

ANNEX 83



IEA EBC Annex 83 on Positive Energy Districts

**Second International Energy Agency,
Energy in Buildings and Communities,
Annex 83 Ph.D. Summer School**

**“Principles of energy system modelling for
Positive Energy Districts”**

Catania, Italy

June 12 – 16, 2023



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Concept

Positive Energy Districts (PEDs) play a significant role in fostering the transition to sustainable, energy-efficient and energy-flexible urban areas, characterized by an annual positive surplus of renewable energy and net zero greenhouse gas emissions. Energy efficiency and energy flexibility are key functions of PEDs that build upon the integration of renewable-based energy systems and their interaction with infrastructures, buildings and markets, while ensuring a reliable access to energy, security of supply and achievement of economic, environmental and social sustainability.

Under this framework, the International Energy Agency (IEA) Energy in Buildings and Communities (EBC) Annex 83 Summer School “*Principles of energy system modelling for Positive Energy Districts*” will provide participants with a perspective at renewables-based production system, energy flexibility issues and sustainability assessment targeted to the PEDs paradigm.

Framework

The School is developed within the Annex 83 on “Positive Energy Districts” of the International Energy Agency, under the Energy Buildings and Communities program.

The aim the Annex is to provide a comprehensive definition of PEDs and technologies, tools, sustainability assessment and guidelines for planning and implementation of positive energy districts.

More details at the website: <https://annex83.iea-ebc.org/>

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Programme

For this second-year edition, the Annex 83 Summer School will embrace the energy modelling of PEDs as main focus. In this context, the School will focus on a range of issues related to the theoretical and practical challenges for PED implementation, design and energy management issues, as well as some consequent sustainability aspects. Existing case-studies will be presented and discussed.

The School is structured along five days. During the first four days, interactive lectures will focus on key aspects of energy system modelling in PEDs. Each lecture will alternate with working activities sessions, allowing participants to collaborate in teams and explore the insights provided by the lecturers. On the final day, participants will be involved in a round-table discussion on the main implications, future research and application.

Lectures syllabus

Monday, 12th June

09:00 – 11:00	School program introduction and students' presentation
11:00 – 11:30	<i>Break</i>
11:30 – 13:30	Lecture, Dr. Adriano Bisello Urban planning, governance perspective, and multiple benefits evaluation in PED
13:30 – 14:30	<i>Lunch</i>
14:30 – 16:30	Group activity, Dr. Adriano Bisello Integrated sustainability assessment of PEDs. Expected multiple benefits

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Tuesday, 13th June

09:00 – 11:00	Lecture, Prof. Giuseppe Inturri Mobility in Positive Energy Districts
11:30 – 18:30	<i>Social activity: Black Sand Beach</i>

Wednesday, 14th June

09:00 – 11:00	Lecture, Dr. Abolfazl Rezaei Renewable-based energy systems in districts
11:00 – 11:30	<i>Break</i>
11:30 – 13:30	Group activity, Dr. Abolfazl Rezaei Simulation of load curves and components
13:30 – 14:30	<i>Lunch</i>
14:30 – 16:30	Lecture, Prof. Rosaria Volpe Energy audits and monitoring for Positive Energy Districts
16:30 – 18:30	Group activity, Prof. Rosaria Volpe Control and CUSUM charts for PEDs

Thursday, 15th June

09:00 – 11:00	Lecture, Prof. Maurizio Cellura and Prof. Francesco Guarino Positive Energy Districts case-studies: towards an urban carbon footprint
11:00 – 11:30	<i>Break</i>
11:30 – 13:30	Group activity, Prof. Maurizio Cellura and Prof. Francesco Guarino Energy and carbon balance calculations
13:30 – 14:30	<i>Lunch</i>
14:30 – 16:30	Lecture, Dr. Topi Rasku Modelling the energy market impacts of PEDs
16:30 – 18:30	Group activity, Dr. Topi Rasku SpineOpt demo

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Friday, 16th June

09:00 – 11:00	Round-table
11:00 – 11:30	<i>Break</i>
11:30 – 13:30	Results' presentation and greetings

Details

Adriano Bisello



Adriano Bisello is an urban planner and holds a Ph.D. in real estate economics. At Eurac Research, in Bolzano (Italy), he coordinates the research team on the “Planning and evaluation of multiple benefits of the energy transition” and works as a project manager. Adriano’s activities range from local to European-funded projects related to smart city governance, innovative nature-based and digital solutions, and sustainable energy communities. In 2022 he has been appointed vice president of ASSURB (Italian Association of Spatial Planners) and delegate to the ECTP-CEU (European Council of Spatial Planners).

Lecture, Prof. Adriano Bisello

Urban planning, governance perspective, and multiple benefits evaluation in PED

The lecture will introduce students to the concept of PED from an urban planning perspective, stressing design and governance issues. PEDs are here presented as urban projects, dealing with technical, social, regulatory, and management complexity. Students will be invited to reflect on what barriers and drivers a project developer or a municipality may face in kicking off an such ambitious project.

Suggested readings:

- Borsboom-Van Beurden, J., Bisello, A., Vettorato, D., Vacha, T. & Jakovijevic D. (2023). Systemic Changes in Governance Equipping local governments for realising climate-neutral and smart cities. <https://smart-cities-marketplace.ec.europa.eu/insights/publications/systemic-changes-governance-equipping-local-governments-realising-climate>

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- Bisello, A. Assessing Multiple Benefits of Housing Regeneration and Smart City Development: The European Project SINFONIA. Sustainability 2020, 12, 8038. <https://doi.org/10.3390/su12198038>

Group activity, Prof. Adriano Bisello

Integrated sustainability assessment of PED. Expected multiple benefits

Students are engaged in a workshop on integrated sustainability assessment of PED. By eliciting expected multiple benefits, they will start defining the framework for the elaboration of environmental, economic, and social indicators. Understanding and communicating multiple benefits is a key to engage stakeholders in PED projects.

Giuseppe Inturri



Giuseppe Inturri is Associate Professor of Transport of the University of Catania, Department of Electrical, Electronics and Computer Engineering. He is Rector's delegate for sustainability and mobility management. He was Technical Manager for transport and infrastructure management of Ferrovia Circumetnea. He was Technical Manager for Misterbianco, a municipality of Catania and Traffic Manager of AMAT, Palermo. He was Technical Manager Assistant and Quality Assurance Manager of SCEV S.p.A. He is an active consulting expert in the field of transport and mobility. He is authors of several international publications in the field of transport policy and planning.

Lecture, Prof. Giuseppe Inturri

Mobility in Positive Energy Districts

Urban mobility has multi-faceted aspects, from electrical transport, to cycling and public transit that needs to be integrated at the district level. The lecture will provide key insights into transport policies and planning, as well as in emerging patterns and trends for Positive Energy Districts.

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Abolfazl Rezaei



He is a Ph.D. student in Building, Civil, and Environmental Engineering at Concordia University. He is part of the Energy System group at Concordia's Next Generation Cities Institute (NGCI). NGCI focuses on urban studies from a variety of perspectives, ranging from buildings to transportation. Within the energy system group, he is developing a framework for an automated building to city-scale energy system modeling. His background is Mechanical Engineering, and he has experience with numerical modeling of fluid flow and heat transfer, and IoT. His Ph.D. research concentrates on the hydraulic and thermal behavior of district energy systems, with a particular emphasis on the integration of renewable energy sources.

Lecture, Dr. Abolfazl Rezaei

Renewable-based energy systems in districts

In this lecture, we will explore renewable-based energy system design by focusing on modeling and simulating different components such as heat pumps and photovoltaics. We will also discuss how to parameterize different systems to automate the energy system modeling process and how the utilized data should be managed using a data model. Additionally, we will analyze the role of heat pumps with different sources (air, ground, surface water) and study the role of district energy systems in reducing carbon emissions and addressing the challenges of climate change.

Group activity, Dr. Abolfazl Rezaei

Simulation of load curves and components

During the class activity, we will provide load curves and demand profiles of a building and guide students in designing a renewable-based energy system for the building. This hands-on experience will allow students to analyze load curves, model energy system components, and analyze data. By the end of the activity, students will have a solid understanding of renewable-based energy system modeling and simulation. Ultimately, students will be able to utilize the energy system model, parameterize it with a Python script, and identify energy system configurations with the lowest emissions, low auxiliary energy needs, and low hours with peak loads (using the thermal storage tank).

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Rosaria Volpe



Rosaria Volpe, Ph.D., is Assistant Professor of Applied Thermodynamics and Heat Transfer of the University of Catania. Her research interests include renewable energies, distributed energy systems, energy management, heat and mass transfer, computational fluid dynamics, energy production from biomass, carbon capture and storage systems. She has been awarded with the “Young Researcher Award Certificate of Merit 2017”. She is the Lead Researcher of a project funded by the European Commission and the Italian Ministry of Education on the topic of biomass exploitation in urban areas. She is Leader of the Subtask C “Organizing principles and impact assessment” of the IEA EBC Annex 83 “Positive Energy Districts”. She authored several publications in international journals and conference proceedings and is Member of the Editorial Boards of several international Journals.

Lecture, Prof. Rosaria Volpe

Energy audits and monitoring for Positive Energy Districts

The Lecture will introduce the main concept of energy management, with specific attention energy audit and energy monitoring at the district level. The energy audit will be explained taking into consideration the main steps of data collection, data analysis, report preparation and performance improvement actions. Energy monitoring will be introduced and the most diffused control charts will be presented and discussed.

Group activity, Prof. Rosaria Volpe

Control and CUSUM charts for PEDs

A walk-through audit will be conducted for a typical district and control charts as well as CUSUM charts will be developed and tested during the activity. The results of the activities will be discussed and energy management decisions for the discussed PED will be evaluated.

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Maurizio Cellura

Full professor of Building physics and Building Energy Systems since 2011 at the University of Palermo, his scientific activity is mainly oriented towards energy and environmental topics, with focus on energy efficiency in buildings, technologies powered by renewable energy technologies and decarbonization strategies of systems and processes. Director of the Centre for Sustainability and Ecological transition of the University of Palermo. Representative for the University of Palermo to the “Sustainable Solutions Development Network – a global initiative for the United Nations” since 2014, he was national vice president of the “Italian Life Cycle Assessment Network” since 2012, becoming president in October 2015. He is member of the Italian consultation board of the Italian Ministry for Education for the challenge “Secure, Cleaner and Efficient Energy” of the EU program Horizon 2020 (from October 2013). He is national representative of the SETPLAN IWG 5 “Energy Efficiency in Buildings”. His research experience is clarified by more than 380 scientific publications.

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Francesco Guarino

Francesco Guarino is Assistant Professor at the University of Palermo, department of Engineering. He completed his M.Sc in Energy engineering in 2011 and got his Ph.D. in Energy in 2015, working on “Building integrated phase change materials energy storage: experimental studies, modelling and parametric analysis”. He participated to multiple International Energy Agency workgroups since 2012 from both the “Solar Heating and Cooling” and “Energy in Buildings and communities” programmes, notably IEA SHC Task 40/ECBCS Annex 52 “Towards net zero energy solar buildings” and is currently Operating agent of Annex 83 “Positive Energy Districts”. Author of around 100 among papers in national and international journals and conferences, book chapters or technical reports, he is reviewer consulted among several international energy and environmental journals. Recipient of several research awards and best paper awards. His work is oriented towards sustainability in the building and energy sector, through research in the fields of Life Cycle Assessment of buildings and energy technologies, building physics and building simulation, low-carbon and renewable energy technologies.

Lecture, Prof. Maurizio Cellura and Prof. Francesco Guarino

Positive Energy Districts case-studies: towards an urban carbon footprint

The lecture will investigate case-studies of existing districts and will investigate the potential for the fulfillment of different Positive Energy District definitions, with a specific focus extended from the mere use of energy within buildings to a larger perspective both in terms of different energy uses computed and life cycle stages introduced within the analysis.

Group activity, Prof. Maurizio Cellura and Prof. Francesco Guarino

Energy and carbon balance calculations

The group activity will include energy and carbon balance calculations applied to PED case-studies and the application of simplified multi-criteria analyses towards the optimal PED oriented renovation design of an existing district.

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Topi Rasku

He has 7+ years of experience as a Research Scientist at the Design and Operation of Energy Systems team at VTT Technical Research Centre of Finland Ltd and is currently a Part-Time Doctoral Candidate at Aalto University School of Science. He has participated in the development of large-scale energy system optimisation frameworks Backbone and SpineOpt, as well as co-authored a few publications on related topics. Topi's main research interests lie in modelling and optimisation of energy systems as well as energy sector integration, with a focus on the coupling of power and heating sectors.

Lecture, Dr. Topi Rasku

Modelling the energy market impacts of PEDs

What happens on future energy markets if and when Positive Energy Districts (PEDs) become mainstream? This lecture aims to provide an overview on how energy markets are modelled, energy sector integration, as well as to how PEDs can be depicted in order to capture their impacts on the future energy systems.

Group activity, Dr. Topi Rasku

SpineOpt demo

This session will give a brief demonstration on how PEDs can be modelled using the open-source energy system modelling framework SpineOpt, and provide a small example system to mess around with. Let's see if we can modify it a bit and see what happens!

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Venue

The School will take place in Catania (Sicily – Italy), from the 12th to the 16th of June.

School venue: Plaza Hotel, website: <https://www.plazahotelcatania.it/>



Participation fee

Participation fee: **250 Euros**: details for payment in the attached form.

Deadline for payment: **1st June**.

Please fill the attached form and return it to: info@plazahotelcatania.it

Tariffs have been specifically reserved for the School participants. When booking and in any contact with the School venue, please mention your registration to the Second Ph.D. Annex 83 Summer School.

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For further information and help please contact Rosaria Volpe (rosaria.volpe@unict.it) and Francesco Guarino (francesco.guarino@unipa.it).

Organizing Committee

Rosaria Volpe, University of Catania, Italy

Francesco Guarino, University of Palermo, Italy

Maurizio Cellura, University of Palermo, Italy

Alberto Fichera, University of Catania, Italy

Francesco Reda, VTT Technical Research Center, Finland

Ala Hasan, VTT Technical Research Center, Finland

Hassam Rehman, VTT Technical Research Center, Finland

Adriano Bisello, EURAC Research, Italy

Topi Rasku, VTT Technical Research Center, Finland