20 years of EESD at UPC Barcelona Tech
Learning by doing

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1. UPC Barcelona Tech and Sustainability planning
2. Institute for Sustainability Science and Technology
3. Integrated sustainability research and problem-solving framework
Fields of teaching activities

- Aerospace Engineering
- Architecture, Urbanism and Building Construction
- Applied Sciences
- Audiovisual Communication
- Biosystems Engineering
- Business Management and Organization
- Civil Engineering
- Environment, Sustainability and Natural Resources
- Health Sciences and Technology
- Industrial Engineering
- Informatics Engineering
- Naval, Maritime and Nautical Engineering
- Telecommunications Engineering

Fields of research

- Architecture, Urbanism and Building Construction
- Civil Engineering
- ICT Engineering
- Sciences
- Industrial Engineering
  - Mechanical Engineering
  - Electrical Engineering
  - Thermal Engineering
  - Chemical Engineering
  - Materials Science
  - Business administration
  - Etc.

Institutes

Institute of Photonic Science (associated entity)
Institute of Textile Research and Industrial Cooperation
Institute of Industrial and Engineering Control
Institute of Sustainability Science and Technology
Institute of Robotics and Industrial Informatics (mixed UPC-CSIC)
Institute of Energy Technology
Institute of Education Sciences
Public higher education and research institution
Specialized in the fields of architecture, science and engineering.

Hub of talent, innovation, technology transfer and regional development:
- 2009: Barcelona Knowledge Campus (BKC), a project carried out with the University of Barcelona
- 2011: Campus of Excellence with the UPC Energy Campus project

23 schools in 8 campuses
42 departments
6 research institutes

35,698 undergraduate and postgraduate students

69 bachelor’s degrees
63 master’s degrees
87 international double-degree agreements with 51 universities
274 doctoral theses defended (2011)

2,780 teaching and research staff members (59% PhD holders)
1,694 administrative and service staff members
126 research groups recognised by the Catalan government
19 research centres belonging to the TECNIO network

- research and innovation projects
- technology-based companies,
- spin-offs and start-ups.
Our “Decades for SD”

- 1990: Cooperation for Development center
- 1995: UNESCO Chair in Sustainability
- 2002-2005: 2nd Plan in Env.
- 2006-2010: UPC Sustainable 2015
- 2015: Institute for Sustainability Science and Technology
- 2010: STEP Program
- 1990: Environmental Declaration of UPC
- 1995: Waste management system
- 1996: UPC signs Copernicus Charter
- 2000: Master in Sustainability
- 2002-2005: PhD in Sustainability
- 2006-2010: UPC Sustainable 2015
Sustainability Planning at UPC Barcelona Tech

- **1st Plan 1996 – 2001**: UPC will promote the development of an environmental integrative model in the university. *Embedding environment in teaching, research and management.*

- **2nd Plan 2002-2005**: From environment to Sustainability. *Include the objectives of the Plan in the strategic plans of the basic units.*

- **Plan “UPC Sustainable 2015” 2006-2015**: The UPC wants to be proactive towards Sustainable Development.
  - Transition from the environmental approach to sustainable human development.
  - Strengthening the social role of the university and the opening to society.
  - Future orientation.
  - Thematic priorities
2. Institute for Sustainability Science and Technology
Research Programmes

Energy & Climate Change

Water Cycle

Waste & Zero Emissions

Territory Planning & Mobility

Health, Air Quality & Food

Responsible Consumption

Social Environment

University Culture

Campuses as Labs

Governance

Sustainability Education and Technology
Sustainability Science Education

- Competences
- Pedagogy (PBL, Blended L, Cooperative L, etc.)
- Assessment
- Curriculum design
- HEI management/governance/culture
Teaching

M. Sc. Courses

– Master’s degree in Sustainability
  • 50 students / year
– Master’s degree in Technology for Human Development and Cooperation
  • 20 students (academic year 2012/13)

Ph. D. Programmes

– Ph. D. in Sustainability (70 students)
– Ph. D. in Environmental Engineering

In-service training / Continuous education

– Map of In-service Training at UPC in the field of Sustainability
• Projects & networks:
  – Edusost: Catalan Research Network in Sustainability Education
    www.edusost.cat

  – CADEP: Spanish network for Sustainability Education in HEI
    http://www.crue.org/Sostenibilidad/CADEP/

  – SDPromo: Promotion of European Higher Education in Sustainability Science
    http://www.sdpromo.info

  – NEPS: International Network of Programs in Sustainability Sciences
• Projects & networks:
  – EESD - Barcelona declaration in EESD
  – Tempus:
    Creation of Third Cycle Studies - Doctoral Programme in Renewable Energy and Environmental Technology (www.eucredo.info)
    Establishing Modern Master-level Studies in Industrial Ecology (www.iemast.info)
    Training courses for public services in sustainable infrastructure development in Western Balkans (http://www.sdtrain.info)
• Projects & networks:
  – Sustainable Technology Excellence Program
    http://www.upc.edu/sostenible2015/step

  – IP: International Seminar in Sustainability and Technology Innovation
    http://is.upc.edu/seminaris-i-jornades/seminaris/std-2014
Integrated sustainability research and problem-solving framework
SWOT

**Strengths**
- Leadership
- Innovators/Champions
- Internal Networks
- Small size
- Coordination unit
- Increase of active learning

**Weaknesses**
- Academic freedom
- Incentive structure
- Conservative administration
- Disciplinary oriented
- Resistance to change
- Staff lack of comprehensive SD
- Overcrowded curriculum

**Opportunities**
- Benchmarking from peer institutions
- Sources of funding available
- Pressure from Accreditation Agencies/Professional bodies
- EHEA
- ESD HEI Networks

**Threats**
- Lack of pressure from society
- Lack of pressure from employers (≈)

**Drivers**
- Internal factors

**Barriers**
- External factors
Engineering Education for a Sustainable Future

Complex problem constellations in the current situation and their history

2009 Design new degrees

Non-intervention future scenarios

Sustainability visions

Sustainability transition strategies

 ✓ STEP 2015
 ✓ Competence SCS
 ✓ Seed projects
 ✓ ...

UPC Sustainable 2015
Focusing on processes

Complex problem constellations in the current situation and their history

Non-intervention future scenarios

Sustainability visions

Sustainability transition strategies
What? Which SD competences must engineers learn at universities?

Why? What is the role of Engineering in SD?

EESD – Engineering Education for Sustainable Development

How? How can these competences be acquired efficiently?

The role of pedagogy

Where? Which education structure is more effective for the required pedagogy and to embed SD in the curriculum
Engineering graduates must have the next SD competences: critical thinking, systemic thinking, to be able to work in transdisciplinary frameworks, and to have values consistent with the SD paradigm.

A common framework to define, describe and evaluate competences is needed.
The role of the teacher is very important for SD learning in terms of implicit learning of sustainability values, principles and critical thinking.
Students achieve better cognitive learning as more community-oriented and constructive-learning pedagogies are applied.

Multi-methodological experiential active learning education increases cognitive learning of sustainability.
There are mainly four approaches to increase EESD in universities: a specific course, a minor/specialization in SD, a Master on SD or Sustainable Technologies and the embedment of SD in all courses.

The main barrier to embedding SD in all courses is the faculty lack of SD comprehension. The individual approach has shown to be a successful approach to overcome this barrier.
There is a need of clear top-down leadership in the ESD process, which must promote the bottom-up approach
By 2015, all graduates of the UPC will apply sustainability criteria in their professional activities and in their sphere of influence.
Generic Competence in Sustainability and Social Commitment Compulsory at all Bachelors
Generic Competence in Sustainability and Social Commitment

• DEFINITION
Knowing about and understanding the complexity of the economic and social phenomena characteristic of a welfare state. Being able to relate social welfare, globalisation and sustainability. Being able to use know-how and technology in a balanced way that is compatible with economic considerations and the goal of sustainability.

OBJECTIVES BY LEVEL
• Level 1: To systematically and critically analyse the global situation, based on an interdisciplinary approach to sustainability, and taking into account sustainable human development; and to recognise the social and environmental implications of professional activity in one’s area of specialisation.
• Level 2: To apply sustainability criteria and professional codes of conduct in the design and evaluation of technological solutions.
• Level 3: To take social, economic and environmental factors into account in the application of solutions; and to carry out projects that are consistent with human development and sustainability.
Sustainable Technology Excellence Program STEP-2015. Institutional change for embedding sustainability at UPC – Barcelona Tech
Program STEP 2015 Goals

- Design specific **units/subjects in sustainability** for each degree.
- Develop the **conceptual framework** and identify reference models in sustainability for all the disciplines offered at UPC.
- Constitution of a **interdisciplinary network** with faculty from all UPC departments.
- Promote and start **new transdisciplinary research activities** related to Technology-Sustainability-Education.
- Graduate the first engineers of the new bachelors (2013) and Masters (2015) that had followed an education with sustainability embedded in its curricula.
Initial structure (2009)
Expansion structure (2010-12)
ERASMUS Intensive Program in Sustainable Technology Development
The Learning Environment

Problem-Based Learning approach

- Transdisciplinary
- International
- Intercultural
- Intergenerational
The Conceptual Approach

BACKCASTING: The Natural Step approach

1. Defining criteria for sustainability
2. Describe present situation in relation to the criteria for sustainability
3. Envision future solutions
4. Finding strategies towards sustainability

[Holmberg and Robèrt, 2000]
The Conceptual Approach

BACKCASTING: The “Dutch” approach
- **UPC Barcelona Tech**, (Master of Sustainability, Master of Environmental Engineering) Barcelona, Spain
- **Delft University of Technology**, (Master of Industrial Ecology) Delft, The Netherlands
- **Chalmers University of Technology**, (Master in Industrial Ecology for a Sustainable Society and Master in Sustainable Chemical Processes) Goteborg, Sweden
- **Royal Institute of Technology, KTH**, (Master in Sustainable Technologies) Stockholm, Sweden
- **Graz University of Technology**, (Master in Sustainable Development) Graz, Austria
- **University of Maribor** (Master in Food safety in the agrofood chain) Maribor, Slovenia
- **Purdue University** (Master in Technology), Indiana, USA.
- **Dublin Institute of Technology** (Master un Sustainability, Technology and Innovation) Dublin, Ireland
1. Water sanitation and treatment
2. Decoupling in food & beverage packaging
3. Overfishing and marine ecosystems degradation
4. Sustainable mobility
5. Agroecology (Erasmus Intensive Programme)
7. Sustainable Clothing

• **Around 2 case studies**
  ✓ Developed/Developing region
  ✓ Global/Local problem
PARTICIPANTS will work in the virtual phase on two main activities:
1. Work in local universities groups: Poster on Local Situation Analysis
2. Work in international groups: Report on Case Study

Working Plan deadline: 23/04
Reference Reports deadline: 07/05
Final Report on Study Case deadline: 28/05
Poster deadline: 29/05
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Sustainability visions

UPC Sustainable 2015

✓ STEP 2015
✓ Competence SCS
✓ Seed projects
✓ ...

Intervention Point
Lessons learnt

• Sustainability is no-one’s domain, but everyone’s.
• A ‘comprehensive’ institutional approach is fundamental
• Balance between “concentrate” and “diffuse”
• We need multiple approaches and “interfacial & connection units” with society (learning inputs)
• Sustainability needs to be practical, shown, counted!
• Research in SD transitions & ESD is necessary as is part of the organisational learning process
• Sustainability has become today a strategic option for UPC. Not only because an ethical will, but also because it is a driver for innovation and triggers us to become more relevant to society
20 years of EESD at UPC Barcelona Tech.
Learning by doing

Thank you for your attention
Tack för er uppmärksamhet

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