

Faculty Engineering

PhD Programme in SUSTAINABLE ENERGY AND TECHNOLOGIES

Website: <https://www.unibz.it/it/faculties/engineering/phd-sustainable-energy-technologies/>

Duration: 3 years

Academic year: 2023/2024

Start date: 01/11/2023

Official language: English

Programme contents:

The activity of PhD students is full-time and the focus of the PhD research topics is focused on Renewable Energy Production, Low Environmental Impact and Energy End-Use Efficiency. The PhD program includes the attendance of courses in specific areas, as well as research activities to be carried out at the Free University of Bozen/Bolzano and other universities in Italy and abroad.

In particular, the teaching activity is to be intended to complete the previous university education in the general themes of the doctorate and to achieve advanced skills necessary to carry out the research project. As far as research activities are concerned, a period spent abroad at universities or research centres is compulsory. With some of these institutions, framework agreements already exist; with others, specific agreements may be established on a case-by-case basis.

The presentation of memoirs at national and international congresses and the publication of journal articles is an important part of the activity of the doctorate and allows the student to discuss with the scientific community.

The doctoral thesis completes the doctoral program. It must be written in English, with an exhaustive abstract in German and Italian.

The student will benefit from the multilingualism that characterizes the Free University of Bozen/Bolzano, which offers various initiatives in Italian, German or other languages (seminars, optional courses, social events, etc.). The student will have access to the language courses offered by the Language Centre of unibz, compatibly with his/her research commitments and institutional activities.

Phases of the PhD:

The research activities are organized in five phases ending after 2, 6, 12, 24 and 36 months.

Phase 1, Presentation (first 2 months): the PhD Committee meets the students and defines a supervisor. Students meet the supervisor to agree on the research topic within the areas in this advertisement. Students start working at his/her study plan that has to be approved by the PhD Committee and start attending courses according to the scheduled timetable.

Phase 2, Introduction (2nd-6th month): students complete an exhaustive review of the literature concerning their subject area as well as the first steps in the research topic activity. Students prepare,

according with the supervisor, their research programme that has to be approved by the PhD Committee. The training activity can continue as established or be integrated according to further needs.

Phase 3, Development (6th -12th month): students continue their research in the chosen topic and attend courses, summer schools, seminars or conferences. Student draw up a report on the state of the art of their research topic to be submitted to the supervisor for a review; this report is discussed in front of the committee.

Students prepare also the public seminar to be held at the end of the first year of activity, in which they present and discuss the state of the art of the research topic. They will also inform the PhD Committee, according with the supervisor, about the research programme that they want to conduct abroad, and propose a co-supervisor at the foreign university or research centre. A report about the first-year activities for the PhD Course Committee concludes the phase.

Phase 4, Deepening and period abroad (12th -24th month): students continue their research and finish any courses that they may have been following. They can attend seminars, schools, or conferences. At this stage, it is recommended to spend a study period abroad. During this phase or in the next, students are also expected to take part in at least an international conference to present the results of the activities developed inner the PhD studies and they should begin to prepare the manuscript(s) for publication in peer-reviewed journal(s). A report to the PhD Course Committee about the second-year activities concludes the phase.

Phase 5, Conclusion (24th-36th month): students finalize their research activity by completing their research and the experience abroad. In addition, if not already done, finalize and submit at least one manuscript that has to be published within the PhD period and finalize the draft of the doctoral thesis. A report to the PhD Committee about the third-year activities concludes the phase.

Each of the activities in the different phases are granted a number of credits as established by the PhD Committee. At the end of each phase, students have to meet the PhD Committee to present and discuss their achievements. In addition, in the middle of the second and third year of the PhD, students will have to present to the PhD committee a state of the art report on the research work in order to verify the fruitful performance of the activities and to check any critical issues within the PhD course. The PhD Committee evaluates the work and provides suggestions if necessary.

Correspondingly, the PhD program foresees the following milestones to be admitted to the following years and to the final exam:

- **Within 6 months:** together with their supervisor or co-supervisors, students develop and organize their research plan which has to be presented to the PhD Committee.
- **Within 12 months:** students have to prepare a public seminar in which they present and discuss the state-of-the-art of their research topic and/or the first results of their own project;
- **At the end of each doctorate year:** students prepare a report of their research activity at the end of each year, to be approved by the PhD Committee, in order to be admitted to the following year or to the final exam. The report has to be presented to the PhD Course Committee at the end of the second and third year, while it is shortly presented at the end of the public seminar at the end of the first year.
- **Within three years:**
 - students have to take part in at least one international conference where they are expected to present a paper or a poster;
 - students must spend at least three months abroad (even not consecutive) conducting research;
 - students must attend, passing the related exam, specific courses among those suggested by the PhD Committee, acquiring a minimum number of credits established by the Committee itself.

- **Within the admission to the final exam the students:** (a) have acquired the necessary CFU as decided by the PhD Committee at the beginning of the cycle, (b) have published or received notification of publication of at least one article in a scientific journal as first author with the affiliation of the PhD, and (c) have to present to the PhD Committee a draft of their final thesis.

Exceptions to the achievement of the credits foreseen for the various activities and on the nature and location of the publications, may be evaluated and approved by the PhD Course Committee, provided that equivalent achievements can be identified in the student's educational and research activity.

Research areas:

The focus of the PhD is on Renewable Energy Production and Low Environmental Impact and Efficiency in End-Use Energy.

In particular, the research activities have two main objectives: (i) energy efficiency in the generation, distribution and use of energy, and (ii) the replacement of fossil fuels with renewable resources. Of particular interest are the aspects linked to peculiar contexts such as the mountain territory of South Tyrol. In this respect, activities focus in particular on energy efficiency in buildings and production systems and on the management of renewable energy sources, including energy generation and supply technologies, as shown below:

a) Energy efficiency and sustainability (EES) in end uses, in particular in buildings and production processes, from the user to the regional scale

- Characterization and improvement of the opaque and transparent elements of the building envelope, and of the HVAC systems of heat production, storage, and distribution, as well as of the ventilation systems.
- Characterization and optimization of the energy performance of the building system in the framework of building design / diagnosis / retrofitting and as regards building management and control.
- Study of energy efficiency solutions for industrial production processes and waste heat recovery.
- Characterization and optimization of the indoor environmental quality, assessed in terms of thermo-hygrometric, visual, and acoustic comfort and air quality, and analysis of the interaction of the occupant with the building system and his/her performance.
- Management of energy consumption at district and urban level, diagnosis of the energy performance of the existing building stock and development of energy policies and energy retrofit at local and national scale.

b) Renewable energy and technology (RET)

Optimization of the production and management of energy from renewable or low environmental impact sources, with particular reference to:

- Optimization and development of technologies for the thermochemical conversion of biomass (e.g. fixed beds, fluidized beds, granular fluidized beds and others), with particular attention to flexibility in feeding, load modulation and by-product valorization;
- Analysis of integrated poly-generation supply chains for the production of solid biofuels (e.g. hydrochar from hydrothermal carbonization), liquid biofuels (e.g., gasoline from Fisher-Tropsch process) or gaseous biofuels (e.g., synthesis gas from gasification processes and/or Power to Gas);

- Development and optimization of fluid machines and energy plants for energy conversion, such as combustion engines and gas turbines fuelled with alternative fuels or run with innovative management solutions;
- Analysis and development of innovative powertrains, electric and hybrid, in the automotive and industrial machinery sectors; study of the energy flow management in the vehicle;
- Study of the decentralized production of hydrogen from biomass or other sources as an energy carrier for stationary generation and/or mobility; energy simulation of the entire hydrogen value chain, i.e. from hydrogen generation to storage and its use. Development and optimization of traditional and innovative hydraulic turbines (e.g. Pump as Turbines, hydrokinetic turbines) with particular reference to energy recovery;
- Development and optimization of generation technologies from hydroelectric and wind power plants and their integration in the territory;
- Development and optimization of networks for the transport of fluids under pressure (such as district heating systems, water distribution networks, natural gas distribution networks) and energy recovery measures;
- Prevention of hydrogeological risks related to water use;
- Optimization, development and advanced control of electrical machines, with particular attention to the reduction of losses;
- Modelling, control and optimization of static power converters, in particular for the integration with battery storage systems.

c) Sustainable production and supply chain management

- Circular economy in production and supply chain
- Decarbonisation and life cycle engineering
- Eco-intelligent production processes and factories
- Smart, resilient and human-centric production

Minimum requirements and documentation to be submitted for admission

Degrees from the old Italian system: all

Master (laurea specialistica/magistrale): all

Foreign degrees

Applicants who have a foreign degree must have a university level education of at least five years.

The application to the PhD program **must include** the following documents:

- personal statement letter written in English (max. 1 page).
- Curriculum vitae (CV) (in English and possibly following the EU format that can be downloaded here <https://europass.cedefop.europa.eu/en/documents/curriculum-vitae>).
- Master degree certificate with indication of final mark /exam transcript. **For admission, the (exams) average grade of master's degree (or equivalent) must be greater than or equal to 24/30.** For foreign degrees, the mark will be converted to an equivalent one in thirtieths. The applicant should provide certified information on the assessment procedure used at the place where the qualification was awarded. In case of Italian university degrees the certification must be substituted by a self-declaration or by the Diploma Supplement.

Additional documents to be attached for the assessment of the preferential criteria, if available:

- reference letters, written in Italian, German or English by a university lecturer or a researcher from a research institute;
- list of publications (published, being published or submitted for publication), with related links, if possible.

Selection of candidates and criteria for assessing tests and/or qualifications:

The preferable requisites for admission to the PhD program are related to an appropriate educational, cultural, or working background within the research themes of the PhD program. Degrees in engineering and architecture are preferable.

The evaluation of candidates for admission will consider:

- the curriculum and the qualifications presented;
- the letter of motivation;
- the interview.

Candidates will be invited to an interview during which the profile of the candidates will be assessed on its quality and its correspondence with the research areas of the PhD programme. During the interview, the knowledge of the English language will be also assessed.

The selection process consists of three stages:

1. Candidates' applications are first examined for completeness and eligibility by the central offices of unibz.
2. Complete applications meeting the basic admission requirements are then assessed by the Selection Committee, which will consider: curriculum vitae, applicant's cover letter, qualifications (including any publications), and the appropriateness of the applicant's profile/interests and the research areas of the PhD program. The Selection committee will then draw up a list of candidates to be admitted to stage 3 of the selection process.
3. Each candidate will be interviewed to assess his/her basic technical knowledge and skills in one or more research areas of the PhD program. During the interview, the candidate's knowledge of English will be also verified. Video conferencing, telephone and the like are allowed for the interview.
The Selection Committee will select the best candidates on the basis of a comparative evaluation.

The following scores will be awarded:

- up to 15 points for: the applicant's CV, cover letter and further qualifications,
- up to 15 points for the interview.

The final score is the sum of the previous points, with a maximum of 30, and will be used to define the priority list and the access to the grants. The lowest score to be admitted in the rank-list is 18/30.

The rank list will be published on the website of unibz (www.unibz.it).

Examination dates

Description	Date	Place
Personal Interview	20 July 2023	At unibz or via MS Teams according to one's availability - if not otherwise communicated

Positions and grants

Total positions:	6
Positions MD 117/2023 under PNRR:	5
Position without grant:	1

PhD scholarship bound to specific research topics/areas:

5 scholarships with bound research topic and minimum 6-month study period abroad requirement pursuant to MD 117/2023 funded by PNRR:

Research topics:

1. Design and process-driven improvement of thermal management in aluminum die-casting manufacturing (in collaboration with *Alupress spa*, supervisors prof. Erwin Rauch/Franco Concli)
2. Development of a data-based sustainability performance measurement and monitoring for ERP in the precast concrete industry (in collaboration with *Progress Software Development srl*, supervisor prof. Erwin Rauch)
3. Thermal treatment of sewage sludge for a sustainable valorization through CRM (Critical Raw Materials) extraction (in collaboration with *HBI srl*/supervisor prof. Marco Baratieri)
4. Sustainability-oriented optimization of modular and reconfigurable cyber-physical production systems (in collaboration with *Fraunhofer Italia Research scarl*, supervisor prof. Erwin Rauch)
5. Sustainability Scope 3 - Dynamic assessment model for sustainability and resilience along the supply chain (in collaboration with *Intercable Automotive Solutions srl*, supervisor prof. Erwin Rauch)