Master’s in Energy Storage
Year 2, Politecnico di Torino

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**Polygeneration**

**Learning Outcomes:**

Applications of fundamentals of chemical thermodynamics and electrochemistry to energy systems. After this course the student must be able to:

- Understand and design of complex energy systems based on thermo-chemical and electro-chemical processes and technologies.
- Understand and design of power-to-X processes.
- Understand and design of technologies and processes for CO2 recovery and re-utilization.
- Understand and design of poly-generation systems.

**Syllabus / Content:**
Fundamentals
- Fundamentals of chemical thermodynamics
- Fundamentals of electro-chemical processes and devices

Electro-Chemical Systems
- PEMFC: Description of the PEMFC and of its operation, Electrochemical model of the PEMFC (polarization curve), Useful expressions for design and operation of the PEMFC, Stack PEMFC: description and analysis of operation in cogenerative configuration
- SOFC: Description of the SOFC and of its operation, Electrochemical model of the SOFC (polarization curve), Chemical model of the SOFC (internal reforming)
- Electrolyzers: alkaline, acid, solid oxide.
- Flow batteries: vanadium-based, Li-air batteries, SOFC redox batteries

Thermo-Chemical Systems
- Pyrolysis
- Gasification
- Supercritical water gasification
- Biogas
- Principles of chemical looping (example: fuel decarbonization)

Hydrogen Technologies
- Physical and chemical properties of H2
- Reforming of hydrocarbons
- Production from renewables
- Storage of hydrogen (liquid, metal hydride)

Chemical Storage For The Production Of Synthetic Fuels
- RES-storage and synthetic fuels
- Processes for CO2 recovery
- CCS processes
- CCU processes
- Principles of power-to-X technologies and processes
- Principles of power-to-gas (P2G) processes
- Production of synthetic methane
- Principles of power-to-liquid (P2L) processes
- Production of synthetic Methanol, DME, diesel

Examples Of Complex Poly-Generation Systems
- WWTU plant with MCFC CHP system and hydrogen recovery
- WWTU plant with SOFC system and CO2 recovery and carbon fixation in algae
- IGCC integrated with SOFC systems and CCS

**Evaluation Methods:** written test; optional oral exam; group project;

**Link:**

Other mandatory courses presented above do not have, at the moment, a detailed description.

The list of courses on this page are examples of possible courses you may be taking in this programme. The universities providing the courses reserve the right to cancel, postpone or reschedule any of their courses.