

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

The contribution of Italy to the higher education in environmental chemistry

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Outline

- **Inventory**

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- Distribution of total ECTS at national and regional level
- Distribution of courses in Environmental Chemistry and related courses in Italian BSc and MSc
- Distribution of courses in Chemistry of Cultural Heritage and related courses in Italian BSc and MSc
- Distribution of ECTS for Environmental Chemistry and Chemistry of Cultural Heritage, and related courses
- List of course subjects

- **Conclusions**

Constitution of the Italian Republic

Art. 9

“The Republic promotes the development of culture and of scientific and technical research.

It safeguards **natural landscape** and the **historical and artistic heritage** of the Nation.”

Art. 117

The State has exclusive legislative powers in the following subject matters:

... protection of the **environment**, the **ecosystem** and **cultural heritage**.

Academic status

In Italy, the Scientific Disciplinary Sector (SSD CHIM/12) of Environmental chemistry includes Chemistry of Cultural Heritage, within the Chemistry area (A03) in Science. In addition to the sector, there is a macrosector including Physical Chemistry, Analytical Chemistry, and Chemistry of the Environment and of Cultural Heritage. In practice, courses assigned to CHIM/12 can be taught by analytical chemists or physical chemists, and viceversa.

Methodology

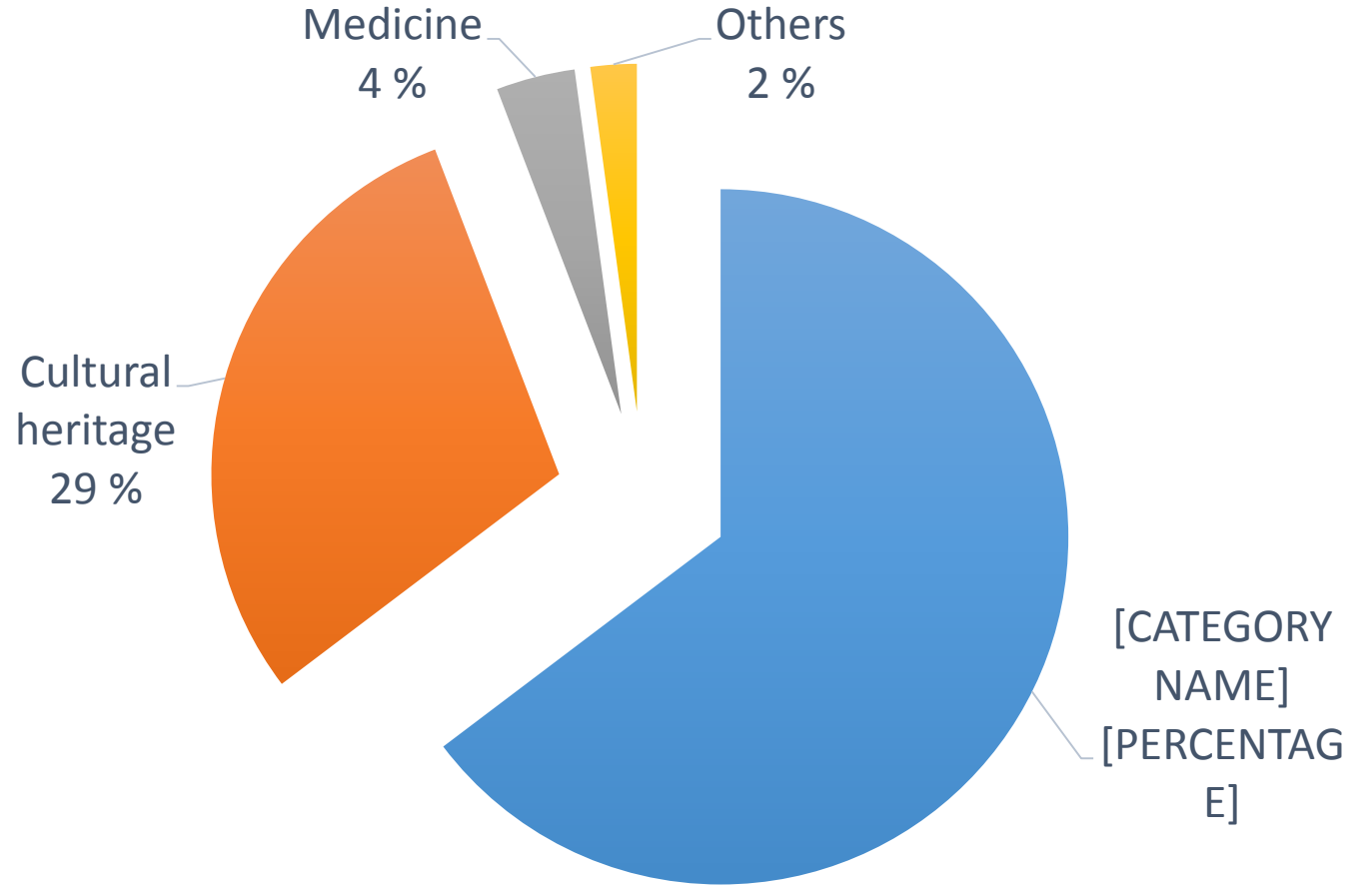
- The inventory has been conducted by exploring the BSc and MSc programs offered by the Italian universities and reported on the web site. Within each programme, the courses assigned to the SSD CHIM/12 were identified and recorded with the number of ECTS (European Credit Transfer and Accumulation System) corresponding to each course.
- The courses identified according to the previous procedure have been further validated by expert judgement (e.g. checking the course subject).
- The output is presented as ECTS with each ECTS corresponding to 6-10 hours of frontal teaching, depending on individual university. Each course accounts for 4 to 12 ECTS, typically 6.

Distribution of ECTS (European Credit Transfer and Accumulation System) by domain

Total ECTS: **1736**

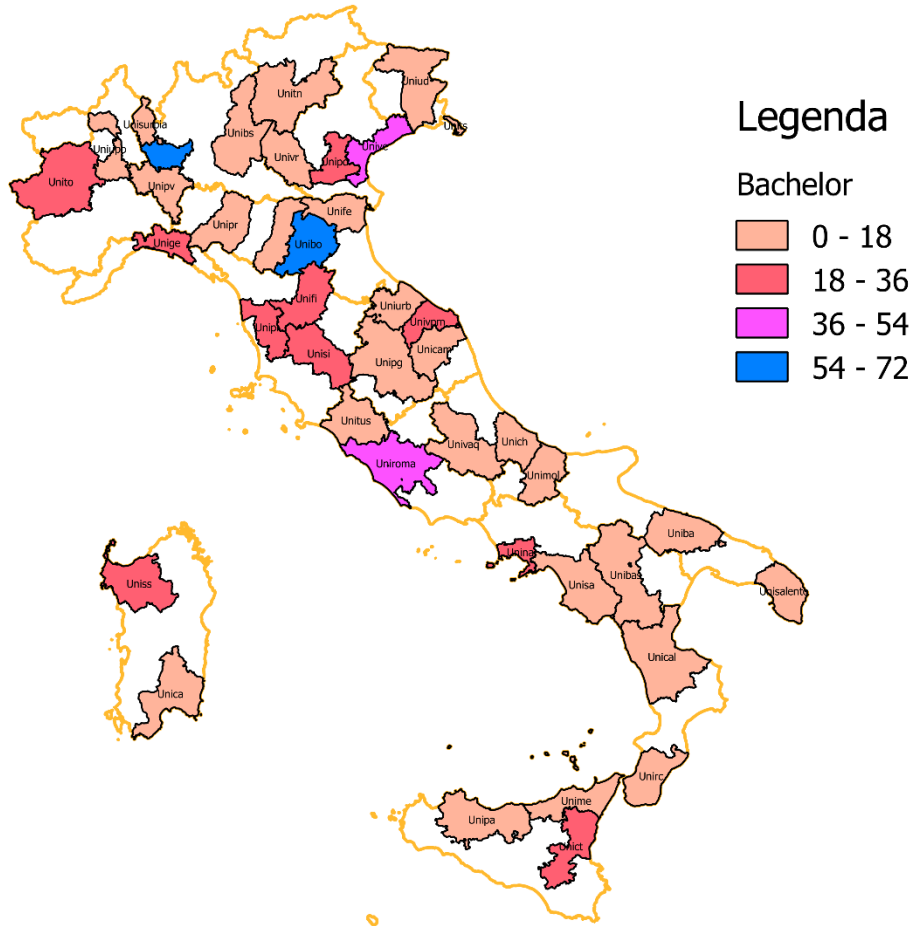
Bachelor ECTS: **684**

Master ECTS: **1052**

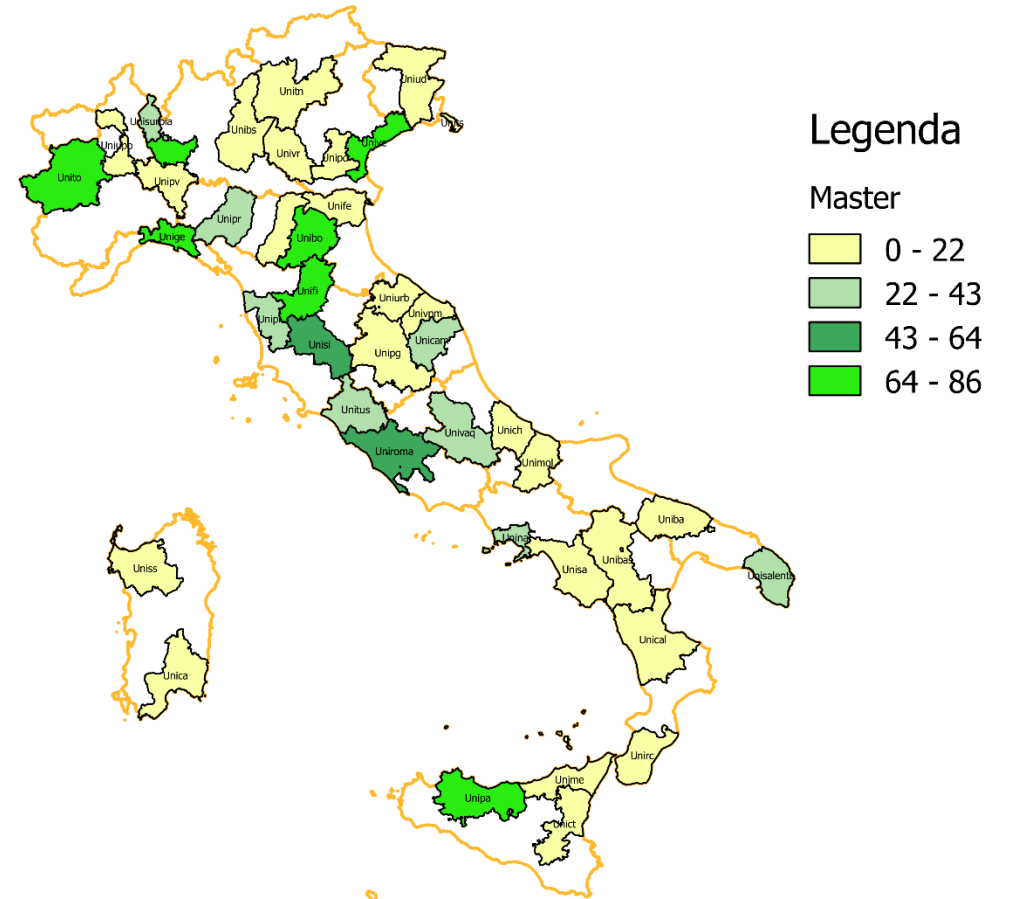


Distribution of ECTS in the Italian University

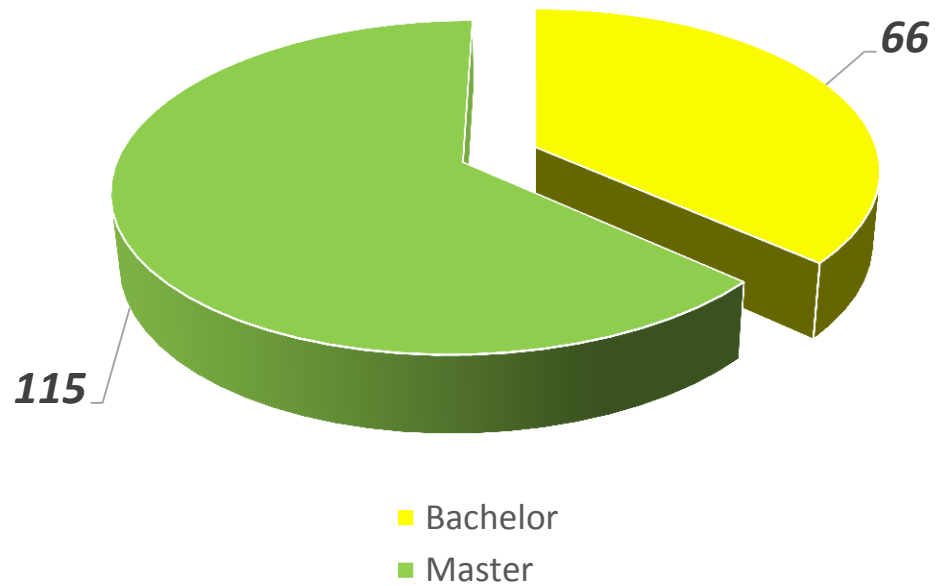
Bachelor



Master



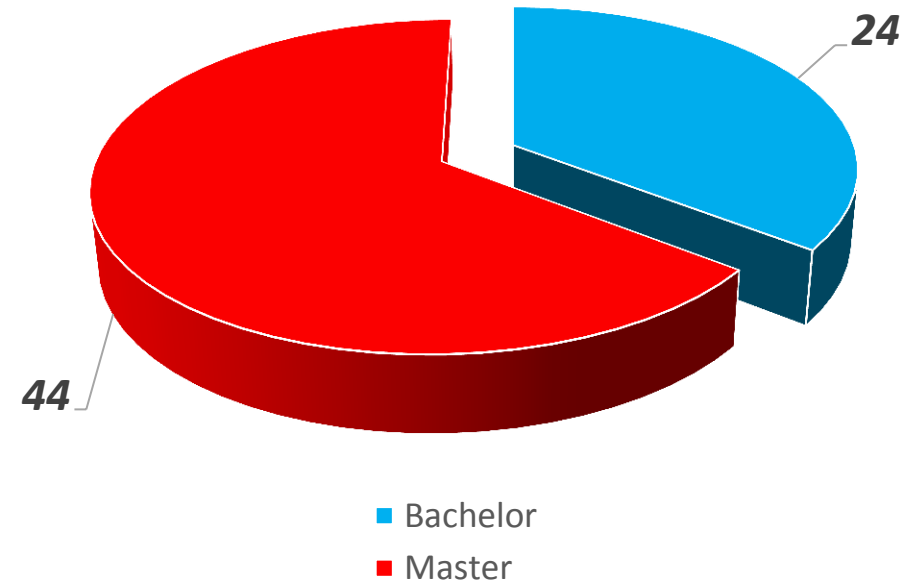
Environmental Chemistry: number of courses (total: 181)



University	Bachelor	Master	University	Bachelor	Master
Bari	1	1	Palermo	2	6
Basilicata		1	Parma	1	3
Bologna	7	6	Pavia	2	2
Brescia	1	1	Perugia	1	2
Cagliari		2	Piemonte	1	1
Campania		3	Pisa	6	3
Chieti	2		Ancona	3	2
Catania	3		Reggio Calabria	1	1
Ferrara	1	1	Roma		4
Firenze	2	7	Lecce		4
Genova	2	9	Salerno	2	2
Modena	2	4	Sassari	1	1
L'Aquila	1	3	Siena	2	6
Messina	2		Torino	1	10
Milano	6	11	Trieste	1	3
Unimore	2	3	Verona	1	
Napoli	4	4	Venezia	3	6
Padova	2	3			

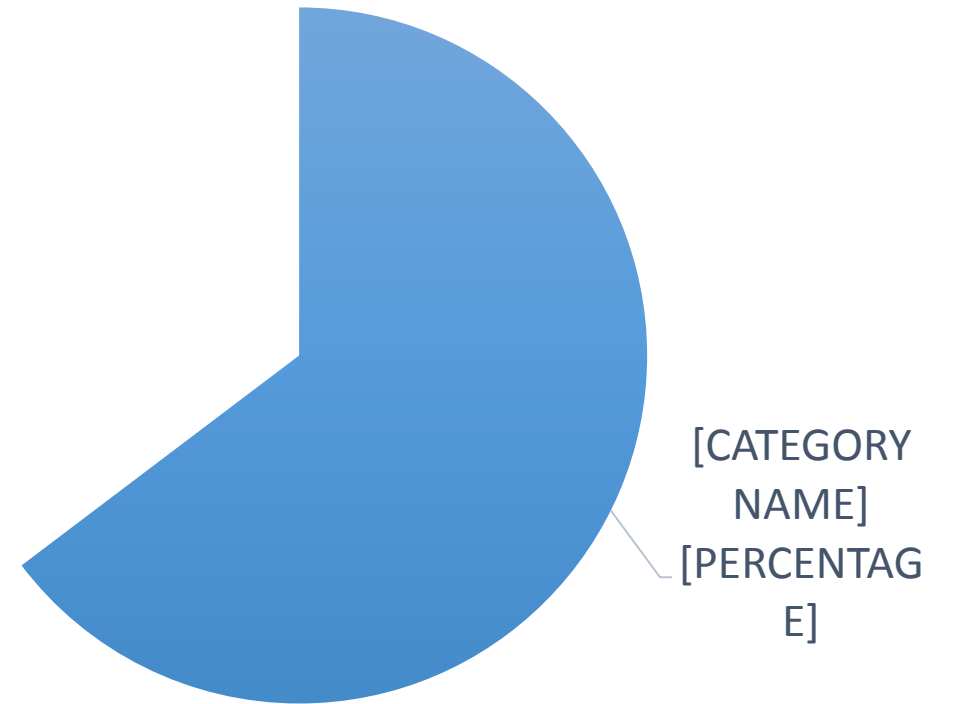
Chemistry of Cultural Heritage: number of courses (total: 68)

University	Bachelor	Master	University	Bachelor	Master
Bari		1	Parma		3
Basilicata	1		Pisa		1
Bologna	2	5	Roma	4	4
Cagliari		1	Lecce	1	2
Calabria	1	1	Siena		1
Firenze	1	3	Torino	1	1
Genova	2	2	Trento	1	
L'Aquila		1	Viterbo		3
Milano	2	3	Udine	2	
Napoli		2	Urbino		2
Padova	2		Venezia	4	4
Palermo		4			



List of degrees including Environmental chemistry and related courses

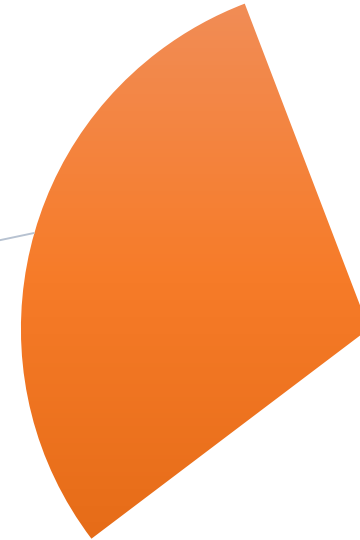
Chemistry
Industrial and Environmental Chemistry
Environmental Science
Geology
Civil Engineering
Environmental Engineering
Safety engineering
Pharmaceutical Science
Biology/Ecological Science
Coastal and marine biology and ecology
Earth Physics
Science and Management of Climate Change



List of degrees including Chemistry of Cultural Heritage and related courses

Chemistry of Cultural Heritage
Science for the conservation and restoration of
cultural heritage
History of Art and Conservation
Economy and Management of Cultural Activity

Cultural
heritage
29 %



Main courses courses in Science domain

Course Title	Bachelor	Master	Degree
Atmospheric Chemistry	X		Earth Physics
Environmental analytical chemistry		X	Chemical Science, Env. Science, Archeology, ...
Environmental chemistry	X	X	Env. Science, Chemical Science, Industrial Chemistry, ...
Civil Engeneering for Env. and Energy	X		Civil Engeneering
Coastal and marine biology and ecology		X	Marine Science
Environmental Science	X		Env. Science, Env. Engeneering
Indicator of Sustainability		X	Ecotoxicology and Sustainability
Biodegradation processes		X	Chemistry
Chemical oceanography		X	Chemistry
Environmental Monitoring	X	X	Chemistry, Env. Science, Industrial Chemistry, ...
Env. Risk Management		X	Env. Science, Env. Biology
Environmental Science	X	X	Science for the conservation
Atmospheric chemistry		X	Environmental Chemistry
Envirinmental Chemistry	X	X	Natural Science
Climate change and env. contamination		X	Master Science and Management of Climate Change
Interaction of pollutants and cultural heritage	X		Chemical and Material technology
Environmental photochemistry		X	Photochemistry and Molecular Materials
Safety and Env. Monitoring		X	Engeneering of protection and safety, Chemistry
Science for the conservation - restoration of cultural heritage	X	X	Architectural
Environmental safety	X		Technology for the occupational safety
Water pollution and waste managment		X	Technology for population and health and wealth
Waste Tratment		X	Ecotoxicology and Sustainability

Main courses in Cultural Heritage domain

Course Title	Bachelor	Master	Degree
Chemistry of cultural heritage		X	Science for the conservation - restoration of cultural heritage
Chemical methods for examination of cultural heritage		X	Science for the conservation - restoration of cultural heritage
Chemical restoration		X	Science for the conservation - restoration of cultural heritage
Air pollutant chemistry		X	Science for the conservation - restoration of cultural heritage
Restoration chemistry	X	X	Science for the conservation - restoration of cultural heritage
Organic chemistry for cultural heritage		X	Science for the conservation - restoration of cultural heritage
Spectrometric methods apply to cultural heritage		X	Material Science, Science for the conservation
Physical-chemistry for cultural heritage	X		Science for the conservation
Analytical Chemistry		X	Science for the conservation - restoration of cultural heritage
Analytical methods for the env. degradation of cultural heritage		X	Science for the conservation - restoration of cultural heritage
Science and engineering for conservation of cultural heritage		X	Architecture
Environmental chemistry		X	Science for the conservation - restoration of cultural heritage
Chromatographic techniques for cultural heritage		X	Science for the conservation - restoration of cultural heritage
Electrochemistry applied to cultural heritage		X	Science for the conservation - restoration of cultural heritage
Materials for contemporary art		X	Science for the conservation - restoration of cultural heritage

Open issues

- Budgeting the number of students attending the courses listed in the previous tables/figs
- Distinguishing courses according to mandatory vs free of choice courses
- Improving the definition of the subjects especially for multidisciplinary courses (e.g. environmental quality assessment, environmental monitoring, assessment and management of environmental risk)
- Identifying the academic area (Chemistry, Biology, etc.), and sector (CHIM/12, CHIM/01, CHIM/02, etc.) delivering the course
- Extending the survey to Ph.D. courses

Conclusions

- Ubiquitous distribution in Italy of Environmental Chemistry and Chemistry of Cultural Heritage, and related courses, in BSc and MSc
- Overall, the number of courses in MSc is by far higher than in BSc
- An increasing number of courses are highly multidisciplinary → need to expand the capability of environmental chemists to address and to include topics such as environmental impact assessment, environmental risk assessment and management, environmental sustainability, etc..
- In Italy, continued effort to support Chemistry of Cultural Heritage.