Co-funded by the European Union

# InnoEnergy Skills Institute

## Materials to Electrodes

Last revised: 2023 March

This certification will introduce you to the operational principles of a rechargeable battery, with a focus on lithium-ion batteries. You will start your learning by looking into the base components of the electrochemical cell and their functions. You will look into important electrochemistry definitions and learn to calculate crucial properties of active materials such as gravimetrical and volumetric capacities, electromotive force, and maximum energy content of a battery. You will also dive into active materials and synthesis routes relevant for the industrial production of commercial active materials for lithium-ion batteries. Lastly, you will learn how these influence battery performance.

## Learning outcomes

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

- Name the main components of a battery and know their purpose
- Summarise the main differences between lithium-ion batteries and other (earlier) types of rechargeable batteries
- Measure, report, and understand the status of a battery using the common technical vocabulary in the battery community
- Summarise what type of redox reactions happen at the anode and cathode of a cell
- Summarise the state of the art active-materials in lithium-ion batteries
- Relate the structure of a material to its performance in the battery

## 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 seven lessons and is structured as follows:

Lesson 1: Electrochemical Cell: The Elementary Building Block of a Battery
Explore what can be found inside a battery and its base component, the electrochemical cell.

Lesson 2: Porous Electrodes
Find out what the cell's electrodes are composed of and parameters governing the electrode's active materials.

Lesson 3: Electromotive Force in an Electrochemical Cell
Learn a few important electrochemistry definitions.

Lesson 4: EMF, Energy, and Measurable Voltage of a Cell
Learn how to calculate energy density and how to differentiate between several kinds of voltages.

Lesson 5: Lithium-Ion Battery Technology
Learn some key differences between lithium-ion batteries and other types of rechargeable batteries.

Lesson 6: Lithium-Insertion Materials
Get introduced to the active materials used for the anode and cathode of lithium-ion batteries.

Lesson 7: Synthesis of Lithium-Insertion Materials
Explore some synthesis-related properties of materials and why they are important for battery applications.

# Instructors

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

**An Hardy**

Full Professor at Hasselt University, Institute for Materials Research (IMO) & EnergyVille. Specialised in the designed synthesis of inorganic and hybrid (nano)materials for various applications including energy storage and conversion.

**Momo Safari**

Associate Professor, Department of Engineering Technology, Hasselt University & EnergyVille. The main area of activity is advanced battery technologies and the fundamental research centres around experimental/theoretical investigation of thermodynamics, kinetics and transport phenomena in batteries.

## 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 process, quality, or design engineers who need to understand or apply battery design, and battery material suppliers, but anyone interested in the working principle of a lithium-ion battery might find it useful.

Prerequisites: Basic general background knowledge of chemistry, physics, and math.

## 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 |
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