SELECT Master Programme’s POLITO Study Track
Engineering

Cittadella Politecnica

Architecture
Politecnico di Torino

~30,000 students:

150 years of higher education

✓ Highly selective

✓ Strong bases for future career success

✓ From engineering to manufacturing: the Polito Incubator was the winner of the world best Science based Incubator award 2004!
Cittadella Politecnica

- Research, teaching and training go hand in hand with
  - local student services
  - financial activities
  - cultural activities
- Business Research Center
- Polo Venture Capital: from research to business
Energy Center @ POLITO
ENERGY challenges face a complex framework characterized by various layers interacting among themselves and involving the decisions of various actors. These layers include:

- **physical/technological** (conversion, storage, distribution/transmission, end uses)
- **environmental** (effects and impacts)
- **cyber** (data collection, transmission and analysis)
- **economic** (market efficiency, affordability, competitiveness, development, productivity)
- **social** (consumer engagement, behavioral change, inclusion, development, health, prosperity, security).

Moreover, the interactions involve two different scales mutually coupled: a **local scale** (city, region, country) and **global scale** (world-wide).
Energy Center @ POLITO

LOCAL SCALE

ENERGY NETWORK (NODES & NETWORKS)

End Users

Technologies/Processes
(energy conversion & storage)

GLOBAL SCALE

ENVIRONMENTAL INTERACTIONS
(from local environment to biosphere)
Energy Center @ POLITO
POLITO SELECT year 2: Energy Efficiency
LAB-centered
PROTOTYPES: polygeneration plant (SOFC-CHP, WWTU biogas, CO2 recovery) in Torino (Italy)
PROTOTYPES: polygeneration plant (SOFC-CHP, WWTU biogas, CO2 recovery) in Torino (Italy)
INDUSTRIAL SIZE: Large SOFC-based CHP systems

Design, installation, operation, test and analysis of a new medium size CHP system based on SOFC fed by biogas: $174 \text{ kW}_e + 90 \text{ kW}_{\text{th}}$ (the largest plant in EU so far)

Collegno city

SMAT Collegno Waste Water Treatment Plant

- Service for the municipality: waste water treatment
- Residual sludges from water treatment are converted in biogas (sub-product)

3 Convion SOFC modules

- High efficiency electricity production (> 53%)
- Heat recovery, required for the anaerobic digestion
- Zero emissions to atmosphere (no NOx, SOx, VOC...)
- 100% modular system
NEW CONCEPTS
Power-to-gas, power-to-chemicals
Fundamental research: nano-structures

Processes: from nano-powders ...

...to nano-structures (anode with PAFES, electrolyte with RF sputtering)
Energy Efficiency track

✓ **Fall-winter semester**
  ✓ 6 ECTS from KTH (iPoY)
  ✓ At least 24 ECTS from Polito courses

✓ **Spring-summer semester**
  ✓ MSc Thesis work (30 ECTS) high industrial and business oriented relevance.
  ✓ Notice: end your Thesis before the July MSc graduation session

✓ During your 2\textsuperscript{nd} year: pass a simple Italian language exam
## Energy Efficiency track

<table>
<thead>
<tr>
<th>Code</th>
<th>Course title</th>
<th>ECTS</th>
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<tbody>
<tr>
<td>SEL071</td>
<td>iPoY</td>
<td>6</td>
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<tr>
<td></td>
<td><strong>Focus Energy Efficiency</strong>*</td>
<td>24</td>
</tr>
<tr>
<td>01QIZND</td>
<td>Building physics and energy system in architecture</td>
<td>6</td>
</tr>
<tr>
<td>01OZMND</td>
<td>Numerical Design of Thermal Systems</td>
<td>8</td>
</tr>
<tr>
<td>01QGXND</td>
<td>Polygeneration and advanced energy systems</td>
<td>10</td>
</tr>
<tr>
<td>01PQCND</td>
<td>Power generation from renewable sources</td>
<td>6</td>
</tr>
<tr>
<td>02OULND</td>
<td>Resources and Environmental Sustainability</td>
<td>8</td>
</tr>
<tr>
<td>01OAJQD</td>
<td>Hydraulic and thermal machines testing</td>
<td>10</td>
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* 24 ECTS or more have to be chosen among the courses listed above.

**IMPORTANT**: A first level course of Italian language (6 ECTS) will have to be passed before graduating, but these credits are considered extra-curricular.
Physical basic concepts of thermal fluid-dynamic, lighting and acoustic phenomena related to indoor environment;
Building design requirements; technical regulations and legislation related to building physics; physical properties of components and materials;
Numerical and analytical methods for building physics and plant design;
Methodologies for experimental verification of building physics requirements in laboratory and in the field.
Numerical design of thermal systems

Romano Borchiellini, Marco Masoero, Vittorio Verda – 8 ECTS

- numerical methods to solve some typical thermal problems
- analysis and design of combustion systems with particular attention to thermal boilers and to the thermal analysis of fire tubes boilers
- fluid dynamic and thermal numerical analysis of fluid networks with particular attention on design and operation of district heating systems
Starting from the fundamentals of chemical thermodynamics and electrochemistry applied to energy systems, the course develops topics related to electrochemical systems (fuel cells, electrolyzers, flow batteries), thermo-chemical systems (gasification, production of biogas, chemical looping processes), concepts of chemical storage for the production of synthetic fuels (CO2 recovery, power-to-gas, power-to-liquid processes) and complete this with the analysis of some examples of complex poly-generation systems.
The course is devoted to present both the Photovoltaic and Wind power systems, and the methods to correctly design the main components, to evaluate the energy production with the economic analysis of investment.
The student is expected to gather basic knowledge about the economic characterisation of energy, mineral, and environmental resources. He should gain a basic understanding of resource management issues and their relationship to property rights, externalities, market structure, as well as the economic analysis tools and valuation techniques used in environmental economics. He should understand what is meant by sustainable development and how sustainability concepts are applied to energy, minerals and to production systems and engineering projects.
The subject aims at providing the students with the basic theoretical knowledge and practical skills needed to face important technical problems in the experimental measurements of the main physical quantities in the mechanical and energetic fields. More specifically, the focus will be on engines and fluid machines.
<table>
<thead>
<tr>
<th>TORINO SELECT Team:</th>
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<tbody>
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Welcome to the city of Torino!