InnoEnergy Skills Institute

Fundamentals on Batteries

Last revised: 2023 March

Batteries are everywhere. Just look around you and you will have no difficulty in finding one in a portable device or electric vehicle. The threat of global warming and dramatic climate changes has put us on the fast lane to decarbonisation and has provided an extra boost for battery technology powered applications.

So, how does a battery work? What are its main components? What are the most important parameters that we should know about a battery? What are the differences between state-of-the-art technologies? What future advances should we expect in this sector? These are some of the questions you will be able to answer by the end of this certification.

This certification is here to provide you with the fundamental knowledge and state-of-the-art insights into battery technologies. You will first get an introduction to the key role of batteries as a tool for energy storage. You will then explore the main components and parameters that characterise a battery. Next, you will dive deeper into the electrochemical phenomena that lie behind battery operation. Then, you will get a concise view of the different currently available battery technologies. Lastly, you will get a peek at the principal and emerging technologies that are poised to reshape the energy panorama.

Learning outcomes

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

- Summarise current battery technologies in terms of working principles and main characteristics
- Understand the limitations of each technology based on their working principles
- Predict the most suitable applications for each battery technology
- Reflect on the challenges that each battery technology faces
- Evaluate emerging, cutting-edge battery technologies and their potential applications

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.

The certification consists of four courses and is structured as follows:

Course 1: Introduction to Batteries

- Discover the value of batteries in both our daily life and in the development of a low-carbon modern society
- Gain a deeper understanding of battery technology, look inside a battery to understand its basic operation and main components, and learn to classify battery technologies

Course 2: Electrochemical Concepts Behind Batteries

- Explore the phenomena that occur within a battery during operation and provide you with in-depth knowledge on the thermodynamic aspects of battery operation and relate them with the common battery parameters

Course 3: Current Battery Technologies

- Investigate the different battery technologies that are currently used in our daily life
- Explain the key characteristics and main applications of eight currently available technologies, starting with the widely used lithium-ion batteries present in most of our electronic devices

Course 4: Emerging Battery Technologies

- Take a peek at the future and explore two important emerging battery technologies: metal-air batteries and solid-state batteries, to understand the potential and challenges behind these cutting–edge technologies

Instructors

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

Fátima Montemor

Full professor at the Department of Chemical Engineering, a researcher at CQE, and Vice President of Instituto Superior Técnico. Her scientific interests include the development of functional surface coatings for multipurpose applications in different fields such as surface protection and energy conversion and storage.

Jean-Luc Delplancke

Scientific co-worker at the Université Libre de Bruxelles (ULB) in Belgium and Honorary Professor at the University of Birmingham. Jean-Luc has also worked in the European Commission (EC) where he was Head of the Program Unit for the Fuel Cells and Hydrogen Joint Undertaking up to 2016.

Jorge Varela Barreras

Senior researcher at Imperial College London in the Department of Mechanical Engineering, where he works on batteries and battery management systems.

Maarten Mees

R&D team leader in Electrochemical Storage at IMEC. Maarten has completed research and research education in physics at KU Leuven while having master level studies in Electrical Engineering also at KU Leuven. Maarten is focused on developing the next generation of solid-state batteries, with an interest in ALD technology and the development of novel nanomaterials for the cause.

How will you learn?

This is an online certification and can be taken at your usual study location. The certification consists of four courses and is self-paced.
Duration: 20 Hours

Is it right for you?

This certification is beneficial for anyone interested in developing their knowledge of battery storage fundamentals and electrochemical phenomena as well as current and emerging battery storage technologies.

Prerequisites: In order to be able to follow and benefit from the Fundamentals on Batteries certification learners would need to have a basic knowledge of chemistry, math, physics, and 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.