InnoEnergy Skills Institute

Battery Management Systems

Last revised: 2023 March

Batteries are versatile and high-potential energy storage devices that will play an important role in the ongoing transition of our energy system. One very important topic for battery application is safety. To ensure a safe operation of batteries in each application, the battery pack must be connected to a battery management system (BMS).

In this certification, you will learn why a BMS is needed for different battery technologies and look at several possible configurations. You will also learn about the communication means and advanced features of the BMS, which provide more information about the state of the battery system and guarantee that it is used optimally.

Learning outcomes

Upon completion of the certification, learners will be able to:

- Explain the exact need for a battery management system in a battery supported application
- List the set of functions a BMS should support
- Choose the best-fit hardware topology for an aimed final battery application
- List the most important BMS components and their value for the system
- Elaborate on the working principles of the standards on functional safety
- List the different existing approaches for determining the SoC and explain the related difficulties
- List some approaches on how to measure SoH and how to implement those on a battery in an application
- Select and tune a balancing strategy based on the topology of the battery and the requirements of the application in which the battery is used

Certification structure

The certification is delivered fully online and is self-paced, making it easy for participants to learn without having to take time off work.

This fully online certification consists of one self-paced online course with seven lessons structured as follows:

Lesson 1: Introduction to Battery Management Systems

- Get introduced to the world of Battery management systems (BMS).

Lesson 2: Battery Management Systems: Topologies

- Learn about the different BMS hardware topologies along with their advantages and disadvantages for the implementation in a specific end application.

Lesson 3: Battery Management Systems: Components and Requirements

- Understand the different subcomponents of a BMS that enable its functions. As well as the requirements for several sensors and different external and internal interface options.

Lesson 4: Functional Safety and Security

- Explore the standards, directives and laws, to be applied or comply with when working with BMS, depending on the specific applications.

Lesson 5: State of Charge Estimation

- Understand how state of charge (SoC) can be estimated as one of the BMS functionalities as well as the determination of the separate factors in the SoC equation using different approaches.

Lesson 6: State of Health Estimation

- Learn definitions and different measurement approaches to perform the state of health (SoH) estimation, with a focus on direct measurement methods.

Lesson 7: Battery Cell Balancing

- Understand what cell balancing is, why it is needed and when it is used.

Instructors

The certification is led by experts from the EIT InnoEnergy ecosystem. Instructors on this certification are:

Dr. Jeroen Büscher

Product Manager Electrical Storage of Vito / Energy Ville. Since 2016 Jeroen is leading the VITO team working on electrical storage technologies and is responsible for the development and execution of the related activity roadmap. Since 2011, Jeroen has been coordinating several projects within Europe on electrical storage, smart grids and e-mobility.

How will you learn?

This is an online certification and can be taken at your usual study location. The certification consists of seven lessons and is self-paced.

Duration: 4 Hours

Is it right for you?

This certification is beneficial for battery system integrators, battery technicians, Energy Management System developers and providers, and researchers in the field of energy willing to develop or build further on battery or energy management systems for optimal integration of batteries in an end product. But anyone interested in understanding Battery Management Systems might find it useful.

Prerequisites: Basic understanding of battery cells, system components and their working principles. Also, a basic understanding of electrical systems.

Certificates of Achievement

We offer two pathways for issuing of certificates, **InnoEnergy Skills Institute Certificate** and **EDC (European Digital Credentials),** each with its own unique set of benefits, allowing your organization to choose the one that best suits the objectives. **The Achievement recognition will be awarded at a >75% course assessment pass rate.**

InnoEnergy Skills Institute Certificates

What is it?

The InnoEnergy Skills Institute serves as the certificate issuer, verifying learners' progress and achievements with the course material.

What are the benefits?

InnoEnergy Skills Institute certificates are highly adaptable for recognizing various learning levels and achievements. We offer Participation, Completion, and Achievement certificates for learners who complete online courses through the Skills Institute platform.

What that means for you?

You will receive a digital credential that you can store in your personal digital credential wallet. You can also add and share these credentials on your social media platforms. The authenticity of the credentials can be verified online by anyone seeking credential verification.

European Digital Credentials (europass)

What is it?

European Digital Credentials provide an online record of an individual's personal achievements and qualifications. Recognized by employers across the continent, InnoEnergy Skills Institute can issue European Digital Credentials, which learners can add to their European Digital Credentials wallet. For this type of credentials, we only offer Achievement certificates, awarded at a >75% course assessment pass rate.

What are the benefits?

It allows learners to signal their skills and qualifications using the European Learning Model — a semantic standard that helps the recognition of qualifications and digital credentials across Europe. It also combats fraud, and greatly reduces administrative costs.

What that means for you?

You can be confident in the authenticity of your credentials and showcase your skills in a way that is understood in the context of the European Learning Model. You'll also be able to access everything quickly and easily via your online European Digital Credentials wallet.

Versioning

#	Version	Summary of Changes	Date
1	v1.1	Updated the formatting as per InnoEnergy Colour and Font styles	09-Dec-24