


FREIE UNIVERSITÄT BOZEN  
LIBERA UNIVERSITÀ DI BOLZANO  
FREE UNIVERSITY OF BOZEN - BOLZANO

Fakultät für Naturwissenschaften und Technik | Facoltà di Scienze e Tecnologie | Faculty of Science and Technology

**Attività di ricerca e formazione nel campo dell'efficienza energetica in edilizia e delle energie rinnovabili**  
**Universitäre Forschungs- und Ausbildungsaktivitäten in den Bereichen Energieeffizienz und Erneuerbare**

Bozen-Bolzano, Italy – 14 November 2012

**Grüne Technologien in der Provinz Bozen**  
**Green Technologies in Provincia di Bolzano**

1. FREE UNIVERSITY OF BOZEN-BOLZANO 

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**UNIBZ - Main informations**


- Public, non-state university (Provincia Autonoma di Bolzano)
- 5 Faculties:
  - Computer Science
  - Economics and Management
  - Education
  - Design and Art
  - Science and Technology (2007)

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1. FREE UNIVERSITY OF BOZEN-BOLZANO				
<b>Unibz</b> <b>Facts and Figures</b> <b>2012.1</b>	<b>University</b> <b>1997</b> year of foundation <b>4</b> teaching languages (English, German, Italian and Ladin) <b>5</b> faculties <b>7</b> research centres <b>3</b> Campuses <b>61.6</b> million Euro budget in 2012	<b>People</b> <b>3.364</b> students <b>110</b> tenured professors and researchers, of whom . <b>31.81%</b> are female <b>47.28</b> the average age of tenured academic staff <b>492</b> contract professors <b>230</b> administration and technical staff, of whom . <b>37%</b> are male . <b>23%</b> part-time	<b>Teaching</b> <b>10</b> Bachelor degree courses <b>6</b> Master degree courses <b>1</b> 5-year degree course <b>2</b> European Master <b>1</b> Master 1st level <b>4</b> PhD courses <b>1</b> Studium Generale <b>119</b> courses held at the Language centre in 2011/12 <b>515</b> internship agreements with companies and institutions	
	<b>Sources of funding</b> <b>92.41%</b> Autonomous Province of South Tyrol <b>5.72%</b> tuition fees <b>1.87%</b> other sources	<b>International profile</b> <b>28.18%</b> tenured professors and researchers of international origin <b>18%</b> of students of international origin (national average 2.6%)		
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1. FREE UNIVERSITY OF BOZEN-BOLZANO				
<b>Unibz</b> <b>Facts and Figures</b> <b>2012.2</b>	<b>Research</b> <b>201</b> current research projects, out of those . <b>9</b> European . <b>6</b> international . <b>5</b> national . <b>22</b> regional . <b>16</b> research contracts . <b>143</b> internal <b>302</b> research projects completed, out of those . <b>15</b> European . <b>22</b> national . <b>11</b> regional . <b>60</b> research contracts . <b>194</b> internal <b>3</b> million Euro external funding in 2011 <b>3.6</b> million Euro total internal budget of current research projects <b>70%</b> of contracts with third parties are with local companies/organizations	<b>International Relations</b> <b>134</b> partner universities with <b>151</b> agreements including: . <b>123</b> LLP/Erasmus agreements . <b>1</b> Leonardo da Vinci agreement: internship for graduates . <b>3</b> agreements for joint degrees in the Erasmus Mundus framework . <b>22</b> bilateral agreements . <b>2</b> BIT (agreements between the universities of Bolzano, Innsbruck and Trento) <b>61</b> nationalities represented in the student body <b>400</b> study places for students of other universities <b>400</b> study places for our students in other universities		
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# 1. FREE UNIVERSITY OF BOZEN-BOLZANO



UNIVERSITÀ DI BOZENO  
UNIVERSITÄT SÜDTIROL  
UNIVERSITY OF BOZEN - BOLZANO

**Unibz  
Facts and Figures  
2012.3**

**Science and Technology**  
Faculty of Science and Technology  
Bolzano | Bozen campus,  
**280 students**  
Bachelor in  

- . **Agricultural and Agro-Environmental Sciences**
- . **Industrial Mechanical Engineering**

 Master in  

- . **Fruit Science**
- . **Energy Engineering**

 Executive Master in  

- . **Innovation Engineering**


 PhD programmes in  

- . **Mountain environment and Agriculture**
- . **Sustainable Energy and Technologies**

 The Faculty is currently working on **51** research projects with a total value of **3 million Euro** (of which **70%** is externally financed)

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# 2. FaST: teaching programs



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**Bachelor programs (3 years 180 credits) - 1<sup>st</sup> level**

**1** Agricultural and Agro-Environmental Sciences (L-25)  
**1** **Industrial Mechanical Engineering** (L-9)

**Master degree programs (2 years 120 credits) – 2<sup>nd</sup> level**

**1** International M. in Fruit Science (LM-69)  
with University of Ljubljana (Slovenia), and the Faculty of Biotechnology at the Mendel University of Brno, Lednice (Czech Republic)

**1** International MD in **Energy Engineering** (LM-30) – Since 2012/13  
with the University of Trento

**PhD programs – 3<sup>rd</sup> level**

**1** Mountain Environment and Agriculture  
**1** **Sustainable Energy and Technology** – Since 2011/12  
in collaboration with: KTH, ESUR Strathclyde, ETH-EMPA, U. Western Australia, U. Adelaide, U. Innsbruck, Appl. Sc. U. Luzern

Second level Master Klimahaus Casaclima for professionals (reopen in 2013-14?)

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2 - FaST: Master Degree

UNIVERSITÀ DEGLI STUDI DI TRENTO

UNIVERSITÀ DEGLI STUDI DI BOLZANO

UNIVERSITÀ DEGLI STUDI DI BOLZANO

## Study plan

1 year 1 semester (Trento)	
Electrical Systems Engineering	
Fluid Machines Engineering	
Engineering Thermodynamics, Heat and Mass Transfer	
Environmental Fluid Mechanics/ Hydropower Plants	<i>Environmental Fluid Mechanics</i>
	<i>Hydropower Plants</i>

1 year 2 semester (Bolzano)	
Building Energy Performance and HVAC Systems	
Advanced Applications of Building Physics Technologies and Production Processes for Energy Engineering	
Functional Mechanical Design for Energy Efficiency	

2 - FaST: Master Degree


UNIVERSITÀ DEGLI STUDI DI TRENTO

UNIVERSITÀ DEGLI STUDI DI BOLZANO


UNIVERSITÀ DEGLI STUDI DI BOLZANO

## Study plan

2 year 1 semester (Bolzano)	
Power Production, CHP and District Heating Systems	<i>Thermal Engines</i>
	<i>Thermal power production and distribution</i>
Electric Power Conversion Equipment	
One between:	
Advanced materials for Energy Engineering	
Mechanics and Structural Design for Energy Engineering	<i>Fundamentals of Structural Mechanics</i>
	<i>Fundamentals of Structural Design</i>
Optional Subjects – Insegnamenti a scelta – Wahlfächer	



## 2. FaST: PhD Program



UNIVERSITÀ BOZENO  
UNIVERSITY OF BOLZANO  
FRIEDRICH-SCHLEGEL-UNIVERSITÄT BOZEN - SÜDTIROL

### Focus

1. Sustainable Energy and Buildings:
  - a. Building Physics
 


Evaluation of energy performance of the envelope and of the building system (heating, cooling, and air conditioning).
  - b. Renewable energy technologies
 

Theoretical and experimental characterisation of renewable energy sources exploitation. Biomass to energy processes.

Sustainable exploitation of the natural resources
  - c. Environmental design
 

Planning of the built environment inserted in the urban and natural context

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## 2. FaST: PhD Program



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### Focus

2. Sustainability in Industrial product and processes:
  - a. Mechanical design and industrial manufacturing
 

Pursue of sustainable products through Life Cycle Assessment (LCA), Customer Value Engineering, new production processes for waste, energy and emission reduction.
  - b. Manufacturing technology
 


Pursue of sustainability in production and engineering of new metal alloys for new products and improvement of existing ones.
  - c. Logistics and processes management
 

Development of the Business Process Reengineering (BPR) and simulation models for industrial production lines for sustainability pursue.

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## 2. FaST: PhD Program



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### Scientific Network

**Cooperation with:**  
Eurac (Institut for renewable energy), Fraunhofer Italia, ENEA

**Partner institutions:**  
KTH Royal Institute of Technology, Stockholm  
Swiss Federal Institute of Technology ETH, Zurich  
Swiss Federal Laboratories for Materials Science EMPA, Zurich  
University of Western Australia  
Strathclyde University, Glasgow  
University of Adelaide  
Universität Innsbruck  
Università di Scienze Applicate, Lucerna

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## 3. FaST: research focuses




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<p><b>1 Agricultural Production and Food Technologies: “AGRICULTURE &amp; FOOD”</b></p> <p>The focus encompasses studies along the food chain from the primary production, passing through processing technologies, logistic distribution, food conservation, till the consumer behavior. These studies emphasize advances and innovations concerning sustainable agricultural practices and novel food processing technologies to enhance the quality, traceability, sustainability and safety of food, especially from alpine regions.</p>	<p><b>2 Management and Technologies for Mountain Environments: “ENVIRONMENT”</b></p> <p>Mountain environment is sensitive and vulnerable to natural or anthropogenic ecological imbalance. The ecological management of mountain environment is based on the understanding of the vulnerability and adaptation potential of mountain ecosystems to both natural and socio-economic changes. The central topic of this research area is therefore the understanding of the effects of natural and anthropogenic disturbances on the functioning of terrestrial and aquatic ecosystems, at both local and global scale.</p>	<p><b>3 Engineering methods and technologies for products and processes innovation: “INDUSTRIAL PRODUCTION”</b></p> <p>The focus studies the technical and organizational optimization of production technologies and processes with the objective of quality and ergonomic improvements as well as cost and lead time reduction. Attention is given to the design and use of management technologies especially in the context of small and medium sized industrial, construction and agricultural enterprises.</p>	<p><b>4 Energy Resources and Energy Efficiency: “ENERGY”</b></p> <p>In strict contact with the local reality of the mountain territory of South Tyrol, the two classical paradigms of energy efficiency in energy production, distribution and utilization and of replacement of traditional fuels with renewable energy sources are here considered. Accordingly, research activities cover, on the side of energy production, the renewable energy resources management and the energy production technology, and, on the side of energy efficiency, the energy efficiency in buildings and the energy efficiency in the production systems.</p> <ol style="list-style-type: none"> <li>1. Biomass to energy</li> <li>2. Building Physics</li> <li>3. Other</li> </ol>
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## 4.1 Energy 1: biomass to energy




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1 AIMS	2 METHODS	3 FINDINGS & APPLICATIONS	4 OUTLOOKS
<p>Pyrolysis, gasification</p> <p>Torrefaction</p> <p>Tar</p> <p>Combined Heat and Power Systems</p>	<ul style="list-style-type: none"> <li>. Advanced thermal analysis (STA/FTIR/GC/MS)</li> <li>. Process simulation (thermofluid-dynamic, kinetic)</li> <li>. System simulation</li> <li>. Pilot/bench scale plant design and development</li> <li>. Monitoring of existing plants</li> </ul>	<ul style="list-style-type: none"> <li>. 2 phase thermodynamic models</li> <li>. 3 phase kinetic models</li> <li>. 3D thermofluid-dynamic models</li> <li>. Bench scale pyrolysis reactor</li> <li>. Tar online /offline methods calibration</li> <li>. Tar bioremediation procedures development</li> </ul>	<ul style="list-style-type: none"> <li>. Comprehensive modeling</li> <li>. Urban scale simulation</li> <li>. Pilot plant setup (Technopark)</li> </ul>

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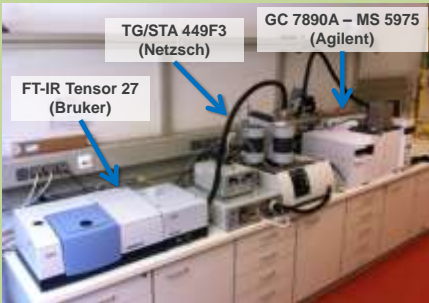
## 4.1 Technical physics 1: biomass to energy




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### 5 LABS

#### Advanced Thermal Analysis



#### Bench scale pyrolysis reactor



- Quartz reactor
- Tar Sampling System (UNI CEN/TS 15439)
- Portable Gas-Sampler
- Micro GC analyzer

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4.2 Energy2: building physics			
1 AIMS	2 METHODS	3 FINDINGS & APPLICATIONS	4 OUTLOOKS
Simulation methods	<ul style="list-style-type: none"> <li>. Extensive comparison</li> <li>. Simulation calibration</li> </ul>	<ul style="list-style-type: none"> <li>. Comparative validation</li> <li>. Quasi steady state methods validations</li> </ul>	<ul style="list-style-type: none"> <li>. Simulation in energy diagnosis and refurbishment</li> </ul>
Opaque components dynamic performance	<ul style="list-style-type: none"> <li>. Laboratory tests</li> <li>. Theoretical analysis (1D-3D Steady/Unsteady)</li> </ul>	<ul style="list-style-type: none"> <li>. Thermal dynamic transfer properties</li> <li>. Laboratory experimental procedures</li> </ul>	<ul style="list-style-type: none"> <li>. Unsteady state lab and on site measurement devices and procedures</li> <li>. 2-3D laboratory test setup (Technopark)</li> </ul>
Envelope dynamic performance	<ul style="list-style-type: none"> <li>. On site monitoring</li> </ul>	<ul style="list-style-type: none"> <li>. School buildings long term survey</li> </ul>	<ul style="list-style-type: none"> <li>. Real Scale Modular Building setup (Technopark)</li> </ul>
System dynamic performance (ventilation)	<ul style="list-style-type: none"> <li>. Thermofluid-dynamic analysis</li> <li>. Laboratory tests (Padova)</li> </ul>	<ul style="list-style-type: none"> <li>. Envelope and System Components (thermal, lighting, comfort modelling)</li> </ul>	<ul style="list-style-type: none"> <li>. Laboratory test facilities</li> </ul>

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## 4.2 Energy 2: building physics

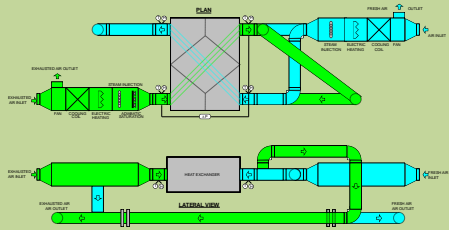

### 5 LABS

#### Envelope characterization



Hot box & thermo-flowmeter (EN1934)  
Laser Flash Analysis

#### HVAC test rig

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## 4.1/2 Scientific network



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UNIVERSITÄT SÜDTIROL  
UNIVERSITY OF SOUTH TIROL

### 1 BIOMASS TO ENERGY

#### National cooperation

- . **Barbara Bosio** University of Genova
- . **David Chiamonti** University of Firenze
- . **Maurizio Grigiante** University of Trento

#### International contacts and cooperation

- . **Marco J. Castaldi** Columbia University NYC
- . **Hui T. Chua** University of Western Australia
- . **Walter Haslinger** Bioenergy 2020+, Wien
- . **Jürgen Karl** University of Nürnberg
- . **Thomas Nordgreen** KTH, Stockholm
- . **He Ping** CRAES, Beijing
- . **Niels Thevs** University of Greifswald

### 2 BUILDING PHYSICS

#### National cooperation

- . **Paolo Baggio** University of Trento
- . **Francesca Cappelletti** IUAV Venice
- . **Giovanni A. Longo** University of Padova
- . **Piercarlo Romagnoni** IUAV Venice

#### International contacts and cooperation

- . **Jan Carmeliet** EMPA-ETH
- . **Joe Clarke** Strathclyde University Glasgow
- . **Jan Hensen** TU Eindhoven
- . **Ardeshir Mahdavi** TU Wien
- . **Thanos Tzempelikos** Purdue University

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## 4.3 Other energy related topics



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UNIVERSITY OF SOUTH TIROL

### 1 ELECTRICAL SYSTEMS

As far as the electrical energy is concerned, the target is to analyze and to design high performance electrical machine and drives so as to optimize the global system efficiency.

### 2 ENERGY CONVERSION SYSTEMS


Theoretical and experimental analysis of the Energy conversion system (ICE, GT, ORC, Stirling engines) fuelled by biomass, intermediate fuels or other sources. Study and design of high performance solar concentration energy conversion systems for thermal and electrical power production.

### 3 CLIMATEINDUSTRY

Definition of an energy audit approach at district, factory and single plant level. Analysis of the energy saving potential, by using more efficient production systems or by adopting distributed generation and combined heat and power systems. Redesign of the production systems in synergy with the green-mechatronics concepts

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## 5. Initiatives: Technology Park



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### Strategic Plan for Research Development in South Tyrol

COMPUTATION & ICT FOR AUTOMATION

**TRANSDISZIPLINÄRE PLATTFORM „TECHNOLOGIE UND GESELLSCHAFT“**

- SOCIAL IMPACT OF TECHNOLOGIES
- ENTREPRENEURSHIP
- COMMUNICATION & DESIGN
- QUALITY CONTROL & CERTIFICATION


KLIMAHaus UND ENERGIE-PRODUKTION

LEBENSMITTEL-TECHNOLOGIE

ALPINE TECHNOLOGIE

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## 5. Initiatives: Technology Park



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### LINEE DI RICERCA (LUB, EURAC, Fraunhofer Italia)

		LUB	EURAC	Fraunhofer
		AMBITO di RICERCA		1L: Prestazioni dinamiche dell'involucro
<b>KLIMAHaus/ PRODUZIONI ENERGETICHE</b>	Klimahaus	2L: Prestazioni operative degli impianti	2E: Solare fotovoltaico e termico e pompe di calore in sistemi solari integrati	2F: Regolazione e controllo del sistema edificio impianto
		3L: Environmental Design	3E: Energia negli edifici storici	3F: Processi nel settore edilizio
	Prod. energetiche	4L: Gestione ed integrazione delle fonti rinnovabili		
		5L: Cogenerazione distribuita da biomasse		
		6L: Fluidodinamica computazionale e convertitori elettrici		

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## 5. Initiatives: Technology Park



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### 1L Prestazioni dinamiche dell'involucro

- Misura in laboratorio e in opera del comportamento dinamico dell'involucro opaco degli edifici
- Misure di proprietà termofisiche
- Modellazione e calcolo (FEM, simulazione)

Applicazione

- Edifici nuovi ad elevate prestazioni invernali/estive
- Diagnosi e riqualificazione energetica



### 2L Prestazioni dell'impianto

- Caratterizzazione delle prestazioni degli impianti in condizioni operative (diverse da quelle nominali) puntuali e medie stagionali
- Misure termofisiche e fluidodinamiche

Applicazione

- Edifici nuovi
- Diagnosi e riqualificazione energetica edifici esistenti

### 5L Cogenerazione distribuita da biomasse

- Studio e ottimizzazione in laboratorio e su scala pilota delle tecnologie di produzione combinata di calore ed energia elettrica da biomasse
- Caratterizzazione e prototipazione dei processi di pirolisi e gassificazione

Applicazione

- Impianti di cogenerazione distribuita

- Test setup per impianti HVAC
- Sensori e misuratori di grandezze termofluidodinamiche in ambito termotecnico

- Reattori per pirogassificazione e trattamento in laboratorio
- Pilot plant per gassificazione e trattamento gas

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## 5. Initiatives: conferences



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Bozen Jan 30<sup>th</sup> – Feb 1<sup>st</sup> 2013

1<sup>st</sup> IBPSA Italy Conference

Jan Hensen, Ardeshir Mahdavi

Natale Arcuri, Paolo Baggio, Vincenzo Corrado, Andrea Gasparella

BOZEN-BOLZANO  
30.01-01.02.2013

BSA

2013

Building Simulation Applications

1st IBPSA-ITALY CONFERENCE



UNIBZ

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