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Freie Universität Bozen
Libera Università di Bolzano
Università Lìedia de Bulsan

Faculty Engineering

PhD Programme in SUSTAINABLE ENERGY AND TECHNOLOGIES

Website:

[PhD in Sustainable Energy and Technologies / Free University of Bozen-Bolzano \(unibz.it\)](https://www.unibz.it/PhD-in-Sustainable-Energy-and-Technologies/)

Duration: 3 years

Academic year: 2024/2025

Start date: 01/11/2024

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 programme includes the attendance of courses in specific areas, as well as research activity to be carried out at the Free University of Bozen/Bolzano and other universities in Italy and abroad.

In particular, the teaching activity is intended both as propaedeutic, to complete the previous university education in the general topics of the doctorate, and to achieve advanced skills necessary for carrying out the research project. As far as research activity is concerned, a period spent abroad at universities or research centres is mandatory. 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 papers at national and international congresses and the publication of articles in journals is an integral part of the activity of the doctorate and enables the student to engage with the scientific community.

The final thesis serves to complete the PhD programme. 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 activity is organized in five phases ending after 2, 6, 12, 24 and 36 months respectively.

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



Phase 2, Introduction (2nd-6th month): the student completes an exhaustive review of the literature concerning his/her subject area as well as the first steps in the research topic activity. The student prepares, under supervision of the supervisor, her/his research programme that must be approved by the PhD Committee. The training activity may continue as established or be integrated according to further needs.

Phase 3, Development (6th -12th month): the student continues his/her research activity in the chosen topic and attends courses, summer schools, seminars, or conferences. Students draw up a report on the state-of-the-art of his/her research topic to be submitted to the supervisor for a review; this report must be discussed in front of the Committee.

The student also prepares the public seminar which must be held at the end of the first year, in which he/she presents and discusses the state-of-the-art of his/her research topic. In addition, in agreement with his/her supervisor, he/she informs the PhD Committee of the research programme to be carried out abroad and proposes the name of the co-supervisor at the foreign university or research centre. A short-written report on the first-year activity is requested and concludes the phase.

Phase 4, Deepening and period abroad (12th -24th month): the student continues his/her research activity and finishes any teaching courses. They may attend seminars, schools, or conferences. At this stage, it is recommended to spend at least part of the study period abroad. In this or the following phase, the PhD student is also expected to participate in at least one international conference presenting his/her results and begins the preparation of the manuscript(s) for publication in peer-reviewed journal(s). A report to the PhD Committee about the second-year activity concludes the phase.

Phase 5, Conclusion (24th-36th month): the student finalizes his/her research activity by completing his/her research and experience abroad. In addition, if not already done, he/she finalizes and submits at least one manuscript that must be published within the PhD period and finalizes the draft of the PhD thesis. A report to the PhD Committee about the third-year activity concludes the phase.

Each of the activities in the different phases is assigned a few credits established by the PhD Committee. At the end of each phase, the student must meet the PhD Committee to present and to discuss his/her results. In addition, in the middle of the second and third year of the PhD course, the student must present to the PhD Committee a state-of-the-art report on the research work to verify the fruitful performance of the activity and to check any critical issues within the PhD programme. The PhD Committee evaluates the work and makes suggestions where necessary.

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

- **Within 6 months:** together with the supervisor or co-supervisors, the student develops and organizes his/her research project which must be presented and discussed in front of the PhD Committee.
- **Within 12 months:** the student must prepare a public seminar in which he/she presents and discusses the state-of-the-art of his/her research topic and/or the first results of his/her project;
- **At the end of each doctorate year:** to be admitted to the following year or to the final exam, the student prepares a report of his/her research activity at the end of each year and submits it to the PhD Committee. The report must be presented more extensively to the PhD Committee at the end of the second and third year, while it is presented more concisely at the end of the public seminar at the end of the first year.
- **Within three years:**
 - students must take part in at least one international conference where they must present a paper or a poster;
 - the student must include a research period abroad of at least 3 months, even if not consecutive;

- the student must attend, and pass the relevant 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 submitted to the PhD Committee a draft of their final thesis.

Reasoned 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 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.

Research activities have three main objectives concerning: (i) energy efficiency in the generation, distribution, and use of energy, (ii) the replacement of fossil fuels with renewable resources and (iii) sustainable production and supply chain management. Of particular interest are aspects related to specific contexts such as the mountain territory of South Tyrol. In this regard, activities focus in particular on energy efficiency in buildings and production systems and 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, of HVAC systems for heat production, storage, distribution and supply as well as ventilation systems;
- Characterization and optimization of the energy performance of the building-plant system during design/diagnosis/renovation and in management and control;
- Study of energy efficiency solutions in 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 energy production and management 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, fluidised beds, granular fluidised beds and others), with focus on flexibility in feeding, load modulation and by-product valorisation;
- Analysis of integrated polygeneration supply chains for the production of solid biofuels (e.g. hydrochar from hydrothermal carbonisation), liquid biofuels (e.g. gasoline from Fisher-Tropsch process) or gaseous biofuels (e.g. synthesis gas from gasification processes and/or Power to Gas processes);

- Development and optimization of fluid power plants and machines for energy conversion, such as combustion engines and gas turbines powered by alternative fuels or innovative management solutions;
- Analysis and development of innovative powertrains, electric and hybrid, in the automotive and industrial machinery sectors; study of energy flow management in the vehicle;
- Energy analysis of agricultural machines also using liquid biofuel mixes also with nanoparticles, fuel cells with biohydrogen, analysis and optimization of food processing plants (in particular for wine production) from a dual machine-process viewpoint, study of bio lubricants (possibly also with nanoparticles) in agricultural machines;
- Study of decentralized hydrogen production 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 then utilization.
- Development and optimization of traditional and innovative hydrogen turbines (e.g. pump as turbine, hydrokinetic turbines) with emphasis on energy recovery;
- Development and optimization of generation technologies from hydroelectric and wind power plants and their integration into the territory;
- Development and optimisation of networks for the transport of fluids under pressure (such as district heating plants, water distribution networks, natural gas distribution networks) and energy recovery measures;
- Prevention of hydrogeological risks related to energy production and water use;
- Optimization and development of electrical machines and their advanced control methods, with emphasis on loss reduction;
- Modelling, control, and optimisation of static power converters, in particular for exchange with battery storage systems.

c) Sustainable production and supply chain management

- Circular economy in production and the supply chain
- Decarbonization and life cycle engineering
- Eco-smart production processes and factories
- Smart, resilient, and human-centric production
- Sustainable organization and supply chain management

Requirements and minimum documentation to be submitted for admission

Degrees from the old Italian system: all

Master (laurea specialistica/magistrale): all

Foreign degrees

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

The application for admission to the PhD programme **must include** the following documents:

- A motivation letter in English (max. 1 page).
- The curriculum vitae (CV) in English and possibly according the European format that can be downloaded here <https://europass.cedefop.europa.eu/en/documents/curriculum-vitae>).
- Master's degree certificate/list of exams passed with indication of final grade /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 candidate should provide certified information on the assessment methods used at the place where the qualification was

awarded. In case of Italian university degree, the certification must be substituted by a self-declaration or the diploma supplement.

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

- Letters of reference, written in Italian, German or English by a university lecturer or researcher from research institution;
- list of the candidate's publications (published, in print or submitted), with relevant links, if available.

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

The preferable requisites for admission to the PhD programme are related to an appropriate educational, cultural, or working background within the research themes of the PhD programme. 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 phases:

1. Candidates' applications are first examined for completeness and eligibility by the competent unibz offices.
2. Complete applications that meet the basic admission requirements are then evaluated by the Evaluation Committee, which will take into consideration: curriculum vitae, the letter of motivation, qualifications (including any publications), and the alignment between the candidate's profile/interests and the research areas of the PhD programme. The Evaluation Committee will then draw up a list of candidates to be admitted to phase 3 of the selection process.
3. Each candidate will be interviewed to assess his/her knowledge and basic technical skills in one or more research areas of the PhD programme. During the interview, English language knowledge will also be verified. Telematic tools are allowed for the interview. The Evaluation Committee will select the best candidates based on a comparative evaluation.

The following points will be awarded:

- up to a maximum of 15 points: for the CV, the letter of motivation, and additional qualifications,
- up to a maximum of 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 scholarship. The lowest score to be admitted in the ranking is 18/30.

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



Examination dates

Description	Date	Place
Interview	within 29 July 2024	At unibz or via Microsoft-TEAMS videoconference according to availability – unless otherwise communicated

Positions and grants

Total positions:	9
Positions with university scholarship:	4
Positions MD 630/2024 from PNRR:	3
Position without scholarship:	2

PhD scholarship linked to specific research topics/areas:

3 scholarships with research topic linked and obligation of minimum 6 months abroad under MD 630/2024 funded by the European Union – NextGenerationEU:

Research topics:

1. Monitoring sustainability performance in manufacturing for the digitalization of group-wide sustainability reporting (in collaboration with DUKA spa, supervisor prof. Erwin Rauch)
2. Dynamic assessment model for sustainability and resilience along the supply chain (in collaboration with Intercable Automotive Solution srl, supervisor prof. Erwin Rauch)
3. Multiphysics Modeling and Thermal Optimization of Cooling Systems for Power Electronics Applications (in collaboration with Alpitronic srl supervisor prof. Massimiliano Renzi)