



Engineering skills and knowledge Building Sector learning from Europe

Talat Munshi, Victor Marina

Background



PARIS AGREEMENT, Article 2 (a)

“Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change”

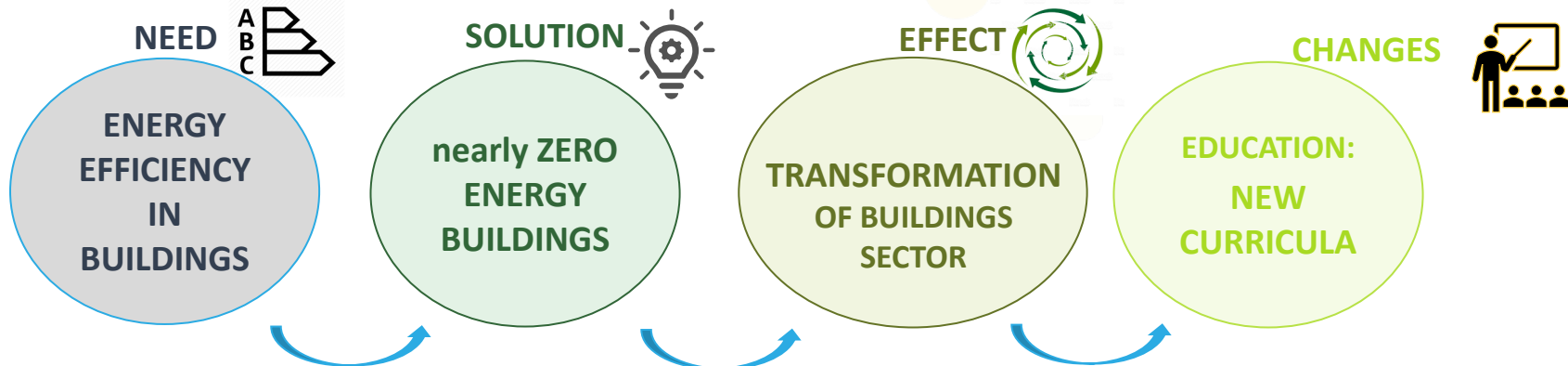


BUILDINGS SECTOR

36% global energy demand (UNEP, 2017)

39% global CO₂ (UNEP, 2017)

77% increase of energy use (IEO, 2019)



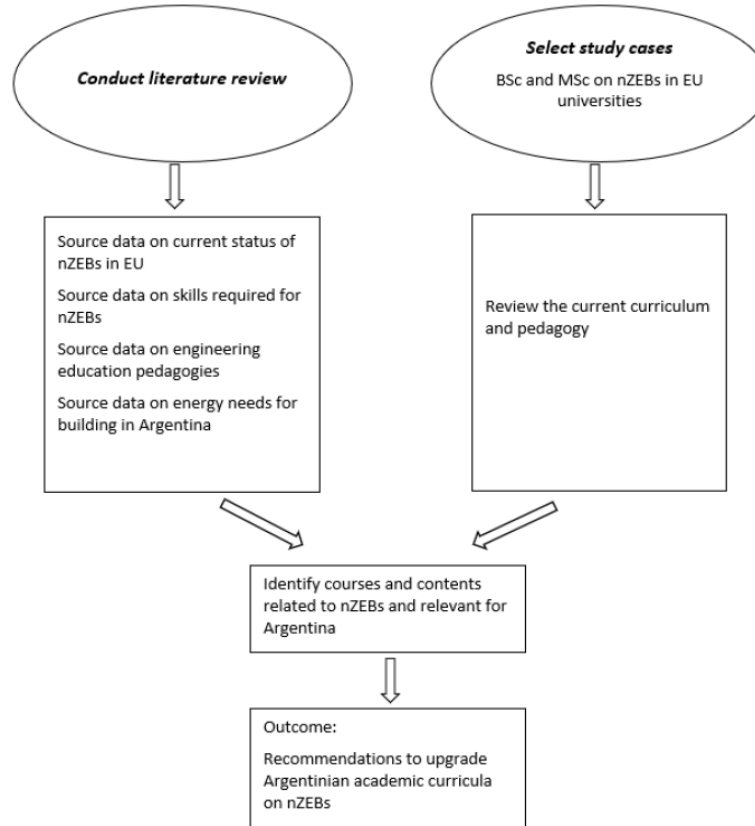


Review of engineering education for design and construction of sustainable buildings in Europe and what Argentina can learn

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Author: Victor Jose Torrejon Marina, s182320

Methods



Skill Category	Concept/Skills	Skill Category	Concept/Skills
General concepts	<ul style="list-style-type: none"> • Energy building performance • Building codes and building regulation • Certifications 	Climate and Comfort	<ul style="list-style-type: none"> • Climate and Weather • Thermal Comfort • Visual Comfort • Indoor Air Quality • Building Typology • Outdoor Spaces
Sustainable architectural design	<ul style="list-style-type: none"> • Orientation and layout of the building to reduce/maximize the absorption of heat from the sun and daylight • Space allocation concerning daylight 		<ul style="list-style-type: none"> • Thermal Environment • Internal heat sources • Passive and Active Design Systems • Dehumidification systems • Dynamic Response of Buildings • Thermal Control Zones • Centralized (district heating) and decentralized systems
Envelope design	<ul style="list-style-type: none"> • Thermal bridges • Windows • Sun shading devices • Windows panes • Insulation • Waterproofing • Airtightness • Roof design to provide overhangs/ Green roofs • Wall greenery 	Heating and cooling system	
		Domestic hot water	<ul style="list-style-type: none"> • DHW system design
Ventilation system	<ul style="list-style-type: none"> • Natural ventilation • Mechanical ventilation (Heat and moisture recovery) 	Lighting	<ul style="list-style-type: none"> • Physics of Light • Natural Lighting • Artificial Lighting

Energy Efficient Buildings: Taught University MSc/BSc Courses

Universities in Denmark, Ireland and the United Kingdom have the highest number of courses on EEB, which is directly linked with a higher implementation on nZEB policies (Tobriska et al., 2018).

Countries	University Courses/ Programmes of Minimum 10 ECTS
Greece	9
Italy	12
Spain	10
Cyprus	14
Ireland	20
UK	20
Germany	5
Denmark	29
Belgium	9
Romania	17
Macedonia	4

Case Selection

Argentinian Context

The Zone I or “very hot climate” is in the northern part and the hot weather is predominant, with less than 390 heating degrees days.

The zone II or “hot climate” has between 390 and 780 heating degree days. In the summer season, the maximum temperature can exceed 30°C, the mean temperature is between of 20°C and 24°C

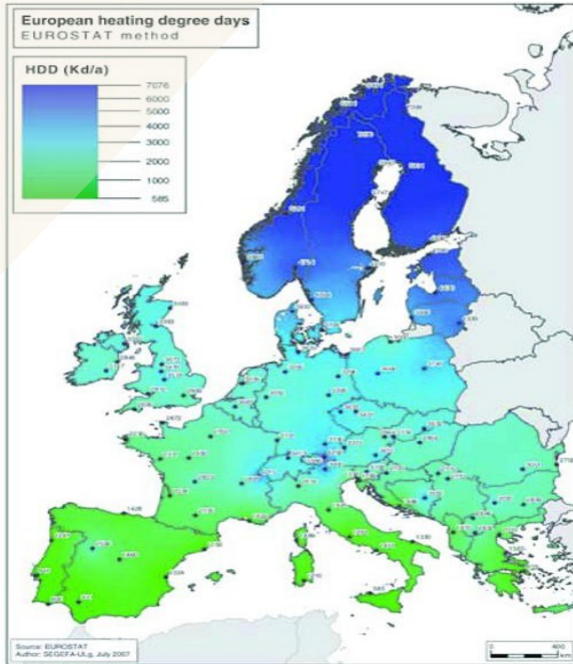
The zone III or “warm temperate climate” has between 780 and 1170 heating degrees days.

The Zone IV is considered as “cool temperate climate” and has between 1170 and 1950 heating degrees days.

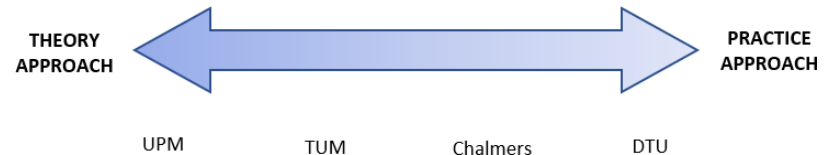
The Zone V is considered as “cold climate” and has between 1950 and 2730 heating degrees days.



Case Selection Universities in Europe



- *University Polytechnic of Madrid UPM, Spain*
Spanish climate provides one of the lowest numbers on heating degree days across the European continent. The southern part of the country has a similar climate to central and northern parts in Argentina as Buenos Aires, La Pampa and La Rioja.
- *Technical University of Munich TUM, Germany*
Germany has a temperate climate, which it translates to higher number of heating degree days compared with Spain. Its climate matches with parts of Argentina like Chubut or Andes range zones.
- *Denmark Technical University DTU, Denmark*
Denmark weather is characterized by long and cold winters, with more heating degree days than meridional zones. This climate relates with Southern areas in Argentina and mountainous areas.
- *Chalmers Technical School, Sweden*
The Northern part of Sweden possesses a sub-Antarctic climate which is comparable to the most Southern parts in Argentina as Patagonia.



Case Selection Universities in Europe

The selection of different programs is listed below:

1. DTU BSc Architectural Engineering
2. DTU MSc Eng. Architectural Engineering, MSc. Eng. Sustainable
3. UPM BSc Building Engineering
4. UPM MSc Technical Innovation in Buildings
5. Chalmers BSc Civil and Environmental Engineering
6. Chalmers School MSc Structural and Building Technology
7. TUM BSc Civil Engineering Energy General,
8. TUM MSc in Resource Efficient and Sustainable Building, MSc. Eng. Civil Engineering

nZEB Skills-Case Programs

Table 5 nZEB academic curricula at DTU BSc Architectural Engineering

Semester	Course name	Main learning objective
2 nd semester	11937 Basic Building Design regarding Indoor Environment, Services and Energy 1	Building services, energy consumption and general teaching on sustainable construction
4 th semester	11957 Sustainable building design	Building services, energy consumption and general teaching on sustainable construction
Elective	11112 Technical Building Services	HVAC systems
Elective	11121 Thermal Building Physics	Indoor climate
Elective	11141 Energy and indoor environment	Calculation of building energy consumption
Elective	11764 Ventilation and Indoor Climate	HVAC systems
Elective	31200 Fundamentals of acoustics and noise control	Acoustics
Elective	62261 HVAC	HVAC systems
Elective	62271 Building Energy & heating systems	Energy consumption calculation and heating systems
Elective	62371 Sustainable building renewal	Building rehabilitation following nZEB requirements

THEORY
APPROACH

PRACTICE
APPROACH

UPM

TUM

Chalmers

DTU

Table 6 nZEB academic curricula at UPM BSc Building Engineering

Semester/Year	Course name	Main learning objective
4 th semester	Installations I	Building services
5 th semester	Installations II	Building services
5 th semester	Roof and envelope	Envelope design
6 th semester	Sustainable construction	General teaching on nZEB

Table 7 nZEB academic curricula at Chalmers BSc Civil and Environmental Engineering

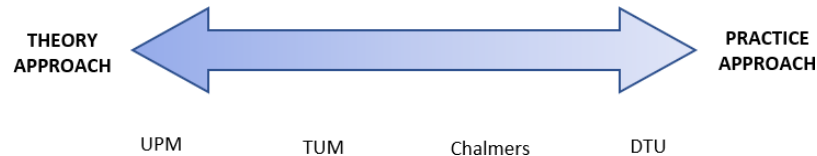
Semester	Course name	Main learning objective
1 st semester	BOM205 - Buildings functions and design,	Building services, energy consumption and general teaching on sustainable construction
1 st semester	BOM235 - Sound and vibration, basics	Acoustics
3 rd semester	BOM265 Building technology	Indoor climate, building systems, envelope and building physics
5 th semester	BOM330 - Building services engineering	HVAC systems
Elective, 5 th semester	ARK675 - Design methodology house building	nZEB design
Elective, 5 th semester	BOM320 - Building physics and building acoustics	Indoor comfort design
Elective, 6 th semester	ARK670 - Refurbishment and maintenance	Upgrade of existing buildings to nZEB requirements



nZEB Skills-Case Programs

Summarize of Bachelor programs compliance with nZEB skills

Categories of skill	DTU BSc	TUM BSc	UPM BSc	Chalmers BSc
General concepts	X	X	X	X
Sustainable Architectural Design	X	X		X
Climate and Comfort	X	X	X	X
Envelope design	X	X	X	
Ventilation system	X		X	X
Heating and cooling system	X		X	X
Domestic hot water	X			
Lighting	X	X	X	
Acoustics	X	X		X



nZEB Skills-Case Programs

Summarize of Master's programs compliance with nZEB skills

Category of skills	DTU MSc	TUM MSc	UPM MSc	Chalmers MSc
General concepts	X	X	X	X
Sustainable Architectural Design	X	X	X	X
Climate and Comfort	X	X	X	X
Envelope design	X	X	X	X
Ventilation system	X	X	X	X
Heating and cooling system	X	X	X	X
Domestic hot water	X			
Lighting	X	X	X	X
Acoustics	X	X	X	X

nZEB Skills-Case Programs- Argentina

National Technological University (UTN)

UTN imparts a graduate degree called MSc Human habitat sustainable development, approved in 2010.

National University of La Plata (UNPL)

The Faculty of Architecture and Urbanism of UNPL offers a two-year master programme dedicated to energy, buildings, cities and landscape

University of Buenos Aires (UBA)

The MSc of Sustainable Architecture and Urbanism

Category of skills	UTN MSc	UNPL MSc	UBA MSc
General concepts	X	X	X
Sustainable Architectural Design	X	X	X
Climate and Comfort	X	X	X
Envelope design	X	X	X
Ventilation system	X	X	
Heating and cooling system	X	X	
Domestic hot water			
Lighting	X	X	X
Acoustics			

Setting scope- Argentina



- *Performed activities*
 - A survey and analysis on the **training** existing **programs** available at both the **national** and **provincial** levels, and their respective **contents**.
 - A characterisation of the **professional profile(s)** in the sector of individual professionals working in EEB.
 - A status report on the **market situation** (goods, services, value chain) and **stakeholders** (professionals, education and government).
 - A diagnosis of **existing programs and demand** to **identify and evaluate gaps**.
 - **Recommendations** to enhance **professionals' profiles** by creating **educational policies** according to local needs and the state of the art at international level.



Ministerio de Economía
Argentina



Secretaría
de Energía



Thank You

LOGOS



**UNEP DTU**
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