

Multidisciplinary master and doctoral programmes at the University of Lisbon

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Geophysics and Energy

Coordinator of the PhD doctoral program on
Sustainable Energy Systems

Energy Clustering Event





- The Universidade de Lisboa (ULisboa) is the largest portuguese university and one of the biggest in Europe
- Number of students – 2017/18 47.794
- Licenciatura (1st cycle) 21.013
- Master (2nd cycle) 8.911
- Integrated Master (1st + 2nd cycle) 14.050
- PhD (3rd cycle) 3.820

RANKINGS

Notwithstanding assessment methods or criteria, ULisboa leads the main international rankings and is amongst the 200 best universities worldwide.

1º

**Ranking University in
Portugal**

SCIMAGO, ARWU, NTU,
CWUR, URAP, CWTR, LEIDEN

2º

**Ranking University in the
Ibero-American Space**

SCIMAGO

31º

**Ranking European
University in Scientific
Publications**

CWTR, LEIDEN

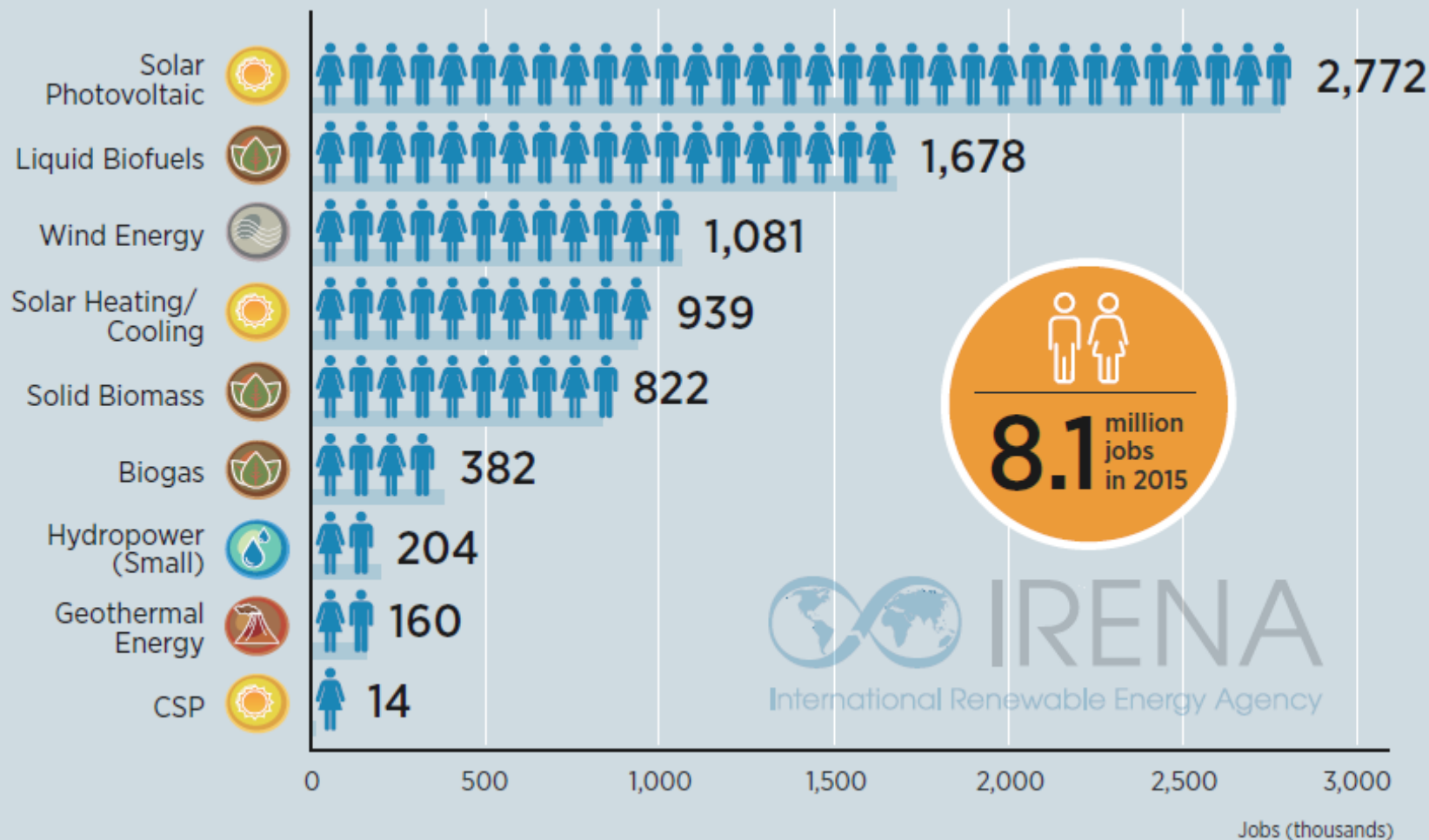


Faculty of Sciences
Department of Geographical Engineering
Geophysics and Energy (DEGGE)

- Undergraduate and post graduate programs in Energy and Environment, Meteorology, Oceanography, Geophysics and Geospatial Engineering
- PhD programs in Sustainable Energy Systems and Earth Science
- Research groups:
 - Atmosphere-Ocean Processes and Climate Modelling (PI: Álvaro Peliz)
 - Climate Change, Variability and Extremes (PI: Ricardo Trigo)
 - Energy Transition (PI: João Serra)

Renewable Energy and Jobs

Annual Review 2016



Sustainable Energy – Education

- Integrated MSc in Energy and Environment Engineering
(around 400 students)

- Doctoral programs
 - Sustainable Energy Systems(MIT Portugal)
 - EarthSystems
(around 60 students)





INTEGRATED MASTER on ENERGY AND ENVIRONMENT ENGINEERING



OBJECTIVE

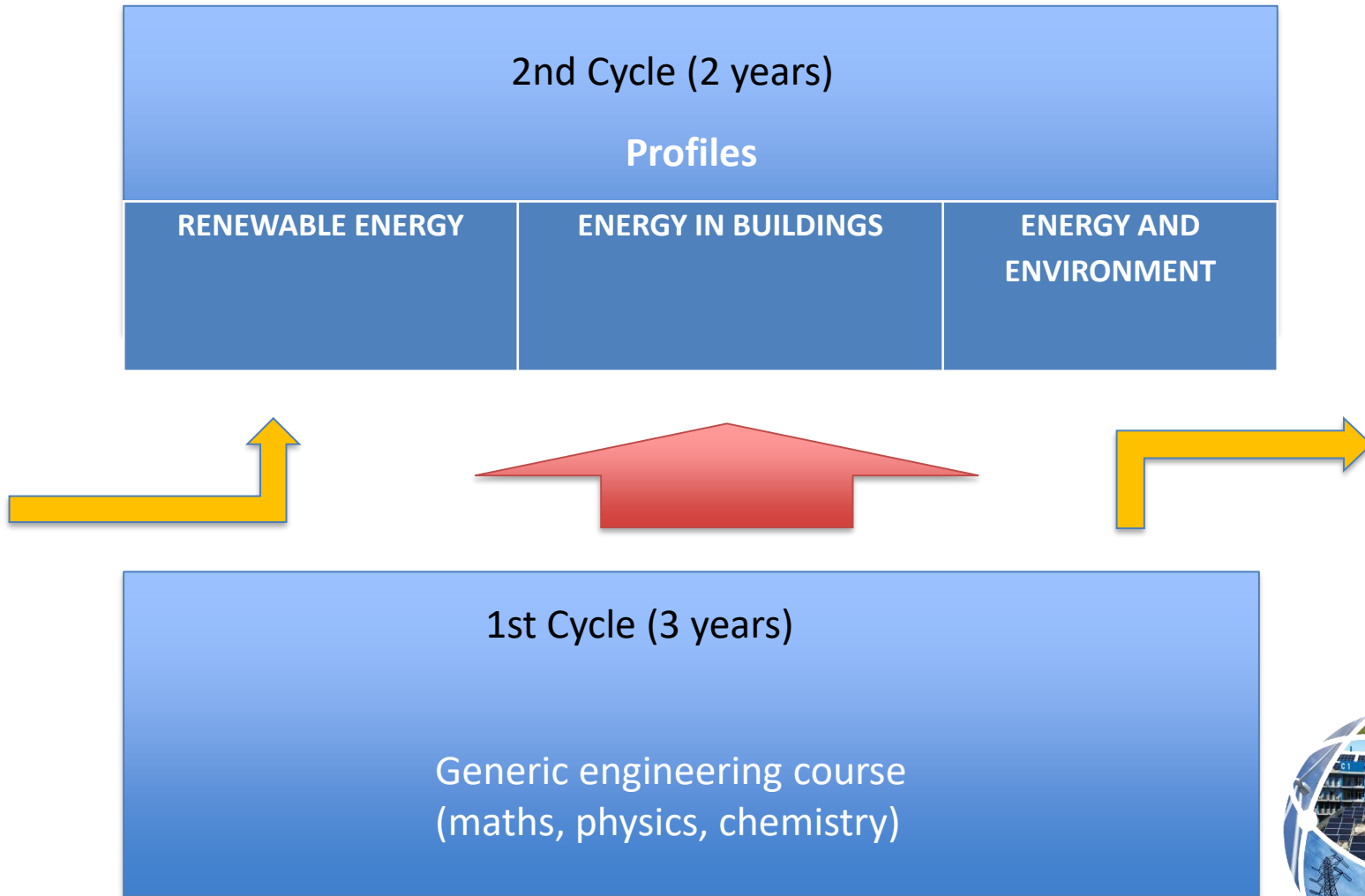
higher education and training of professionals, acquiring the skills to intervene in the energy transition

It covers the area of energy production through the use of renewable sources

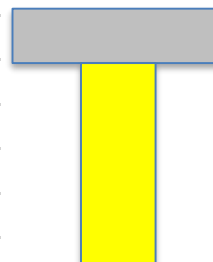
And efficient use of energy, in a perspective of sustainable development.



STRUCTURE



T-Shape



	RENEWABLE ENERGY	ENERGY IN BUILDINGS	ENERGY AND ENVIRONMENT
	SEMESTER 1		
M M	Energy Efficiency	Energy Efficiency	Energy Efficiency
	Energy Networks	Energy Networks	Energy Networks
	Photovoltaics	Heat Transfer in Buildings	Environmental Assessment
	Solar Thermal Energy	Photovoltaics	Ecosystem services
	Hydro Energy	Solar Thermal Energy	Environmental Monitoring
	Environmental Law	Environmental Law	Environmental Law
	Investment Project Evaluation	Computer Simulation in Buildings	Investment Project Evaluation
	Sustainable Mobility	Investment Project Evaluation	Sustainable Mobility
			Life Cycle Assessment
	SEMESTER 2		
M M	Energy Systems	Energy Systems	Energy Systems
	Combustion Technologies	Combustion Technologies	Combustion Technologies
	Solar Cells	Energy Systems in Buildings	Energy of Biomass
	Energy of Biomass		Air Quality
	Wind Energy		
	Storage and PV Conversion		
	Hydrogen and Energy vectors	NZEB Project	
	Geopolitics of Energy Transition	Geopolitics of Energy Transition	Geopolitics of Energy Transition
	Entrepreneurship Project	Entrepreneurship Project	Entrepreneurship Project



Sustainable Energy Systems PhD Program

Sustainable Energy Systems PhD Program

A network of advanced studies throughout Portuguese Universities and the Massachusetts Institute of Technology

J.M. Serra

Program coordinator at Faculdade de Ciências
Universidade de Lisboa

Scope of the doctoral program

The study of Sustainable Energy Systems (SES) involves a complex framework characterized by wide time and spatial scales, requiring a [multidisciplinary approach](#)

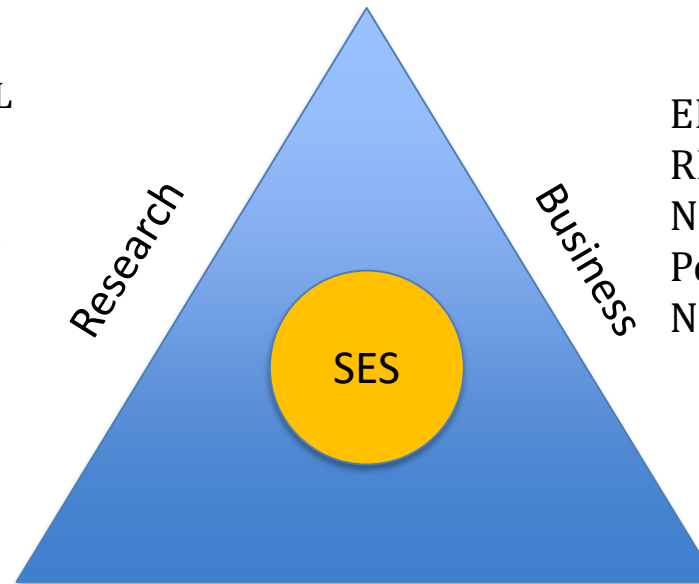
The Sustainable Energy Systems (SES) PhD program aims at educating the leaders that will contribute to the development of so-called Carbon-Free Society.

The program intends to:

- Promote the rational use of energy, energy efficiency and the use of endogenous energy resources, in particular renewable energy;
- Reduce energy costs by developing new open energy and ancillary services markets with different agents;
- Increase energy security through the diversification of energy sources;
- Deliver extra network capacity and system flexibility to manage large scale integration of renewable power sources in the electric grid.

Affiliated institutions

INESC-TEC (UP), LAETA (UP, UL - IST, UC), LARSYS (UL - FCUL, UL - IST), INESC Coimbra (UC), CICC (UC), IDL (UL - FCUL) and CESA (UL - ISEG)



EFACEC, PT (Portugal Telecom), REN (Redes Energéticas Nacionais), EDP (Energias de Portugal), Galp, IBM, RD Nester and Novabase.

High Education

- **Universidade de Lisboa (UL)** – Faculdade de Ciências (FCUL); Instituto Superior Técnico (IST); Instituto Superior de Economia e Gestão (ISEG)
- **Universidade de Coimbra (UC)** – Faculdade de Economia (FE) and Faculdade de Ciências e Tecnologia (FCT)
- **Universidade do Porto (UP)** – Faculdade de Engenharia (FEUP)
- **Massachusetts Institute of Technology (MIT)**

Curriculum Outline

YEAR 1 :

- Students choose their elective courses under the guidance of their thesis supervisors and the program director.
- Individual study plans ensure that students can obtain the specific knowledge needed to develop their work and to complement their original background (engineering, science, architecture, economics, or other).
- Students profit from the rich multidisciplinary offerings of the partner institutions, providing them the flexibility needed to build a curriculum tailored to their needs and aspirations.

YEARS 2-4:

- PhD thesis preparation (180 ECTS).

Curriculum: Year 1

integrating multi-disciplinary aspects in the curriculum

Mandatory courses (30 ECTS)

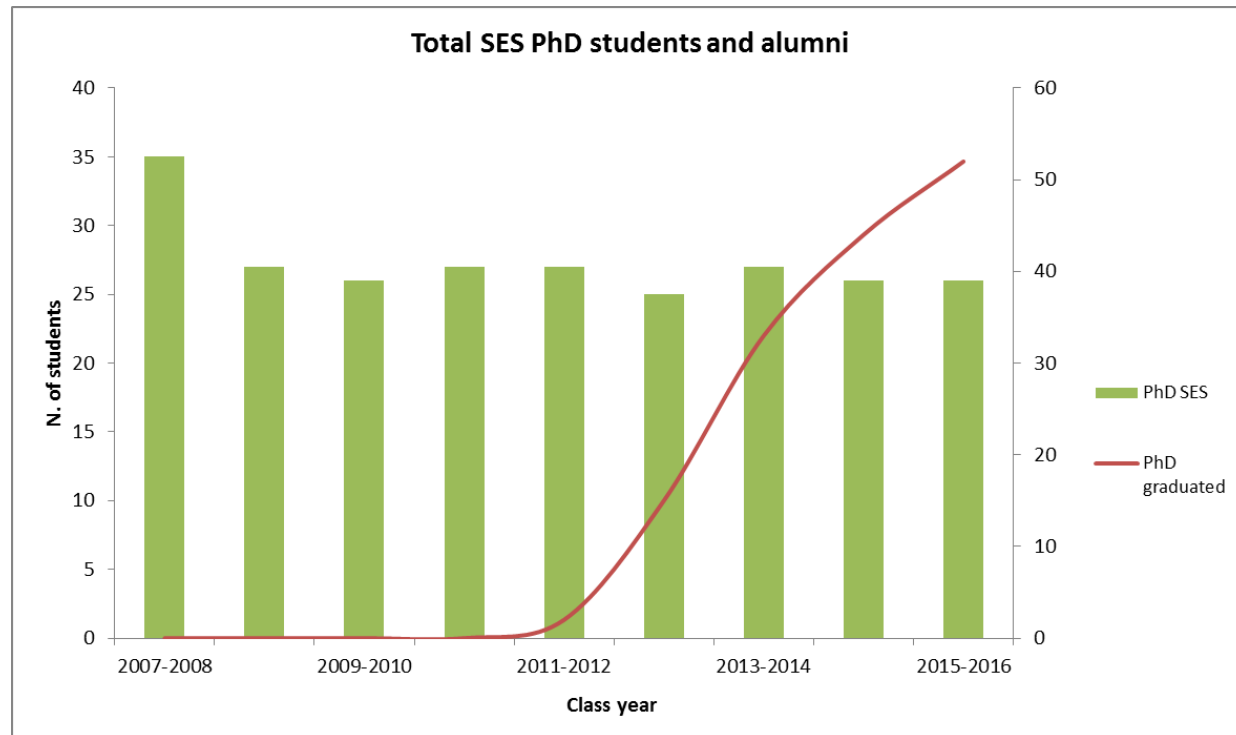
- i) Research methodologies.
 - ii) Innovation and Entrepreneurship.
 - iii) Energy Environment and Sustainability
 - iv) Thesis project.
-

Elective courses (30 ECTS)

- i) **Energy Planning including Economics:** Energy Planning; Renewable Resources: Wind; Solar; Biofuels; Energy Markets; Economics.
- ii) **Sustainable Built Environment:** Buildings Technology; Energy in Buildings; Urban Studies; Storage and Electrical Vehicles.
- iii) **Smart Energy Networks:** Management of large scale grid integration of renewable sources; Smart Grids and Vehicle Transportation.

Outputs of the SES PhD: enrolled students and alumni

- The SES PhD program has enrolled **246** students, and **52** have already graduated since 2007



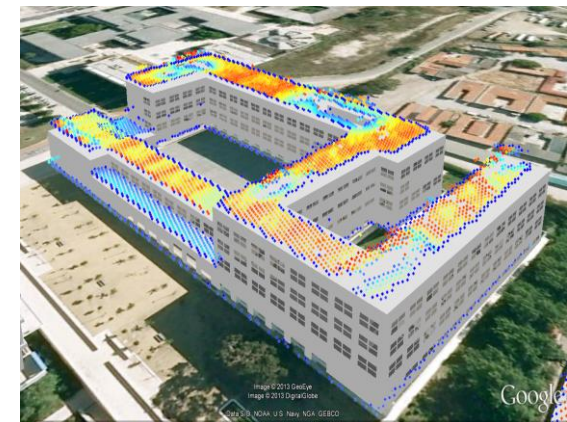
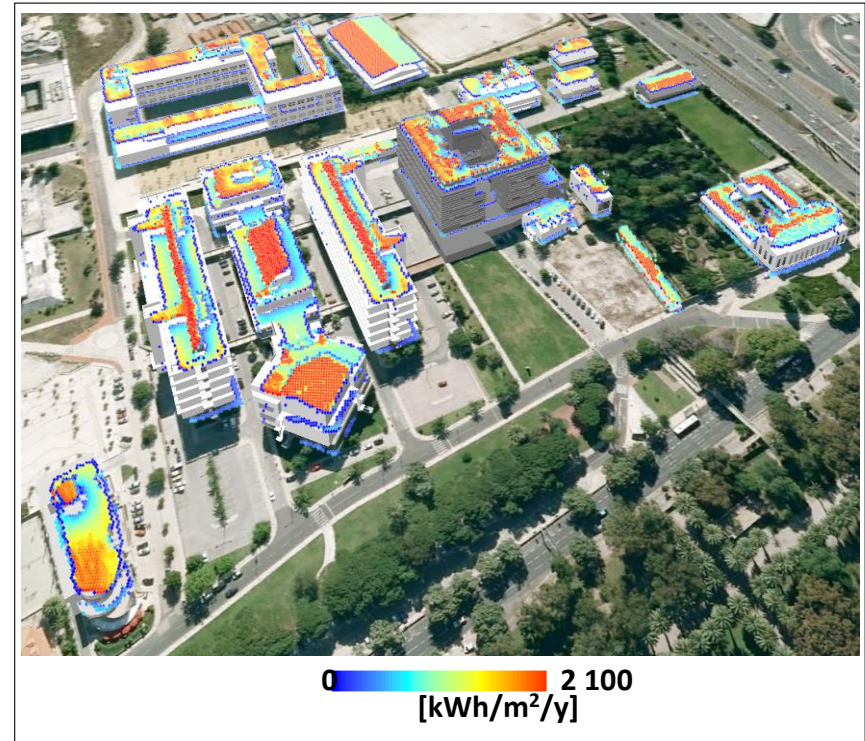
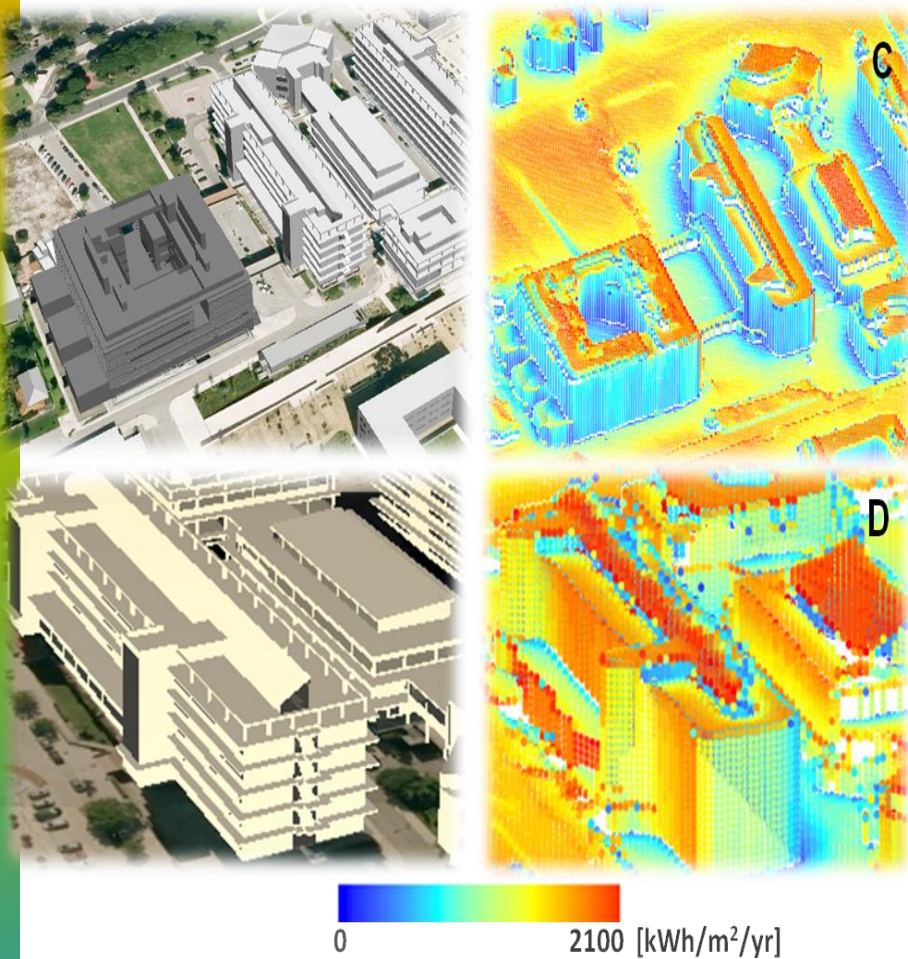
Combining Science & Skills for Renewables Integration

Geographical Information Systems (GIS)



SOLAR Potential in buildings (roofs and facades)

Redweik et al., (2013)

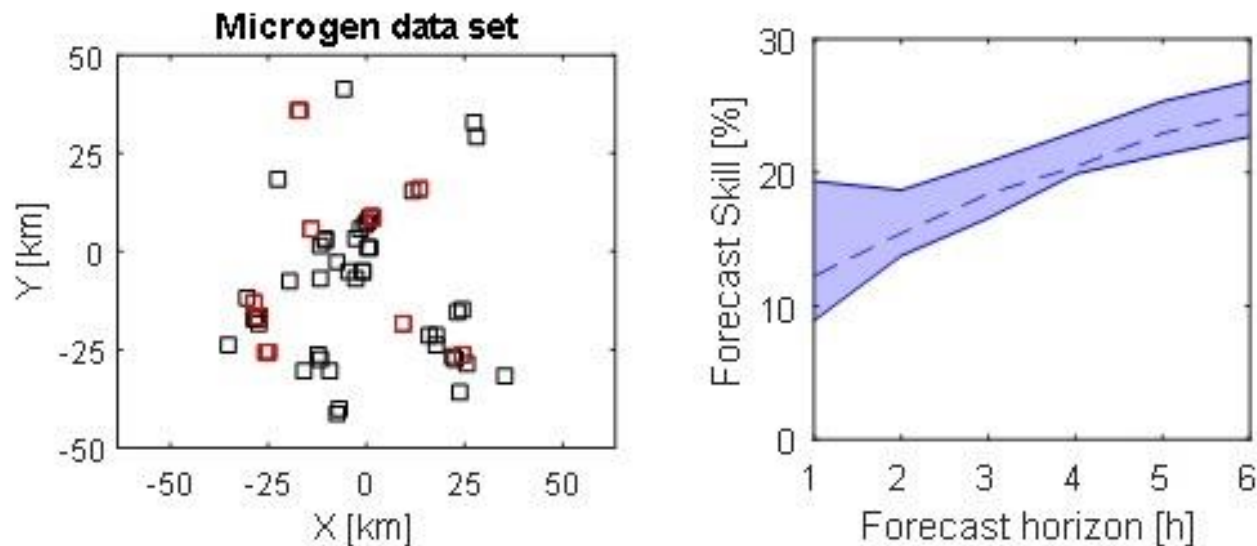


Annual global solar radiation
(kWh/m²/y) on Campus buildings
roofs

Going to the next level:

New business appear as Energy becomes a service

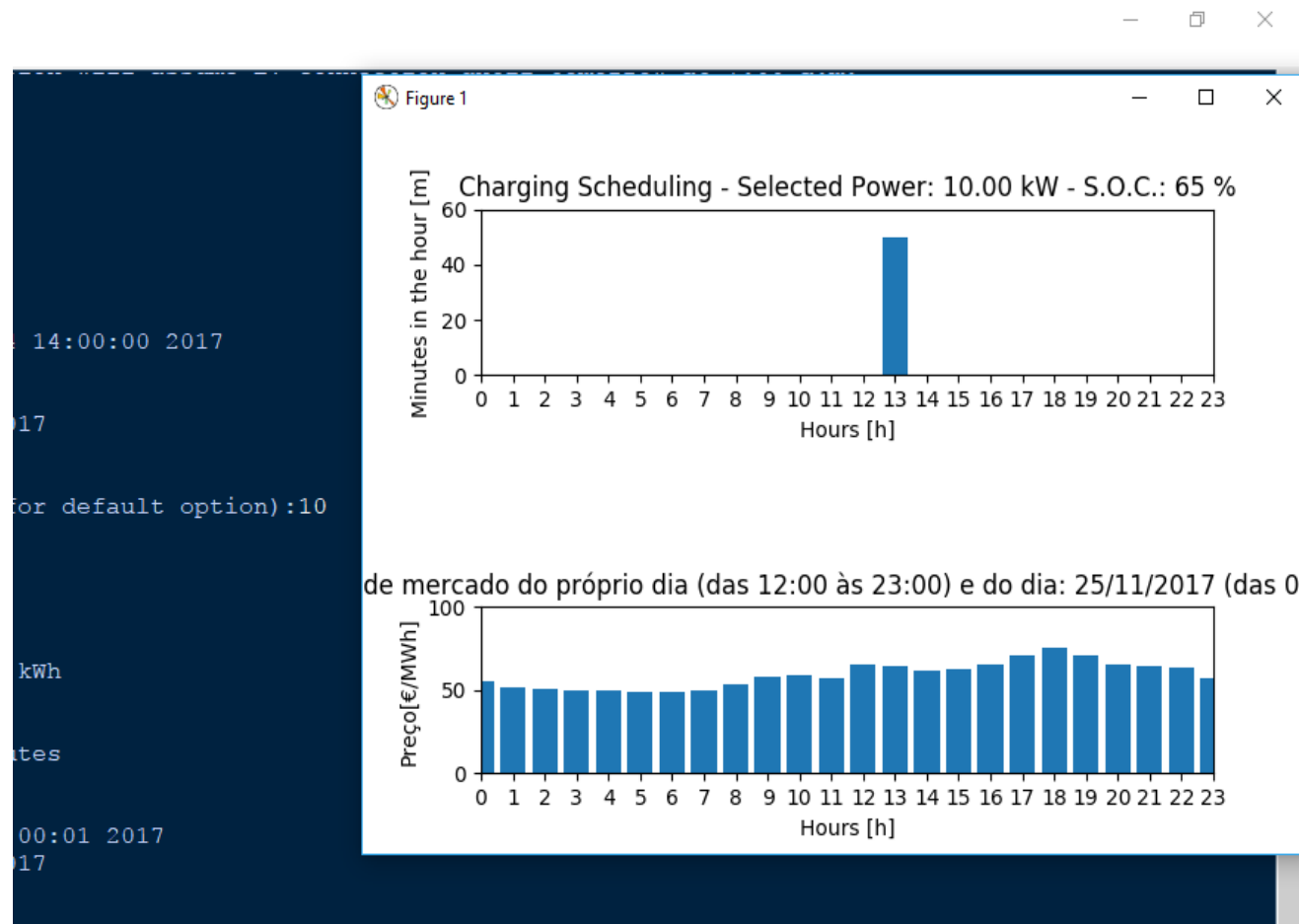
Short time Solar forecasting



Machine learning algorithms are used to produce short time forecasts for PV production based on a spatial distribution of micro generation stations

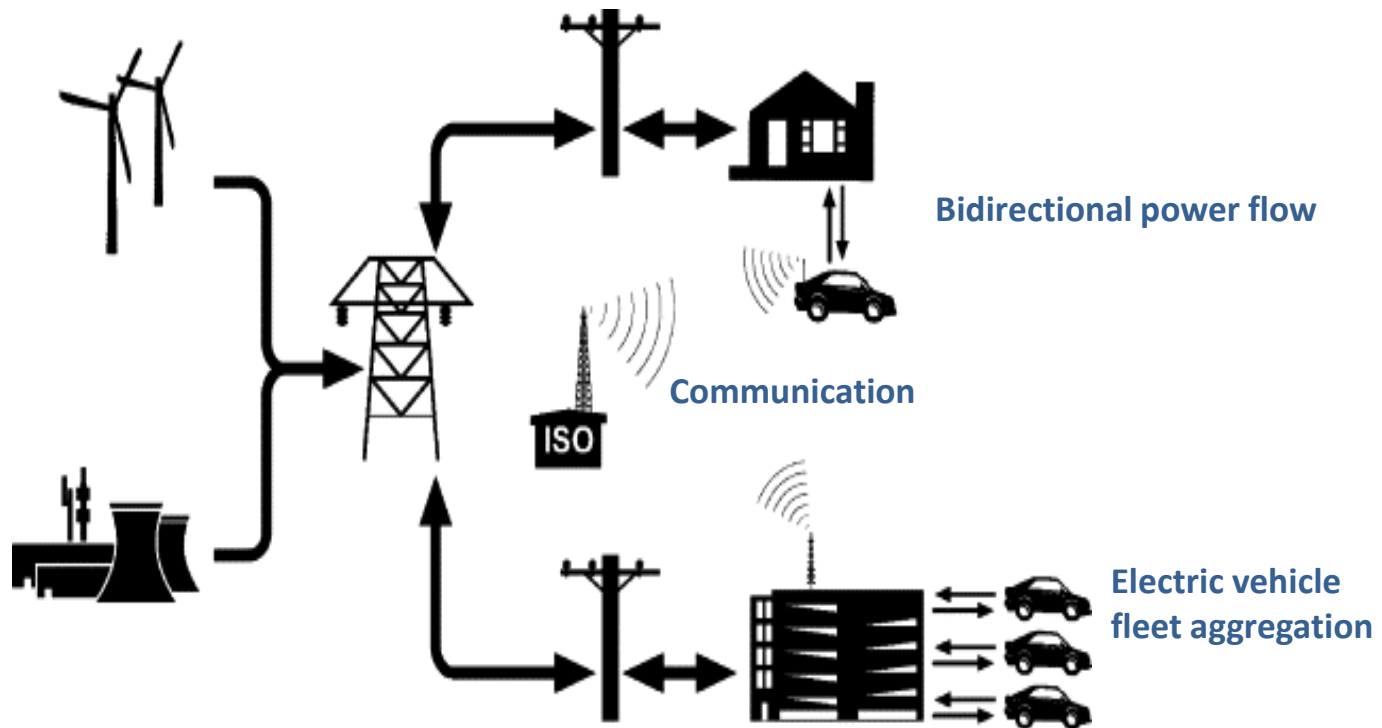
Electric vehicles and V2G

Charging optimization based on hourly electricity prices (REAL CASE using real EV and real V2G charger)



Electric vehicles and V2G

Fleets of electric-drive vehicles provide services for grid support

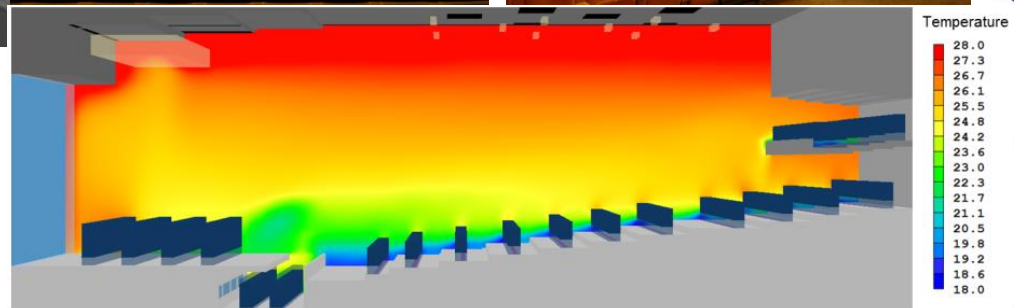
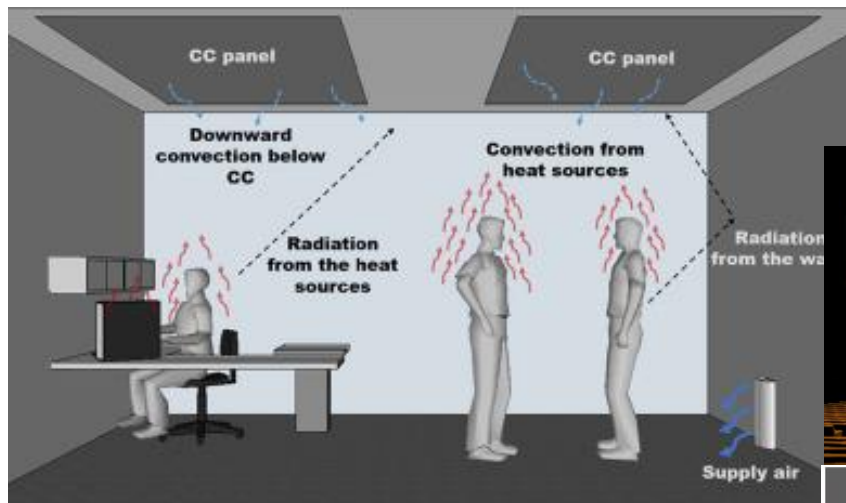


Combining Science & Skills for Renewables Integration

Computer simulation applied to buildings

Building Energy Efficiency

- Building thermal (EnergyPlus) and airflow simulation (Fluent).

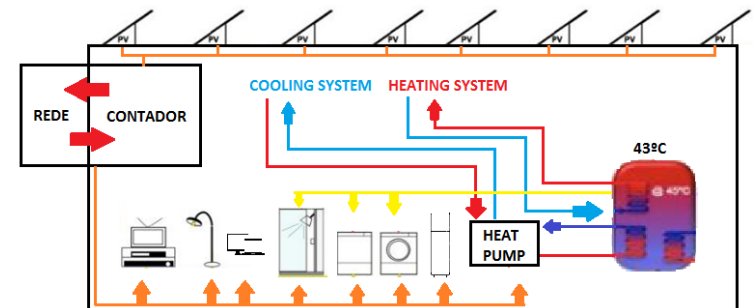


Building Energy Efficiency and Sustainability

Innovative 4th year course on Net Zero Energy Building Design

This innovative 4th year course on Net Zero Energy Building Design relies on a practical design exercise (a school and hotel, etc) that is developed by groups of **two architects and two engineering students**

Student design work:



Combining Science & Skills for Renewables Integration

Integrating Energy and Climate Models

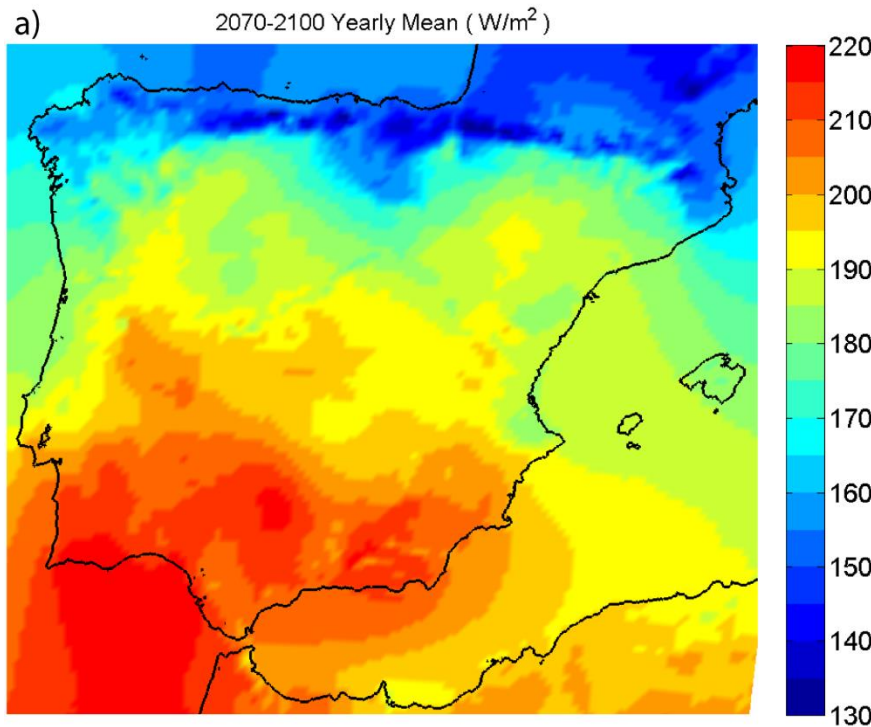


Combining Science & Skills for Renewables Integration

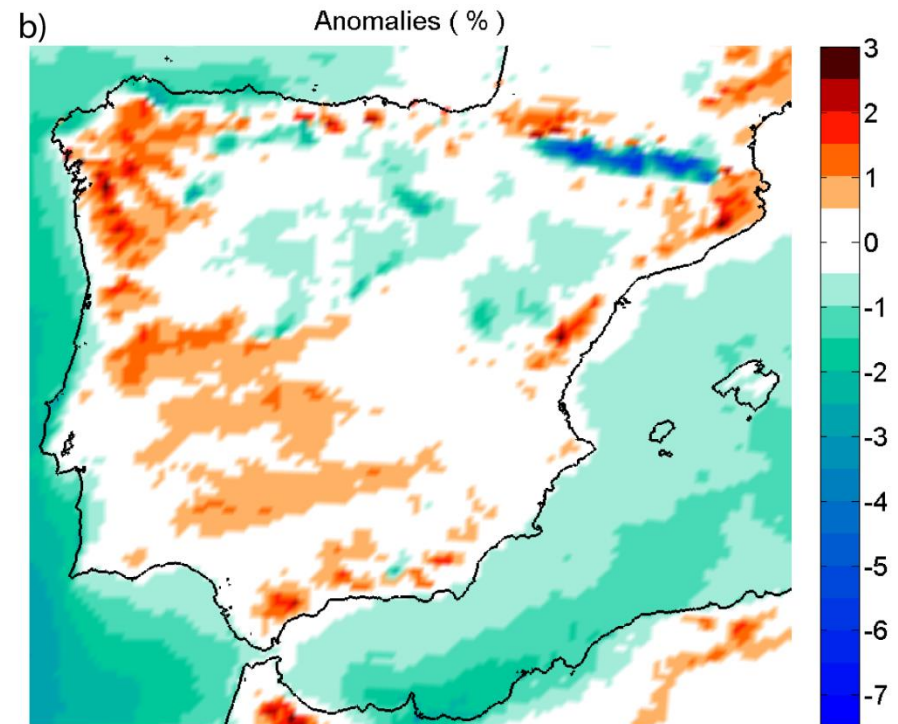
Solar Energy Potential in a Changing Climate

Integrating Energy and Climate Models

[2070-2100] Yearly mean (W/m^2)



[2070-2100] – [1970-2000] (%)



Combining all in a case study

Within the SUSCITY project (involves IST (UL), U Coimbra and U Porto)

- ☐ 3D mapping of the solar potential on roofs and facades of a Lisbon Quarter
- ☐ Measurement and modelling of diffuse and global radiation for different orientations and inclination
- ☐ Short term solar forecasting based on artificial neural networks
- ☐ building dynamic thermal simulation to develop control methods for intelligent design and operation of buildings with hybrid ventilation
- ☐ Development of demand-response energy management approaches, price-responsive and reacting to the distribution system operator requests

A City Dashboard





A wonderfull world of
opportunities is ahead

Thank you!

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