitigated by the Battery Management System (BMS), which ensures safe operating conditions. However, external factors such as mechanical damage or excessive heat from nearby sources can lead to thermal runaway and potential explosions. We will explore the underlying causes of such incidents, discuss prevention strategies, and examine how system designs can be optimized to mitigate the impact of battery failures when prevention is not possible.

- Lecturers: Simon Ravyts (professor, KU Leuven) and Wim Verbakel (volunteer Hulpverleningszone Noord-Limburg)

5.2: Visit C-Fire/Cordeel (Temse)

C-Fire, part of the Belgian Cordeel Group, manufactures innovative and eco-friendly fire-fighting solutions. Their entire product range meets the strictest Belgian and European standards. Additionally, C-Fire handles the installation, annual maintenance, and inspection of fire extinguishers and hose reels in accordance with these standards.

- Lecturer: Diego Abeel (CEO, C-Fire / Cordeel Group)

MODULE 6: Batteries and flexibility services

6.1: (Batteries for) flexibility across different levels (@ KU Leuven Gent)

Introduction: batteries, flexibility services and congestion

The first part of this session introduces recent developments around congestion problems and the (increasing lack of) network capacity to accommodate industrial electrification and renewable energy sources, both at a transmission and distribution system level.

Lack of capacity (transportschaarste) contributes to long connection queues for new demand and generation, which jeopardizes future electrification and industrial processes, with potentially detrimental impact for decarbonization and economic welfare.

This sub-module introduces (hosting) capacity calculations and their challenges, motivating

why it is not straightforward to anticipate congestion issues. The concept of capacity maps as a transparency measure to support investors and companies towards effective connection requests is explained.

An overview of potential solutions to mitigate congestion and make optimal use of the remaining capacity is provided, setting the scene for the subsequent industry talks.

- Lecturer: Marta Vanin (professor, KU Leuven)

Behind the business model of a stationary use case - Yuso

Over the last decade, costs for Li-ion batteries have substantially decreased, reaching a point where grid parity is achieved for flexibility services. Worldwide production capacity, primarily for Li-ion cells, is expected to reach 6.5 TWh by 2030. In addition to device and electric vehicle powering, stationary battery applications have seen a significant increase. In this session, we examine the role of Battery Energy Storage Systems in providing grid stabilization services and explore revenue opportunities for stationary applications, with Belgium serving as a case study subject.

- Lecturer: Michel Verschuere (Owner & Managing Director, Yuso)

(Future) challenges of battery systems for distribution grids - Fluvius

In this session, grid operator Fluvius goes into the challenges of integrating battery systems into distribution grids. Fluvius also addresses the evolving technical, market, and regulatory requirements needed to enable the safe and effective deployment of distributed storage.

- Lecturer: Joris Soens (Transition Manager, Fluvius)

Target audience

This programme is tailored for graduates and professionals looking to deepen their knowledge in various aspects of the battery value chain.
The ideal candidates are those who already possess a foundational understanding of technology, preferably at the (minimum) level of **a technical bachelor's degree**, such as engineering.

Practical

When?

- The programme runs over eleven days, with a mix of evening and afternoon sessions
- 11 consecutive (except for holidays) Thursdays from 14 January to 15 April 2027
    - Classes on campus Rabot (KU Leuven Ghent): 18:00 - 21:30 (incl. a sandwich break)
    - Company visits: 14:00 - 17:00

Where?

- Sessions will be hosted primarily at KU Leuven, Ghent Campus: Gebroeders de Smetstraat 1, 9000 Gent
- Industry visits to various locations across Flanders (transportation is to be provided by yourself)

Certificate KU Leuven

This programme is recognised by the Faculty of Engineering Technology (KU Leuven).

Upon successful completion of a practice-based assessment (incl. a reflective report), participants receive a KU Leuven microcredential certificate.

Registration and payment

- The deadline to register online is 8 January 2027.
- The fee is €2750 and includes course material and catering.
    - Early bird registration (before 15 November 2026) is €2475.
- Members of Agoria receive a 10% reduction.
- Second participants and additional participants from the same organisation receive a 10% reduction
- The programme is registered for Flemish Training Leave (Vlaams Opleidingsverlof, VOV) under recognition number ODB-2000119.
- Payment can either happen without an invoice by transferring the amount to the account number IBAN BE31 2850 2133 2955 (PUC - KU Leuven Continue), with reference '400/0029/80666 + name participant(s)', or pay after receiving the invoice.

All sessions will be conducted in English, including lecture materials.

PUC - KU Leuven Continue

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By registering, I declare that I agree to the use of the information I provide to contact me in the context of this training and for any necessary follow-up.