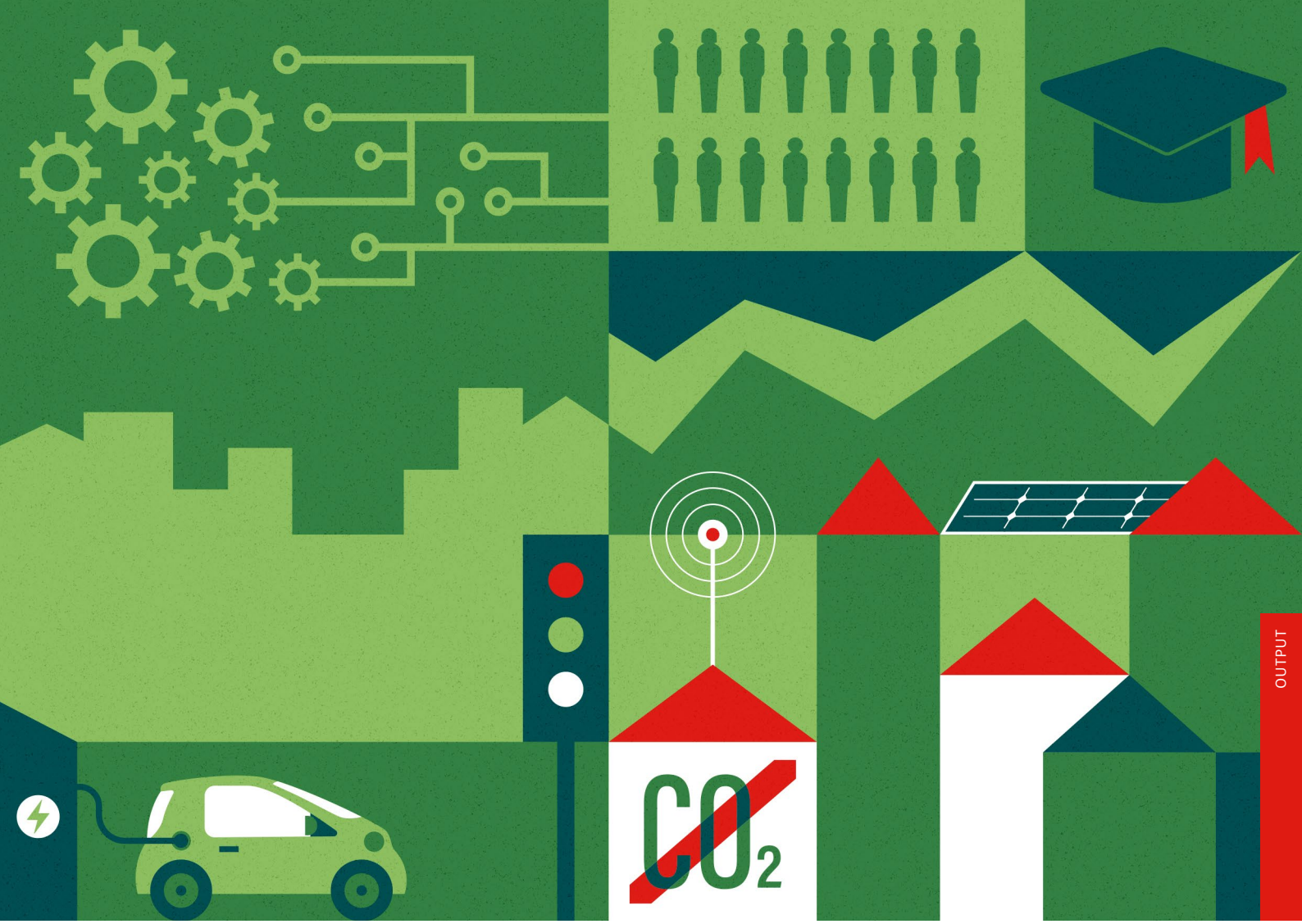

SSPCR 2025

Smart and Sustainable Planning for Cities and Regions Conference

BOOK OF ABSTRACTS

9-12 December 2025
Eurac Research
NOI Techpark, Bolzano/Bozen, Italy

eurac research

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DOI: https://doi.org/10.57749/8f1b-7z02

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Photos: p4-5: Eurac Research/Daniele Fiorentino

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10 years of Smart and Sustainable Planning for Cities and Regions Conference

For a decade the SSPCR International Conference has been shaping the future of urban and regional development. The conference brought together the international scientific and professional community to discuss pathways for more sustainable, resilient, and inclusive cities and regions. The **SSPCR - Smart and Sustainable Planning for Cities and Regions 2025** conference was held from **9 to 12 December 2025**, organized by **Eurac Research** at the **NOI Techpark, Bolzano** (Italy).

SSPCR 2025 gathered **269 on-site participants from 47 countries** and featured a rich programme including **7 thematic tracks, 16 special sessions**, and **7 events**. The discussions addressed the interconnected challenges of climate neutrality, energy transition, mobility systems, social justice, governance, circular economy, and the growing role of data and artificial intelligence in urban and regional planning.

Moments from SSPCR 2025: Daniele Vettorato opening the conference

The seven Thematic Tracks covered key domains shaping contemporary planning debates:

1. energy transition towards climate-neutral cities;
2. adaptive regeneration strategies;
3. sustainable mobility systems;
4. just and inclusive urban governance;
5. economics and valuation of the urban energy transition;
6. circular economy approaches;
7. data- and AI-powered territories for planning and management.

A key focus of the conference was the shared understanding that the climate transition can no longer be addressed from a purely technical perspective.

Instead, it requires integrated solutions that take into account the quality of living spaces, social inclusion, community well-being, and the cultural value of places. In this respect, SSPCR 2025 aligned with the principles of the New European Bauhaus, promoting an ecological transition that combines sustainability, aesthetics, and inclusiveness.

Central questions discussed during the conference included how to integrate energy efficiency and mobility within urban systems facing rapid economic and social change; which strategies can enhance urban resilience to extreme climate events; and how planners can effectively use data, artificial intelligence, and digital models while ensuring meaningful community involvement. SSPCR 2025 emphasized the importance of fostering dialogue across disciplines, reinforcing the idea that urban and regional transformation is not only a technical or engineering challenge, but also a cultural and social process requiring new imaginaries, new living models, and innovative forms of participation.

Closing Plenary Session: "Global reflections and future pathways„ - from left to right Rolf Schuett, Pietro Elisei, Giancarlo Cotella, Li Fan, Daniele Vettorato

The SSPCR 2025 conference also featured two exceptional keynote speakers: **Barbara Widera** (Associate Professor at the Faculty of Architecture of Wroclaw University of Science and Technology in Poland, and Board Member of the EU Mission for Adaptation to Climate Change) and **Thomas Maloutas** (Researcher Emeritus at the National Centre for Social Research – EKKE, and Professor Emeritus in the Department of Geography at Harokopio University in Athens, Greece).

Keynote Speakers: on the left Barbara Widera "Why Beauty, Sustainability, and Inclusiveness Must Be Considered Together„ - on the right Thomas Maloutas "The challenge of inclusiveness„

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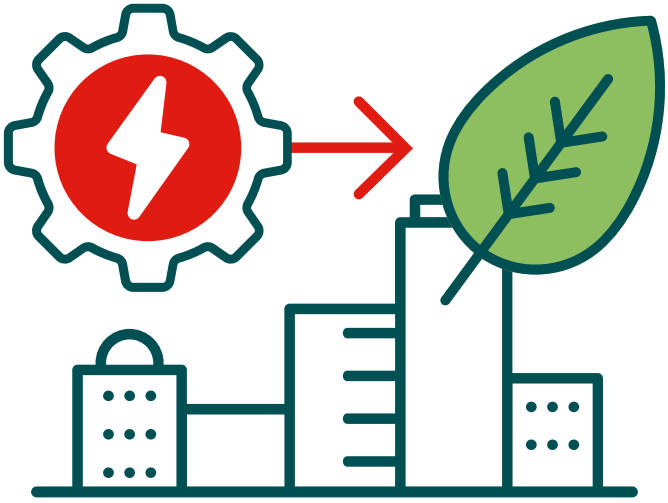

TRACK 1

Energy Transition: Towards Climate Neutral Cities

TRACK 1
Energy Transition: Towards Climate Neutral Cities

Achieving climate neutrality in cities requires a fundamental transformation of urban energy systems, integrating sustainability principles across multiple scales — from individual buildings to entire districts. This transition necessitates a shift towards energy-efficient technologies, the reduction of greenhouse gas emissions, and the widespread adoption of renewable energy sources. At the same time, it has to consider the social and economic dimensions of sustainability, ensuring that solutions are inclusive, affordable, and adaptable to diverse urban contexts.

This track explored evaluation frameworks supporting decision-making in the context of energy transition and climate neutrality at the urban level, providing insights into effective planning, policy-making, and implementation strategies. The focus included energy renovations, low-energy and low-emission buildings, nearly Zero or Positive Energy Buildings (nZEB or PEB), Positive Energy Districts (PED), and urban plans for climate-neutral cities.

REGULAR SESSION

ENERGY TRANSITION: TOWARDS CLIMATE NEUTRAL CITIES

Chair: Gianluca Grazieschi (Eurac Research - Institute for Renewable Energy)

Reaching climate neutrality in cities demands a comprehensive transformation of urban energy systems that balances environmental, social, and economic sustainability. This involves adopting energy-efficient technologies, reducing emissions, and expanding renewable energy use across all scales—from individual buildings to entire neighbourhoods.

The session examined evaluation frameworks and decision-making tools that support this energy transition, covering topics such as energy renovations, low-emission buildings, nearly Zero or Positive Energy Buildings (nZEB/PEB), Positive Energy Districts (PED), and urban climate-neutral planning strategies.

These approaches ensure solutions are not only effective but also inclusive, affordable, and adaptable to different urban environments.

ORAL PRESENTATIONS

030 - Comparative Case Study of Ownership Models in Renewable Energy Communities

Marcello Avanzini (1) - Francesco Guarino (1) - Maurizio Cellura (1) - Sonia Longo (1)

(1) Università Di Palermo, Palermo, Italy

Keywords: Renewable Energy Communities, Energy Sharing, Techno-Economic Analysis, Energy Performance Simulation

Abstract The Renewable Energy Directive (RED II) introduced Renewable Energy Communities (RECs) into European legislation as a new mechanism to empower local communities in the energy transition. RECs allow for the local sharing of energy produced from renewable sources and ensure democratic control over their activities and revenues. In Italy, RECs receive financial incentives for the electricity virtually consumed by their members. This article proposes a classification of RECs based on the ownership of energy assets, identifying four main models: 1) public ownership, 2) community prosumerism, 3) REC ownership, and 4) external producer. These four models were applied to the same case study, followed by an energy performance simulation to carry out a comparative techno-economic analysis.
The technical analysis focused on electricity and emissions balances, while the economic analysis evaluated the distribution of revenues from electricity surpluses, bill savings, and REC incentives. Zonal electricity prices and the national energy mix were used in the calculations. The results highlight the strengths and limitations of each proposed ownership model, offering suggestions for potential adjustments in model design and policy recommendations to support widespread adoption.

060 - Expanding BIPV city deployment against urban and climate change related temperature increases: The BIPV-city project

Nikolaos Skandalos (1) - Tsampika Dimitriou (1) - Georgios Mitsopoulos (2) - Ilias Kasmeridis (3) - Vasileios Kapsalis (2) - Athanasios Tolis (2) - Vassilios Dimakopoulos (3) - Dimitrios Karamanis (1)

(1) University Of Patras, Agrinio, Greece - (2) National Technical University Of Athens, Athens, Greece - (3) University Of Ioannina, Ioannina, Greece

Keywords: BIPV, Carbon-Neutral City

Abstract The transition to NZEBs is not an easy process due to its complexity and the associated costs. BIPVs could make a substantial contribution towards this transition due to their passive energy benefits, as well as electricity production. The large available surfaces on the buildings' facades offer unique opportunities to integrate photovoltaics into opaque or transparent areas. Despite the technical maturity and substantial cost reduction of BIPV technologies, there are still challenges to overcome for the expansion of BIPV applications and their wider adaptation at global level. They can be grouped as follows:

a. Complexity of energy-related properties of BIPV modules and systems
b. Difficulty in assessing the quality of architectural integration
c. Outdoor performance and predictive maintenance
d. Integration dependence on regional climate conditions
e. Early-stage sustainable BIPV design approach for end-users implementation

Recently, four articles have covered the four challenges considerably by N. Martín-Chivelet et al. [j.enbuild.2022.111998], I. Custódio et al.[j.solener.2022.02.019], D. S. Pillai et al. [j.rser.2021.111946] and N. Skandalos et al. [j.rser.2022.112950] respectively. Since building structure is the interface between humans and their natural environment, the proposed framework with the associated integration criteria prioritizes photovoltaics integration in harmony to local environmental and bioclimatic conditions towards sustainable development. In designing PV building integration in an early-stage approach, detailed building simulations with complex, energy and time-consuming numerical tools is required to be performed by specialists which hinders BIPV deployment. Therefore, the fifth challenge is very weakly addressed in the scientific literature.
Therefore, this works aims to contribute substantially in addressing the fifth challenge by bringing forward three major and important innovations against urban and climate related temperature increases:

— the energy lower boundaries of BIPV deployment at the urban space in Europe was determined. All studies have been confined so far the rooftop PVs potential. We have conservatively estimated the potential of BIPV in Europe towards NZEBs. The estimation will accelerate the BIPV implementation and open the discussion and research for the BIPV-UHI interaction effects.
— the SERAS principle ((Sufficiency, Efficiency, Renewables and Sharing) was applied in a realistic case of a typical Mediterranean city and the

feasibility of carbon neutral city until 2030 was validated.
- an innovative and novel BIPV climatic design tool was developed for design, outreach and educational purposes.

This research is implemented in the framework of H.F.R.I call “Basic research Financing (Horizontal support of all Sciences)” under the National Recovery and Resilience Plan “Greece 2.0” funded by the European Union—NextGenerationEU (H.F.R.I. project number: 14812).

079 - Urban Design and Energy Demand Patterns: A Spatial Analysis Using Geolocated Smart Meter Data from UK Households

Matteo Barsanti (1)

(1) University College London, London, United Kingdom

Keywords: Energy Demand Patterns, Urban Context, Demand-Side Solutions, Spatial Regression, Smart Meter Data

Abstract As city become more decarbonised and electrified, understanding how energy demand varies across time and space is increasingly important for effective energy management and planning. Such insights enable targeted infrastructure investments in areas of highest need and supports the design of demand-side strategies that optimize the use of variable renewable energy sources while managing growing peak loads.
While existing research has primarily focused on household-level determinants (e.g. socio-demographics, building characteristics, and appliance ownership) and environmental conditions (e.g. temperature and solar irradiance), growing evidence from urban and transport studies underscores the importance of the urban spatial context. For instance, the built environment, land-use patterns, and transport infrastructure influence human mobility and daily activity rhythms, which in turn shape where and when energy is consumed. Overlooking these contextual factors not only leads to suboptimal energy planning interventions but also constrains the development of systemic demand-side solutions. This research investigates how urban spatial context influences household energy demand, aiming to inform new demand-side strategies that support urban energy transitions. We use spatial regression techniques to analyse geographic variation and the underlying drivers of household electricity use, with a focus on both physical (e.g. urban density, urban form) and functional (e.g. land-use mix, transit accessibility) urban characteristics. Our analysis draws on a unique dataset that combines georeferenced smart meter data from over 13,000 UK households, detailed household surveys, and spatial context indicators derived from OpenStreetMap.
Our findings demonstrate that urban design characteristics—such as compact vs dispersed, mixed-use vs mono-functional, transit-rich vs car-dependent—significantly affect the synchronization and predictability of household energy demand. These insights underscore the importance of integrating urban spatial context into both demand-side interventions and strategic infrastructure planning. Ultimately, by bridging urban and energy planning, this research offers actionable insights for distribution system operators, policymakers, and urban planners working toward carbon-neutral cities.

085 - Peer-learning experiences on climate governance for climate and energy transition in the Italian Mission Cities: insights from the Let’s GOv project

Saveria Olga Murielle Boulanger (1) - Martina Massari (1) - Danila Longo (1)

(1) Università Degli Studi Di Bologna, Dipartimento Di Architettura, Bologna, Italy

Keywords: Energy Transition, Climate Neutral Cities, Smart Cities, Governance

Abstract Overcoming governance barriers is a crucial condition for accelerating climate and energy transition. Many local administrations face persistent challenges, such as poor cross-sectoral coordination, limited vertical alignment with higher levels of government, and insufficient stakeholder engagement, especially in sectors like energy consumption reduction. The current necessity of accelerating climate transition toward 2030 and 2050 requires to take those barriers seriously and to find solutions to overcome them also considering countries and local specificities.
The Let’s GOv project (GOverning the Transition through Pilot Actions) supported the 9 Italian cities selected into the European “100 Climate-Neutral and Smart Cities by 2030”, which aims to make 112 cities climate-neutral by 2030, to undertake a common path of mutual learning and understanding of those governance barriers, focusing on three key dimension: internal, external and multi-level. The project partners took part in a bench learning program for sharing and exchange, jointly organized by the University of Bologna (responsible for the activity),

AESS, and the City of Bologna (project coordinator). The programme focused on exchanging knowledge and practices to accelerate decarbonisation focusing on major themes such as cities' energy infrastructure, energy citizenship and energy data monitoring systems and tools. Bologna, Bergamo, Florence, Milan, Padua, Parma, Prato, Rome, and Turin with additional 15 Italian Follower cities took part in the activities.
The initiative aimed to foster mutual learning and collective reflection among local administrations by identifying common governance challenges and sharing strategies to overcome them. Through a series of structured exchanges in person and online, the cities explored critical issues related to climate action and co-developed digital training pilots focused on selected themes. The process proved valuable not only for sharing best practices, but also for generating actionable knowledge through peer dialogue, joint problem-solving, and the co-construction of replicable solutions.
This contribution presents insights from this peer learning experience deepening the methodological aspects and some key findings both at the governance level and on the specific key topics.

113 - Validation of Solutions Toolkit through a Complete Building Energy Simulation: Civitavecchia Case Study, MAKING PEDs Project

Vanesa Saez (1) - Joana Ortiz (2) - Giordana Panella (1) - Carlos Chang (2) - Paolo Civiero (1) - Jaume Salom (2)

(1) Roma Tre University, Deparment Of Architecture, Rome, Italy - (2) Catalonia Institute For Energy Research (irec), Climate Neutral And Resilient Buildings And Communities, Barcelona, Spain

Keywords: Solution Toolkit, Energy Refurbishment, Hygrothermal Comfort

Abstract The development of methodologies that integrate digital tools, technical solutions, and environmental sustainability criteria is key to moving toward climate-neutral urban models. Along these lines, the European project MAKING PEDs aims to plan and test climate-neutral, positive energy districts (CNPEDs) through the use of Digital Twins that support participatory decision-making processes based on real-world data. The project is being implemented in four Urban Living Labs (ULLs) located in Bærum (Norway), Linz (Austria), Sant Esteve de Palautordera (Spain), and Civitavecchia (Italy).
This study focuses on the validation of the Solutions Toolkit, a package of solutions in the energy category, by assessing energy performance and hygrothermal comfort through dynamic urban simulation, combining georeferenced databases following the CityGML standard and energy simulation in TRNSYS. The analysis is carried out on a multi-family housing complex built in the 1990s in Civitavecchia, selected as a representative case study of the local housing stock. The objective is to verify, in a controlled urban simulation environment, the impact of the proposed energy measures in terms of reducing energy consumption and CO2 emissions, and improving indoor thermal comfort. The methodology used uses energy simulation with hourly data to determine the current energy performance of each building and estimate its improvement after implementing interventions from the Solutions Toolkit's energy package. This simulation tool is used to perform a thermal comfort analysis based on adaptive comfort (EN16798-1-2019), complemented by the heat index for a more detailed analysis of overheating and the effect of humidity. The toolkit's solutions were analyzed using the Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) indicators, in accordance with ISO 7730, assessing the level of thermal comfort achieved in the different simulated scenarios. The results show that, although the building has reasonable thermal performance given its construction period, there are significant opportunities for improvement in both energy efficiency and interior comfort. The application of the toolkit's solutions allows for a significant reduction in annual energy demand and a substantial improvement in thermal comfort during the critical winter and summer months, reducing the percentage of thermal dissatisfaction under international ASHRAE 55 and ISO 7730 parameters. It is concluded that this process not only verifies the technical and energy viability of the solutions package, but also its impact on user well-being, reinforcing the validity of the Solutions Toolkit as an adaptable and scalable tool in real-life urban contexts. The Civitavecchia case thus contributes to strengthening the applicability of the MAKING PEDs approach to the sustainable energy transformation of European districts.

195 - How Urban Form and Land Use Shapes Energy Emissions? A Data-driven Comparative Study of Seoul

Syifa Hana Agristya (1) - Seunghyun Jung (2)

(1) Korea University Of Science And Technology, Urban And Geotechnical Engineering, Goyangsi, Gyeonggido, Korea, Republic Of - (2) Korea Institute Of Civil Engineering And Building Technology, Architectural Research, Goyangsi, Gyeonggido, Korea, Republic Of

Keywords: Urban Form, Land Use, Urban Structure, Energy Emissions, Machine Learning, Regression Model

Abstract Studies of urban energy emissions tend to assume that urban form has the potential to shape human behaviour, driving both human development and technological progress. Previous empirical studies have emphasised the role of urban form typologies in enhancing energy efficiency in the context of urban planning. However, most of these studies focus solely on building-related energy consumption through electricity and gas usage, overlooking other urban emission sources. To better understand the complexity of urban systems regarding energy emissions, this study expands the analytical scope by integrating both urban form and urban function as key components of urban structure typologies. Specifically, this study investigates how the combination of both urban form and land use contributes to energy-based emissions across neighbourhoods in Seoul. Typologies of urban structure are derived using the Gaussian Mixture Model (GMM) clustering method, based on 18 variables that represent urban geometry, land-use composition, and socio-economic characteristics. These include metrics such as the number of buildings, number of plots, average plot size, Floor Area Ratio (FAR), building coverage, building age, building height, road/pavement area ratio, transit accessibility, population density, household income levels, and ratio of each existing land use (residential, commercial, industrial, infrastructure, green space, waterbody, and vacant). To measure emissions, the study integrates multiple sources of energy-based emissions data in 2021, including electricity and gas consumption, as well as transport-related emissions.
The urban typologies are then used as explanatory variables in four regression models, such as Ordinary Least Squares (OLS), Random Forest (RF), XGBoost, and Spatial Lag Model (SLM), to assess their predictive power in explaining emissions intensity at the neighbourhood level. Among them, spatial regression modelling (SLM) offers improved explanatory power in accounting for spatial autocorrelation effects, particularly in peripheral urban areas where emissions patterns tend to cluster geographically. This study demonstrates that urban typologies with compact built environments characterised by high-density residential, commercial, and infrastructural land uses are significantly associated with higher energy-based carbon emissions. The emissions show a strong positive relationship with built-up land types, while natural and undeveloped lands exhibit weak to moderate negative correlations. Compact typologies with greater transit accessibility and vertical development tend to exhibit lower per capita emissions, reinforcing the efficacy of dense, transit-oriented development in mitigating urban carbon output.

230 - Achieving the Carbon Neutrality of New District in Czech Context

Tomas Matuska (1)

(1) Czech Technical University In Prague, University Centre For Energy Efficient Buildings, Prague, Czech Republic

Keywords: Photovoltaics, Heat Pump, Energy Simulation

Abstract A new district with about 50 residential apartment buildings in Prague (CZ) is being developed as positive clean energy district (PCED) within the Horizon project ASCEND. Beside the organizational, financial and regulatory issues, the planning phase also includes the number of analyses regarding the energy system concept leading to carbon emissions neutrality. Energy simulations of given district performance (heat and electricity) have shown the realistic use, efficiency and benefits resulting from the application of different technologies as solar thermal, photovoltaics, heat pumps, combined heat and power, bioenergy etc. Paper shows how the individual energy sources solutions and their combination influence the final result, i.e. possibility of carbon neutrality achievement, expected investment costs and real annual operation costs for the district in the context of Czech Republic (carbon emission factors, energy prices, technology costs) compared to legal building energy requirements (business as usual). A specific attention will be paid to time-step of energy balancing which significantly affects the real potential for achievement of district carbon neutrality.

235 - Spatial energy planning and municipal heat planning - Experiences and developments in Austria

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Keywords: Spatial Energy Planning, Municipal Heat Planning, Urban Development, Decarbonisation, Infrastructure

Abstract Austria has seen dynamic developments in the integration of spatial energy planning (SEP) and

municipal heat planning (MHP) as strategic tools to accelerate the decarbonisation of its heating sector. This contribution presents current experiences, methodological approaches, and policy frameworks that support the integration of these planning instruments at regional and local levels.
Drawing on research and applied projects, this presentation analyses the synergies and differences between SEP and MHP and their roles in shaping decarbonisation pathways for urban and rural areas. Best practice examples from Austrian municipalities illustrate how spatial data, renewable potential and waste heat mapping, stakeholder engagement, and scenario modelling tools / GIS-based heat atlases support evidence-based decision-making. This approach cannot only fundamentally support and enable Substainable Energy and Climate Action Plans (SECAPs), but also allow for clear boundary conditions for urban development and for long-term infrastructure planning (e.g., district heating and cooling, decentralized heating and cooling grids, development of natural gas grids).
Furthermore, the presentation explores the challenges related to governance, data availability, cross-sectoral coordination, and institutional capacity, and outlines ongoing efforts to embed SEP and MHP in regulatory and planning frameworks, in line with national and European climate goals.
Finally, the presentation provides an outlook on how Austria's experience can inform the scaling and replication of integrated heat and energy planning in other European contexts and which role the IEA Cities Task 2 "Data for Urban Energy Planning" can disseminate this information on global scale.

249 - Open Geographic Information System for Energy Transition : citiwatts.eu

David Wannier (1) - Noémie Jeannin (2) - Peter Sorknæs (3) - Jakob Rager (4) - Lukas Kranzl (5) - Nicolas Wyrsch (6)

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Keywords: Geographic Information System, Open-Source, DevSecOps, GDPR, Electric Vehicles, District-Cooling

Abstract The OpenGIS4ET project successfully delivered the Citiwatts 3.0 platform, a comprehensive open-source energy planning tool that advances the green transition across heating, cooling, mobility, and sector coupling domains. Building on the former H2020 Hotmaps foundation, the project achieved its core objective of creating an accessible, interoperable platform for public authorities and energy planners operating from local to national scales.
The project established a robust DevSecOps development framework ensuring security throughout the development lifecycle, with SonarQube integration for continuous code quality monitoring. The platform features responsive design compatibility across desktop and mobile devices, advanced session management enabling users to maintain multiple calculation results per module, and comprehensive two-factor authentication through Keycloak services. A secure public API also enables external system integration. Sophisticated calculation modules were developed and validated through real-world case studies. The EV-Mobility tool provides Vehicle Kilometer Travelled mapping with charging behavior modeling across four scenarios including home, workplace, points of interest, and home office charging, coupled with photovoltaic production potential analysis. The District Heating and Cooling tool addresses temperature-level optimization requirements with economic feasibility assessment tools. The Sector Coupling tool integrates electrical, heating, and transport systems through connection with EnergyPLAN, enabling comprehensive flexibility analysis for multi-sector energy planning.
The project delivered a comprehensive CO2 impact assessment and quality control processes applicable to future energy planning initiatives. Open dataset repositories with automated quality validation ensure data integrity, while GDPR risk analysis templates provide reusable compliance frameworks for similar European energy planning tools. Export capabilities, which include PDF reports with indicators and charts, ZIP packages, and Excel format compatibility for external analysis, extended the original platform capabilities. The platform's open-source architecture reduces market entry barriers.
A usability analysis has been conducted and was followed by the implementation of release 3.0 with UX improvements. Training programs delivered to energy planning professionals across partner countries established new competency frameworks, while comprehensive documentation and tutorial materials support ongoing knowledge transfer. Case studies

across Denmark, Austria, Switzerland, and Germany confirmed the platform's effectiveness in diverse regulatory and technical contexts. Derived projects such as CoolLIFE and SAPHEA also display the adaptability of the current platform, which demonstrates its adaptability to diverse geographical and technical contexts.

SPECIAL SESSION

GO-PCEDS - GOOD PRACTICES FOR ENABLING POSITIVE AND CLEAN ENERGY DISTRICTS

Chairs: Paolo Civiero (RomaTre University - Architecture Dept.), **Giulia Turci** (Cesena Municipality), **Beril Alpagut** (DemirEnergji), **Francesco Guarino** (University of Palermo), **Michal Kuzmic** (Univerzitní centrum energeticky efektivních budov, ČVUT v Praze), **Adriano Bisello** (Eurac Research - Institute for Renewable Energy)

The aim of the session was to take further steps towards the climate transition of cities by following a systemic approach across multiple Positive and Clean Energy Districts (PCEDs) ecosystem domains, identifying and addressing key challenges at the neighbourhood scale. In line with this ambition, the session focused on specific topics and addressed three main areas of PCED implementation, contributing to the sharing of innovative planning policies and tools.

1. PCEDs are framed not as products, but as ambitious processes, involving multiple domains and implementation phases, ranging from urban planning to construction and use.
2. PCED development relies on a well-structured data framework, based on digitalization and the availability of data, key performance indicators, and platforms enabling the understanding of local needs, priorities, technical solutions, and cost efforts in order to identify potential intervention scenarios.
3. PCEDs require cross-sectoral and multi-stakeholder collaboration, as well as a shared effort and perspective. The session aimed to attract and involve diverse target audiences, fostering dialogue across disciplines and sectors.

Building on these three areas, the session explored implementation strategies, enabling factors, and data systematization approaches to support PCED development. Emphasis was placed on multi-actor cooperation, gamification, decision-support tools, and technical solutions driving innovation in PCED design. Presentations highlighted advanced technologies and analytical methods for assessing energy efficiency, environmental impact, and economic sustainability, with a particular focus on the digitalization of the built environment and on modelling and simulation techniques, including GIS and CityGML.

ORAL PRESENTATIONS

090 - Validating simulation tools for local energy transitions: A methodology to assess accuracy and support municipal planning

Martina Dell'Unto (1) - Louise-Nour Sassenou (1) - Claudia Collar (1) - Enrique Fuster-palop (2) - Francesca Olivieri (1) - Lorenzo Olivieri (1)

(1) Universidad Politécnica De Madrid, Department Of Construction And Technology In Architecture, Escuela Técnica Superior De Arquitectura, Madrid, Spain - (2) Impacte, València, Spain

Keywords: Positive Energy District, Simulation Tool, Transition Planning, Validation, Methodology

Abstract Positive Energy Districts (PEDs) are defined as urban areas that achieve a positive annual energy balance and net-zero greenhouse gas emissions. Their development plays a key role in supporting cities' decarbonization goals and promoting sustainable urban transformation. However, implementing PEDs represents a complex challenge for municipalities, as it requires tools that allow evaluation and planning based on local needs and resources. This research proposes a simulation-driven methodology to facilitate the identification and implementation of PED scenarios adapted to the specific characteristics of each city. By relying on simulation-based analysis, the approach provides municipalities with a practical framework to decision-making and refine the simulated environment. This will provide a basis for evaluating different technical and operational strategies before deployment.
The proposed methodology is structured in three stages. The first stage focuses on identifying the most widely used energy simulation tools in existing literature and assessing their suitability for municipal use. This evaluation considers the Key Performance Indicators (KPIs) generated by each tool, analysing their relevance to local authorities' priorities. The second stage focuses on assessing the accuracy and reliability of the simulated KPIs with measured real-world data. First, the required inputs and outputs for each simulation tool are identified. Then, a

monitoring framework is defined, detailing sensor specifications and data-collection protocols, to systematically capture real-world performance for comparison with the simulation results.
The third stage establishes a systematic validation process, comparing simulated KPIs against monitored field data. This comparison will enable performance verification and model calibration, improving the predictive accuracy of the simulations and ensuring greater reliability for decision-making processes.
The complete methodology has been applied in a feasibility study conducted in a district of Alcorcón, Spain, serving as a practical case to refine the approach. Results demonstrate the potential of simulation-driven methodologies to support municipalities in the planning and implementation of Positive Energy Districts aligned with their climate and energy objectives.

145 - How digital tools can engage stakeholders: Munich's digital twin and an interactive 3D print model

Andreas Baernreuther (1) - Stefan Dr. Synek (1)

(1) City Of Munich, Department Of Labor And Economic Development, Munich, Germany

Keywords: Stakeholder Involvement, Digital Twin, PCED, Decision-Makers-Engagement, Citizens-Engagement

Abstract Urban areas play a pivotal role in achieving climate neutrality, yet the transformation of existing districts into energy-positive environments remains a complex challenge. The ASCEND project, funded by Horizon Europe, addresses this by establishing one of Munich's first Positive Clean Energy Districts (PCED) in Harthof. The project responds to the urgent need for innovative, and replicable strategies to achieve district-level energy positivity.
Harthof, home to 6,000 residents and mainly developed between the 1950s and 1970s, represents a typical residential area setting where most buildings are owned either by the city's social housing company or private owners. These buildings require significant energy retrofitting. ASCEND aims to demonstrate how the combination of digital innovation, stakeholder engagement, and integrated energy planning can transform such a district into an energy-positive one. Implementation actions include high-efficiency retrofits (e.g. upgrades toward Nearly Zero Energy Building standards), serial renovations, photovoltaic installations on roofs and façades, improvements to district heating and e-car charging stations.
In Munich, more than 20 solutions are being co-designed with municipal departments, scientific institutions, local businesses, and residents. Importantly, the implementation of PCED solutions is accompanied by a strategic roadmap for upscaling and replication. Stakeholder engagement is central to ASCEND's success: tenants and property owners have been activated through a variety of formats—information events, online surveys, counselling services, and on-site engagement—to foster their participation in energy communities, refurbishment initiatives, and a district energy council.
Digitalisation plays a critical role through the development of a local monitoring framework that combines real-time data collection and simulation tools to assess key performance indicators. These indicators track progress toward PCED targets and measure impacts in terms of energy efficiency, cost savings, and social acceptance. Additionally, innovative communication tools— e.g. a VR implementation of the semantic 3D model and an interactive 3D printed model—are proving valuable for engaging both citizens and decision-makers. ASCEND developed a transparent 3D print model of the district where one can select different layers from a touch screen. The results are immediately displayed so that the affected buildings are highlighted from underneath. Those representations of the Urban Digital Twin of the district enables the project to visualise data and objectives, thereby bridging the gap between technical detail and public understanding, thus embedding the ASCEND's results in Munich's urban policy and planning.

147 - Co-producing Spatial Data and Representing Social Practices for Energy Planning

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Keywords: Co-Production, Co-Creation, Digital Twins, Positive Energy District, Energy

Abstract In the ongoing transition process, energy planning seems to be in turmoil, as it is no longer possible to set standard and fixed goals due to the uncertainty and variability of energy developments. At the same time, the wider use of local tools, such as SECAPs (Sustainable Energy Climate Action Plans), reproduces the same goals to be achieved through standard solutions, but without any contextual interpretation. This defines an approach to energy

planning that is blind to space. The overall result is a set of objectives that are often vague and technical, overlooking the socio-spatial dimension of energy and entailing low adaptation capacity, as well as creating obstacles and inertia to the transition.
In the face of these issues, what reinterpretation should energy planning take? Through two parallel research projects – Making PEDs and PEDFORALL – the authors are exploring a range of both conventional and digital methodologies and tools for planning with the Positive Energy Districts (PEDs) model in existing urban environments.
The European research project Making PEDs in particular, proposes the development of a digital platform for energy planning simulation and decision support. At the heart of this platform is a digital twin of the San Liborio neighbourhood in Civitavecchia, developed by combining open-source data and manually collected information. This model generates key energy performance indicators and predictive scenarios, enabling more informed, adaptive, and context-sensitive urban governance. A key part of this process is the collaborative elaboration of spatialized energy data, which serves as the foundation for a dynamic and shared decision-making framework.
At the same time, the European project PEDFORALL is developing a complementary qualitative approach, which has been tested in the Ostiense district of Rome, to create a strategic integration plan. Through interviews, mapping activities, and domestic-scale models, residents co-create narratives that reveal the relationships between energy practices, building characteristics, and environmental factors, as well as potential tailored energy transition strategies.
This contribution reflects on the tensions and potential interferences between these two complementary approaches. Although they are still in progress, they present specific opportunities and risks for energy planning, as well as potential synergies to investigate. As both approaches are context-specific, they encourage the exploration of their potential to inform practice-based, place-specific energy planning that integrates technical and socio-spatial dimensions in the transition towards Positive Energy Districts (PEDs).

181 - Energy demand and urban morphology: a model to include thermodynamic behavior of built-up contexts

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Keywords: Energy Demand, Urban Morphology, Simulation Models, Urban Thermodynamics

Abstract In recent decades, many studies have been developed to simulate the energy demand of buildings at the urban scale (UBEM) and to include the of assessment parameters related to urban morphology and, above all, climate variations, which, especially in densely built-up urban contexts, depend greatly on the built environment and the climate.
Currently, alongside existing energy models (top-down and bottom-up), hybrid models are emerging that seek to combine the complexity of physical models with the difficulty of providing complete information required for data-driven models.
Thanks to previous research experience on the relationship between energy consumption and urban morphology in some built-up contexts in the city of Rome and considering the results of the energy demand simulations conducted with bottom-up models (clustering-based method and physics-based models), the paper investigates the influence of the external environment on the overall energy balance of urban buildings and explore possible emergent behaviors in urban building clusters under various climatic conditions.
The starting hypothesis is that the spacing between buildings serves as an interaction parameter influencing their collective thermodynamic behavior.
By integrating Computational Fluid Dynamics (CFD) methods and concepts from Statistical Mechanics, we develop an approximate model for urban thermodynamics.
To test this hypothesis, we first simulate a single building maintained at a constant internal temperature under different climatic conditions, measuring its energy consumption. Next, we extend the model to an ensemble of identical buildings to evaluate collective behavior with and without green spaces interspersed between structures.
Finally, we apply these insights to a realistic case study of an urban area in Rome in order to evaluate the impact on energy consumption of the different climatic conditions.
Our results indicate that, according to the proposed model, the linear regime typically observed in the allometric scaling of energy consumption can shift toward a sublinear regime by altering the use of external spaces that, therefore, could play an important role in mitigating energy demand.

234 - Positive effects of a PED: the Italian case in the city of Rome

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Keywords: Positive Energy District, Urban Energy Modelling, City Energy Analyst, Retrofitting, Photovoltaics

Abstract This study explores the feasibility and replicability of Positive Energy Districts (PEDs) within existing urban environments, focusing on two morphologically distinct districts in Rome: Testaccio and Valco San Paolo. The research applies a dynamic, simulation-based methodology using the City Energy Analyst (CEA) tool to evaluate energy retrofit scenarios at the district scale. The approach integrates building envelope insulation, high-performance glazing, HVAC system upgrades, efficient lighting (LED relamping), and large-scale deployment of rooftop photovoltaic (PV) systems. The study also investigates the optimal sizing and implementation of lithium-ion battery storage systems to enhance self-consumption and reduce reliance on the electrical grid.
Buildings were grouped into archetypes based on thermophysical properties, HVAC configurations, and occupancy patterns. Real consumption data were used to calibrate the simulation models, ensuring high accuracy and transferability. Key performance indicators, such as the Load Cover Factor (LCF) and the Grid Interaction Index (GII), were applied to assess the alignment between energy generation and demand, as well as interactions with the grid under various retrofit scenarios.
The results demonstrate that, in the final integrated scenario which includes full electrification, thermal and transparent envelope renovation, system upgrades, and PV integration, electricity demand in the Testaccio district is reduced by over 24 percent, while natural gas consumption is entirely eliminated. Similar outcomes are observed in Valco San Paolo, despite its larger and more recent building stock. Photovoltaic systems covering between 55 and 61 percent of available roof surfaces deliver peak capacities of over 14 megawatts per district. When combined with appropriately sized storage systems, these interventions bring both districts close to achieving energy positivity.
This research provides a replicable methodological framework for evaluating PED potential in dense urban contexts. It supports decision-making processes for urban planners, local authorities, and energy policymakers who aim to promote decarbonisation, resilience, and energy autonomy at the neighbourhood level. Future developments will focus on the environmental life-cycle impact of battery technologies and the integration of PEDs within broader urban energy ecosystems.

239 - Empowering Local Stakeholders: Effective Stakeholder Mapping Approaches for Positive and Clean Energy Districts

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Keywords: stakeholder mappings, urban retrofitting, vulnerable groups

Abstract The transition to climate-neutral cities necessitates inclusive urban strategies that prioritize sustainability, resilience, and social equity. Positive and Clean Energy Districts (PCEDs) have emerged as a crucial mechanism in achieving these goals by fostering collaboration among diverse local stakeholders to create livable and energy-positive urban neighborhoods.
To ensure effective stakeholder engagement, it is vital to understand the varying roles, needs, and capacities of local actors. Stakeholder mapping serves as a strategic tool to facilitate this understanding and promote collaborative efforts in energy-related activities. This paper explores different approaches to stakeholder mapping and assesses their impact on fostering co-creation processes and collective action in mitigating energy poverty. By applying these methodologies in six pilot sites across Europe, we provide insights into how local actors can work together to address energy vulnerabilities, challenges, and opportunities.
Energy efficiency measures and coordinated urban retrofitting processes towards climate-neutrality in urban neighbourhoods are complex, time consuming and require intense cooperation between public authorities, the building sector, owners and tenants, investors and other stakeholders (Cheng et al. 2021). Thus, the participating sites address the complex nature of energy efficiency measures by acting at the intersection with social innovation (Baer et al. 2021) for selecting, evaluating and implementing technological solutions for neighbourhood-oriented strategies for retrofitting and refurbishment of buildings. It aims to foster promote co-creation with the local residents and relevant stakeholder groups to enhance

the implementation of PCEDs in Europe and increase local resilience against energy crisis.
PCEDs rely on the cooperation of key stakeholders and problem owners. Their realization requires a long-term commitment, cross-sector collaboration, and governance at multiple levels. To maximize the potential of PCEDs, local initiatives and energy communities must be empowered, ensuring that all voices, especially marginalized groups, are heard in decision-making processes.
Several challenges hinder the participation of energy-vulnerable citizens in research and decision-making, including economic constraints, lack of awareness, policy barriers, and social stigmas. To counter these barriers, stakeholder mapping must account for the specificities of energy needs in different spatial contexts and integrate historical and structural inequities, cultural influences, and governance models. This paper provides analytical insights from stakeholder mappings across Europe (Innsbruck, Austria; Krakow, Poland; Iasi, Romania, Budaörs, Hungary; Karlsruhe, Germany; Helsingborg, Sweden), revealing that place-based and context-sensitive approaches are vital in ensuring meaningful participation.

SPECIAL SESSION

ADAPTATION OF THE BUILT ENVIRONMENT: CHALLENGES AND OPPORTUNITIES IN LIGHT OF THE EPBD4

Chair: Elena Mazzola (University IUAV of Venice | University of Padua)

One of the most significant and timely challenges in the European landscape consists of adapting the existing building stock in response to the new Energy Performance of Buildings Directive (EPBD4). To this end, the energy performance of the vast existing building stock needs to be substantially improved through a systemic, integrated, and sustainable approach. The goal is ambitious: to make buildings not only more energy-efficient, but also more resilient, digital, and socially inclusive.

In this context, urban and energy planning plays a crucial role. Cities, as major centers of consumption and emissions, are required to take a leading role in the transition. An integrated approach is needed, combining urban planning, renewable energy technologies, sustainable mobility, and smart grid management. At the same time, the implementation of the EPBD4 directive cannot overlook the social and economic dimensions of the transition. Renovation also means creating jobs, revitalizing local production chains, and, above all, ensuring equity and accessibility. It is essential that the costs and benefits of the energy transition are distributed fairly, avoiding new forms of energy poverty and promoting social inclusion.

During this session, experts, researchers, and institutional representatives discussed technical solutions, governance models, financial tools, and social impacts, with the shared goal of focusing on a collective vision for a more sustainable, equitable, and inclusive urban and energy future.

ORAL PRESENTATIONS

130 - Reactivating post-industrial areas as enabling infrastructures for Positive Energy Districts: A strategic approach towards climate-neutral cities

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Keywords: Energy Transition, Positive Energy Districts, Urban Brownfields, Climate Neutrality, Adaptive Reuse

Abstract Achieving climate neutrality in cities requires transformative approaches that integrate renewable energy systems, spatial planning, and socio-economic sustainability. In this context, the regeneration of post-industrial areas offers a strategic opportunity to accelerate the transition towards climate-neutral urban districts. Characterized by underutilized land and embedded infrastructure, these areas hold significant potential to support the development of Positive Energy Districts (PEDs), contributing to the decarbonization of urban energy systems through localized renewable energy production, energy efficiency, and circular land-use practices.
This contribution investigates the adaptive reuse of disused industrial sites as enabling infrastructures for PED implementation, reframing them as active nodes within multi-scalar urban energy networks. Grounded in the principles outlined by the European sustainability frameworks for the urban environment, the study adopts a cross-disciplinary methodology that integrates spatial design, energy planning, and policy analysis. A central focus is placed on energy flexibility – defined as the capacity to dynamically manage energy demand and supply across temporal and spatial scales – as a critical enabler of

both decarbonization and the achievement of positive-energy targets in complex urban systems. Drawing from scenario-based design exploration and comparative case studies, the research outlines a replicable framework for the spatial and energy transformation of industrial brownfields. Particular attention is paid to governance mechanisms and planning tools that align PED deployment with broader urban development goals, addressing issues such as affordability, stakeholder engagement, and adaptability to diverse urban contexts.
The results highlight the capacity of post-industrial areas to function as critical enablers in the shift towards climate-neutral cities, supporting integrated approaches to urban regeneration and energy transition. By coupling technological innovation, energy flexibility, and spatial strategies, the study demonstrates how reactivated industrial areas can facilitate the implementation of PEDs, enhancing resilience and energy self-sufficiency at the district scale.

197 - Optimisation models for sustainable decarbonisation pathways in the real estate

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Keywords: Decarbonization Pathway; Real Estate; Optimization Model

Abstract The decarbonisation procedures in the real estate sector require multi-value combinations across several multi-objective decision-making levels. This work seeks to provide a machine learning assistance system to aid public-private institutions in prioritising energy retrofit investments for building assets within a distinct investment portfolio. The proposed algorithm utilises an automated approach in financial and economic analysis. Market performance and impact values from retrofitting are governed by operational research and goal programming methodologies via the formulation of linear algebraic connections of functional interrelations, organised within a multicriteria framework.
The machine learning optimisation method is tested by applying a real estate portfolio comprising urban properties, resulting in an ideal schedule for portfolio energy performance. The ranking established by the suggested optimisation methodology is based on investment expenditures in regard to the total CO2 emissions associated with energy retrofit activities. The Carbon Risk Real Estate Monitor (CRREM) establishes emission objectives for 2030, acting as a target for assessing asset performance regarding long-term energy efficiency.
The evaluation instrument will enable the creation of a prioritised inventory of assets based on a "win-win" rationale to optimise the decarbonization performance of a real estate portfolio. The model's implementation provides various and multifaceted pathways for the decarbonisation of urban properties in alignment with CRREM's objective of achieving long-term climate neutrality. Through an ESG standardisation lens, this study presents a methodology for managing the energy efficiency mechanism optimally, reducing environmental impact in urban context, and promoting social well-being and economic sustainability in the management of the contemporary real estate stock.

247 - Using a regional database of sustainable materials to lower the environmental impact of building retrofits

Elena Poma (1) - Jela Kohse (2) - Dario Bottino Leone (1) - Gianluca Grazieschi (1) - Dagmar Exner (1)

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Keywords: LCA, Low-carbon Construction Materials, Energy retrofit of Historic Buildings, Alpine Buildings

Abstract The refurbishment of historical Alpine buildings can contribute to European decarbonization process. However, it poses specific challenges in balancing heritage conservation with sustainability. While Life Cycle Assessment (LCA) is increasingly applied to guide design decisions, practitioners often lack accessible tools to identify regional, low-impact building materials. To address this gap, the Italy-Austria Interreg SUSMAT project has developed a regional database of sustainable construction materials, providing technical and environmental data to support material substitution in refurbishment projects located in the cross-border cooperation area. This study demonstrates the application of the database in the retrofit of the Mesnerhaus building in Anras (Austria). After a first proposal for the retrofit was defined by the appointed designers based on the guidelines of the stakeholders, an LCA of the planned intervention was conducted. This process allowed to identify the most impactful construction processes and material choices. Based on these results, within the boundaries of variable elements of the design, alternative products with same performance and application method, but lower environmental impact were selected using the SUSMAT database. At this point, a new LCA was performed to evaluate the

potential reduction on environmental impact. The comparison highlights the potential of integrating regionally sourced sustainable materials in reducing embodied environmental impacts while preserving cultural identity. The case study illustrates the challenges and benefits of this workflow, positioning the database as a practical tool to support designers, researchers, and policymakers in advancing sustainable retrofitting practices across Alpine regions and beyond.

248 - Multidimensional decision-making approach for the retrofit of historic building typologies

Daniel Herrera (1) - Alexandra Troi (1) - Elena Poma (1) - Signe Sand (2) - Morten Ørsager (2) - Ernst Jan De Place Hansen (3) - Peter Scheutz (3) - Gustaf Leijonhufvud (4)

(1) Eurac Research, Institute for Renewable Energy, Bozen, Italy - (2) Erik Arkitekter As, Copenhagen, Denmark - (3) Aalborg University, Department Of The Built Environment, Aalborg, Denmark - (4) Uppsala University, Department Of Archaeology, Ancient History And Conservation, Uppsala, Sweden

Keywords: Multidimensional Approach For Building Retrofit; Future-Proofing Historic Buildings

Abstract Future-proofing historic buildings presents a significant opportunity to reduce carbon emissions and enhance occupant comfort. However, the diverse and specific requirements of this heterogeneous building stock—along with its multidimensional constraints—continue to limit renovation rates. Multidimensional approaches are needed to address these complex challenges.
The Horizon Europe project FuturHist tackles this challenge by identifying and characterising historic building typologies to develop replicable, typology-based intervention strategies. These strategies can be adapted with limited modifications, supporting broader application within the historic building stock.
To enable systematic planning and evaluation of typology-based solutions, key performance indicators (KPIs) and decision criteria have been established. KPIs are divided into use-phase metrics (e.g. energy performance, indoor climate) and renovation-phase metrics (e.g. embodied carbon, investment cost). Furthermore, decision criteria, address context-dependent factors that influence choices but may not be easily quantifiable.
This methodology promotes a shift from case-by-case decisions to comparative assessments across typologies, bridging a gap in applying performance metrics to heritage-sensitive renovations. It aligns with European policy goals such as the Green Deal and the EPBD.
Based on the typology-based approach, a multidimensional digital toolkit is being developed. Integrating cultural value, technical performance, energy, indoor climate, economic aspects, and environmental impact, this toolkit is meant to support professionals and building owners in making informed decisions for retrofitting historic buildings. This presentation focuses on the specifics and potential of multidimensional decision-making approach for the retrofit of historic building typologies.

SPECIAL SESSION
AFFORDABLE HOUSING FOR THE ENERGY TRANSITION

Chair: Michael Heidenreich (FH Technikum Wien)

The European Commission reports that buildings account for 40% of the EU's energy use and 36% of its greenhouse gas emissions. To meet the EU's Climate Target Plan for 2030, a transition towards highly energy-efficient buildings is required. As part of this effort, the European Green Deal prioritizes the development of Positive Energy Districts and nearly zero-energy buildings.

These solutions are usually characterized by high investment costs and by a significant shift of the environmental burden towards embodied impacts. Experts are concerned about how socially vulnerable groups, particularly those relying on affordable housing, could be included in this transformation process.

This thematic session aimed to demonstrate how innovative approaches could address the broader sustainability challenge of making the building energy transition affordable for a diverse range of people. Presenters explored a wide spectrum of methodologies, ranging from Life Cycle Assessment (LCA, LCC, and S-LCA) and sustainability protocols to community engagement and empowerment approaches.

ORAL PRESENTATIONS

025 - From Attitudes to Survey results in prolight-project.eu

Michael Heidenreich (1) - Evelyn Hummer (2)

(1) Fh Technikum Wien, Wien, Austria - (2) 4ward Energy, Wien, Austria

Keywords: Smart City; Positive Energy District; Renewable Energies; Stakeholder Engagement, Persona

Abstract www.prolight-project.eu: Under the Affordable Housing Initiative, the EC funds projects combining technological innovation, co-creation, and new business models for renovating affordable housing. ProLight applies a smart neighbourhood approach to renew over 1,040 dwellings in 6 demo districts (DD in AT, ES, FI, GR, IT, PT) from Oct 2022 to Sept 2026. Persona – To ensure that actions implemented at demo sites effectively align with the concerns, motivations, and expectations of potential end-users, a persona-based approach was developed. This approach involved defining a set of representative user profiles across all demo districts, capturing the diversity of end-user types and contexts. By incorporating these personas into the design and deployment of interventions, the initiative aimed to enhance relevance, acceptance, and overall impact at the local level. Selected insights from these surveys are presented below. Across the participating countries of hypothetically designed ProLight, residents show a diverse yet overlapping set of motivations related to energy use, shaped by socio-economic, environmental, and cultural factors.

To complement the persona-based analysis, surveys were conducted among end-users across the various demonstration sites. A range of outreach methods—including door-to-door interviews, mailed or distributed paper questionnaires—were employed to maximize participation and capture diverse perspectives.

Beyond presenting the survey results and the application of the persona approach, this research will also investigate the alignment between predefined personas and the actual survey responses. This comparison will enable a critical assessment of the methodology used to construct personas across demo sites. Where strong alignment will be observed, the findings will support the validity of defining personas as a practical and resource-efficient strategy for guiding end-user engagement.

In the Austrian demo district, financial prudence and environmental consciousness may drive Carmen and Maria, with Maria also drawn to showcasing innovative technology. In Finland, Ghulam's motivations are rooted in cost savings, climate awareness due to personal experiences, and convenience, valuing digital tools that save time. In Spain, Elena integrates sustainability into her daily routine, balancing environmental and economic concerns with strong local community ties. Similarly, Greece's Dimitra combines cost-awareness with a desire to improve home life, while maintaining a strong civic role in her neighbourhood. The Italian profile reveals a blend of cost-consciousness, future planning, and eco-responsibility, with a strong inclination toward market-savvy choices and smart energy practices. Finally, the Portuguese resident values community life but requires tailored educational support to understand energy efficiency.

088 - Sustainable Retrofits for Affordable Housing: A Comparative Analysis in Mediterranean Contexts

Claudia E. Collar (1) - Vanesa Saez-giunta (2) - Martina Dell'Unto (1) - Louise-Nour Sassenou (1) - Francesca Olivieri (1)

(1) Universidad Politécnica De Madrid, Department Of Construction And Technology In Architecture, Madrid, Spain - (2) Università Roma Tre, Architecture, Rome, Italy

Keywords: Positive Energy Districts, Embodied Carbon, Affordable Housing, Energy-Efficient Retrofitting

Abstract Cities account for over 66% of global energy and are major contributors to climate change. Within Positive Energy Districts (PEDs), retrofitting existing buildings is key to reducing operational energy demand. However, embodied environmental impacts of construction materials are frequently overlooked, particularly in affordable housing, where cost constraints are critical. This study evaluates how material selection can balance environmental, technical, and economic criteria to support a more inclusive and sustainable energy transition. A four-step methodology is applied: (1) defining scope and materials for energy retrofitting in Spain, drawing from the portfolio of solutions developed within the POSEIDON project; (2) collecting data on embodied impact, thermal performance, service life, and cost from recognized local sources; (3) compiling a comparative table; and (4) interpreting the results to assess the strengths and limitations of each material, emphasizing their implications for decision-making in affordable housing renovation. The analysis of façade, roof, and window components reveals trade-offs between cost, environmental impact, thermal efficiency, and durability. Among the materials

evaluated, insulation types illustrate these trade-offs particularly well. EPS is cost-effective with low thermal conductivity but entails moderate embodied carbon and a high reliance on fossil resources. Mineral wool, though more expensive and emissive, offers better fire resistance, durability, and thermal efficiency at similar or lower thicknesses. Roofing systems show significant GHG variability during installation. Double-glazed windows offer strong thermal performance, though their carbon footprint varies with frame and glazing type. These findings highlight the importance of detailed life cycle data to guide sustainable retrofit strategies. Due to limited data availability, the use (B1–B7) and end-of-life (C1–C4) stages were excluded. Future research should consider these phases to capture the full life cycle impact of retrofit materials. Despite these limitations, the study offers practical recommendations to support more inclusive and informed decisions in energy-efficient renovation, contributing to a socially just and environmentally responsible energy transition.

250 - Performance Evaluation of a Pilot Apartment Building in Vaasa, Finland: Pathways to Low-Carbon Housing

Xiaoshu Lu (1) - Teppo Rasku (2) - Gianluca Grazieschi (3) - Tao Lu (1)

(1) University Of Vaasa, School Of Technology And Innovations, Vaasa, Finland - (2) Voas, Vaasa, Finland - (3) Eurac Research, Institute for Renewable Energy, Bolzano, Italy

Keywords: Decentralised Ventilation, Air Handling Units (Ahus), Low-Carbon Housing, Energy Efficiency, Indoor

Abstract This study evaluates the performance of a pilot multi-apartment building in Vaasa, Finland, focusing on ventilation, renewable energy integration, and occupant engagement as pathways to low-carbon housing. In most apartment buildings, ventilation relies either on exhaust or centralised mechanical systems. Exhaust systems are inexpensive but compromise indoor air quality (IAQ) and increase energy use, while centralised systems maintain IAQ but lack flexibility for individual preferences. By contrast, decentralised apartment-level air handling units (AHUs) offer a better balance of efficiency, IAQ, and autonomy. The pilot building adopts such an advanced decentralised system, making it an ideal case for analysing and assessing the potential of distributed ventilation solutions. The 1113 m² building is equipped with decentralised AHUs, district heating with underfloor distribution, and an 11.6 kWp photovoltaic system that supplies about 25% of annual electricity demand. Its space and ventilation heating intensity is 34.5 kWh/m², well below national benchmarks, thanks to a low specific fan power (1.6 kW/m³s), 82% exhaust heat recovery, and efficient system design. Domestic hot water remains the largest end-use (46.6 kWh/m²), highlighting the influence of occupant behaviour. To support behaviour change, tenants are provided with a mobile app to monitor water use, which has already shown potential to reduce demand. The performance assessment demonstrates a strong synergy between decentralised ventilation, renewable integration, and user engagement. The combination of low operational energy, high recovery efficiency, and partial on-site generation ensures both cost-effectiveness and environmental benefits. At the same time, the analysis points to opportunities for further optimisation through demand-responsive ventilation control, which will be explored in a future work on an AI-based demand-controlled ventilation strategy. A planned comparative study will test three AI-equipped apartments against 25 conventional units. A preliminary life-cycle cost analysis indicates that the proposed strategy could be implemented at relatively low investment cost, with energy savings enabling a reasonable payback period. Existing literature also supports the potential for substantial reductions in ventilation-related energy demand when compared with constant-rate systems.

251 - Energy efficient and affordable housing for students in Vaasa

Teppo Rasku (1) - Gianluca Grazieschi (2) - Xiaoshu Lü (3)

(1) Voas, Vaasa, Finland - (2) Eurac Research, Institute for Renewable Energy, Bolzano, Italy - (3) University Of Vaasa, School Of Technology And Innovations, Vaasa, Finland

Keywords: Student Housing, Energy Efficiency, Life Cycle Assessment, Affordable Housing, Sustainability

Abstract The University of Vaasa is growing and attracting international students. Currently housing demand within the city is high, driving up private rental prices. At the same time, utility costs, particularly heating-related expenses, are significant. The Student Housing Foundation (VOAS) provides affordable housing for around 2700 students, offering many individuals their first independent living experience and contributing to the renovation of the city building stock. The average length of stay in one apartment is one year and seven months, which means a fairly high

turnover. VOAS in collaboration with the University of Vaasa and the city administration, promoted the construction of a new student residential building with attention to energy efficiency, high indoor comfort and resource conservation. This work examines the strategies adopted to save energy, ensure comfort and maintain affordable housing for students. The impact of these strategies was evaluated through monitoring, key performance indicators and life cycle assessment methodologies. The project demonstrated a high level of energy efficiency, consuming about one third less energy compared to older buildings, while also delivering consistent reductions in emissions. The moderately high building costs were contained by the lower operational costs and grant funding, which helped achieve the life-cycle economic sustainability of the intervention. The intervention raised awareness about energy transition issues and helped address the student housing shortage in Vaasa. The building will serve as a living lab to explore how residents' housing and consumption habits can be influenced. Successful practices can later be applied to both new construction projects and existing buildings.

TRACK 2

Adapting Cities and Regions: Transformative Strategies for Adaptive Regeneration

TRACK 2
Adapting Cities and Regions: Transformative Strategies for Adaptive Regeneration

As climate change intensifies, cities and regions worldwide faced increasing challenges in maintaining livability, functionality, and resilience. Rapid urbanization, extreme weather events, and rising temperatures requires innovative approaches to urban planning and development. This track explored transformative strategies enabling cities and metropolitan areas to adapt effectively, with the aim of ensuring long-term sustainability. By fostering interdisciplinary collaboration and integrating ecological, social, and technological perspectives, the track sought to identify forward-thinking solutions to enhance urban resilience.

This session examined innovative adaptation strategies to address the impacts of climate change in urban and metropolitan areas, with a particular focus on nature-based solutions, urban design interventions, and disaster risk reduction. Topics included strategies to mitigate the urban heat island effect, enhance biodiversity, improve water management, and strengthen social and institutional capacity to respond to climate risks.

By exploring cutting-edge frameworks, real-world case studies, and policy-driven approaches, this session aimed to inspire actionable strategies bridging the gap between research and implementation. By fostering climate-responsive urban environments, the session contributed to promoting solutions that were sustainable, adaptable, and capable of addressing the future challenges faced by cities.

REGULAR SESSION

ADAPTING CITIES AND REGIONS: TRANSFORMATIVE STRATEGIES FOR ADAPTIVE REGENERATION

Chair: Rocco Pace (Eurac Research - Institute for Renewable Energy)

As climate change accelerates, cities faced mounting pressures from extreme weather, rising temperatures, and rapid urbanization that threaten their livability and resilience. This session explored innovative adaptation strategies for urban and metropolitan areas, emphasizing nature-based solutions, urban design interventions, and disaster risk reduction. Key topics included mitigating urban heat islands, enhancing biodiversity, improving water management, and strengthening social and institutional capacity to respond to climate risks.

Through interdisciplinary collaboration and the integration of ecological, social, and technological perspectives, the session examined cutting-edge frameworks, real-world case studies, and policy-driven approaches that bridged research and implementation, fostering climate-responsive urban environments capable of addressing future challenges in a sustainable and adaptive manner.

ORAL PRESENTATIONS

045 - BAD again - Bad Aachen design again

Anna Weber (1) - Jantje Engels (1)

(1) Rwth, Architecture, Aachen, Germany

Keywords: Building Typology, Transformative Design, Design Communication

Abstract In Germany, the "Bauwende" (construction turnaround) was officially proclaimed in 2020 –"a climate- and socially compatible construction sector [...] will be completely converted to sustainable construction and operation of buildings in order [...] to future-proof the quality of life of our entire environment. Elementary changes are urgently being made with regard to building materials, recyclability, life cycle assessment, protection of existing buildings, biodiversity, education/teaching and demand planning." (A4F 2021)
This process is supported by many. It must deal intensively with the existing building stock of cities and municipalities. In existing buildings, the goals often lead to conversion as systematic and transferrable transformation and upgrading. It is an open-ended challenge to accommodate the requirements on a broader scale in cities in a way that is sensitive to building culture and context. The task is complex, with interdisciplinary interactions that must be taken into account in the design process and communicated to society. The typological approach allows for a principled transferrable design approach that can be applied to a concrete situation.
"BAD again" is an interdisciplinary project dealing with the upgrading of existing architectural and open space types in Aachen's historically charged city center with the aim of making the city center, that becomes very hot on sunny summer days (40.2° were measured on July 11, 2023, which corresponds to the second-highest heat stress category of the Universal Thermal Climate Index) accessible to a wider audience again. In the project we developed sketches of ideas for the climate-friendly development of existing types -typogenesis- on the one hand, and on the other hand, we developed the elevation-section as a design and communication tool. We aim for a graphical framing of concepts that takes into account technical, biological and design complexes, that include both quantifiable data and qualitative ideas, and that corresponds to the heterogeneous "pragmatist approach" to design. (Nijhuis et al, 2017). Informed by the "thick description" (Geertz, 1973) of cultural studies, the representation of the design proposal is slow, multi-layered and transdisciplinary. The transect (Humboldt, 1807) serves as the starting point for the drawing format. It stems from a geological and ecological context and supports our understanding of the city as a "habitat". Due to the looseness of its system it invites a simple integration of different components of knowledge.
From a dense analysis and a contextual design proposal, we thus develop a thick design narrative that is able to follow the thematic complexes of the Bauwende and communicates the integration of scientific findings and design ideas towards transformation of urban spaces through a graphic representation as a common, dense and beautiful story.

049 - Regional convergence toward low-carbon and just development: insights from a systematic literature review

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Keywords: Regional Convergence, Low-Carbon, Just Development, Spatial Disparities, Climate Policy, Systematic

Abstract Many regions and cities worldwide are striving to become climate-neutral, with numerous initiatives and projects underway to support this goal. However, each region is shaped by distinct structural conditions and governance capacities, leading to disparities in the progress of climate policy implementation, particularly in emissions reduction, energy efficiency, and the adoption of green technologies. While climate policies are often well-intentioned, they may reinforce regional inequalities or generate new ones, such as more developed regions benefiting from low-carbon subsidies or green technologies that less-developed areas cannot afford, undermining the goals of just development. These externalities highlight the need for continuous analysis of regional convergence and development trajectories. Such efforts are critical not only for aligning with international climate agreements but also for designing region-specific, equitable, and effective policy measures, consistent with the principle of common but differentiated responsibilities. This study presents a conceptual overview of regional convergence and its transformation under the green transition. It identifies emerging trends and innovations in this evolving field, based on a systematic literature review of 109 scientific articles retrieved from the Web of Science and Scopus databases, covering the period from 2011 to 2024. Findings show that convergence research has expanded beyond the national level, with growing application to regions, cities, and sectors. Most

studies remain concentrated in Asian countries (49%), with 31% addressing global-scale issues. The convergence concept has shifted from a single-dimensional economic focus to a multidimensional framework, incorporating emissions intensity, energy efficiency, carbon productivity, governance and coordination. Despite this broadening, the economic dimension remains central, often connecting other components. Governance and coordination component is mostly associated with environmental one, reflecting a recognition that sustainable development requires not only technological progress but also policy-driven mitigation strategies. Recent research complements traditionally used economic indicators with environmental (e.g., CO_2 per capita, CO_2 per GDP) and energy indicators such as energy intensity and renewable energy share. For more accurate convergence analysis, researchers advocate the use of sophisticated approaches and methods, such as input–output models (including both desired and undesired outputs), factor decomposition techniques, the principle of "shared responsibility". Club convergence, stochastic convergence, and spatial convergence methods are increasingly applied, supported by advanced mathematical techniques. This research contributes to the theoretical development of convergence research.

126 - A Dynamic Bayesian Network Approach to Multi-Hazard Risk and Resilience Assessment of Urban Infrastructure

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Keywords: Multi-Hazard, Risk, Resilience, Infrastructure, Dynamic Bayesian Network

Abstract Assessing the risk to buildings and infrastructure systems from multiple natural hazards, both spatially and temporally, is essential for evaluating the resilience of urban and metropolitan settlements. The rapidly evolving built environment, shaped by human activity and intensified by climate change, has led to an increasing occurrence of multi-hazard interactions, potentially resulting in compounding risks, where the impacts of multiple hazards interact and amplify the initial consequences (e.g., physical damage) affecting built environments. As a result, there is a growing shift from traditional single-hazard approaches toward integrated multi-hazard and multi-risk perspectives. In this study, we present a methodology based on Dynamic Bayesian Networks to probabilistically evaluate the risk and resilience of structures and infrastructure systems over time. Our analysis focuses on critical infrastructure (e.g., hospitals, schools), road networks, and residential buildings, using key risk and resilience indicators such as post-disaster hospital accessibility and building functionality (i.e., the ability of a building to perform its intended purpose). We also assess the temporal evolution of these indicators by incorporating repair actions and various mitigation interventions. To demonstrate the real-world application of the proposed methodology, we present a case study of Pompei, located in the Naples metropolitan area of Italy—a region exposed to multiple natural hazards, including pluvial flooding, earthquakes, and volcanic activity. The findings of this study aim to support decision-making for resilience-informed policies and robust mitigation strategies under multi-hazard conditions.
This study was carried out within the RETURN Extended Partnership and received funding from the European Union Next-GenerationEU (National Recovery and Resilience Plan – NRRP, Mission 4, Component 2, Investment 1.3 – D.D. 1243 2/8/2022, PE0000005)."

128 - A spatial structure of green walkability to foster climate resilience in ageing cities

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Keywords: Climate Change, Urban Heat, Elderly Population, Walkability, Nature-Based Solutions

Abstract In cities, today home to half of the world population, temperature increase related to climate change is a global challenge exacerbating local phenomena, such as Urban Heat Islands. Adapting cities to urban heat is a crucial aspect of citizens' quality of life and wellbeing and becomes increasingly important considering ageing population trends in developed countries, with a constantly growing share of vulnerable population facing always more frequent heatwaves in cities. Assuming walkability as the core of future healthy, resilient and decarbonised cities and Nature-based Solutions as a main adaptation factor to urban heat, this paper develops a spatial structure of green walkability for elderly people. The proposed model is applied at the district scale to the redevelopment area of Porta Genova

railway yard, within the city of Milan, as a case study to understand the role of urban regeneration to promote active mobility in vulnerable neighbourhoods and to reduce urban heat island effects introducing new green areas, overall improving elderly people's wellbeing. New proximity relations among city districts that Porta Genova regeneration could mend are analysed with a data-driven methodology, producing GIS-based sets of maps representing main urban-scale and district-scale connections, origin-destination relations between dense residential blocks, public transport deliveries, public spaces and rare-functions landmarks, and time-related isochrones covered distances with a specific focus on elderly users. The result of the study is the definition of planning recommendations and masterplanning criteria aimed at improving age-friendly design and planning, offering a strategic and innovative overview on how urban design criteria and strategies should consider liveability and walkability for vulnerable population as a fundamental tool to inform the urban project.

146 - Nature-Based Solutions between Urban Density and Climate Resilience: Barriers, Opportunities, and the Role of the Private Sector

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Keywords: Nature-Based Solutions Implementation, High-Density Urban Areas, Private Sector Engagement

Abstract As cities increasingly face the dual challenges of climate change and urbanization, numerous conflicts arise. One critical tension lies between the push for the densification of existing urban areas as an alternative to further land consumption and the growing need to allocate space for climate adaptation measures. Nature-Based Solutions (NBS) are now widely recognized as a more sustainable alternative to conventional infrastructure, offering a broad range of co-benefits - from enhanced biodiversity and microclimate regulation to improved public health and the delivery of essential ecosystem services.
Despite their potential, the implementation of NBS remains limited, particularly in high-density urban areas and historic centers - contexts that are especially vulnerable to climate change impacts due to their impermeable surfaces, high building density, and exposure to heat stress and flooding. These areas also face significant challenges related to integration with existing infrastructure, limited design flexibility, and, in many cases, the need to preserve built heritage. If cities opt to pursue densification as an alternative to further land consumption, the spatial conflict between development pressures and the need for climate adaptation will only intensify.
In these environments where the availability of public space is scarce, the engagement of the private sector is crucial to expanding NBS implementation beyond publicly owned land. However, private actors often remain marginal due to high upfront investment requirements, delayed financial returns, and a lack of targeted incentives or supportive policy frameworks.
This research proposes to examine the barriers and enablers for implementing NBS in dense and heritage urban contexts, with particular attention to strategies for mobilizing private sector participation. Through a literature review and comparative analysis of case studies, the study intends to identify key research gaps, especially in relation to context-sensitive design approaches, collaborative governance models, and integration within planning and regulatory systems. It will also assess best practices where public-private cooperation has successfully facilitated NBS in compact, historically sensitive environments.
This study represents the initial phase of a doctoral research project that has the final objective of contributing to the broader integration of NBS into urban planning and policy by generating insights to inform future decision-making. Practical applications may include the design of incentive schemes for private stakeholders, integration of NBS in heritage-sensitive redevelopment plans, and formulation of flexible regulatory models that balance conservation with innovation.

160 - Promoting urban resilience through Nature based Solutions: insights from five Central European cities in GreenScape CE

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Keywords: Urban Nature-based Solutions (NbS), Citizen Engagement, Co-creation, Innovative Financing

Abstract In the context of the growing climate challenges increasingly impacting Central European cities, the GreenScape CE project – Climate-proof landscape through renaturing urban areas in Central Europe, funded by Interreg CE, has developed and tested innovative approaches for the strategic inte-

gration of Nature-based Solutions (NbS) and Green Infrastructure (GI) in five urban areas that differ significantly in terms of challenges and scale: Metropolitan area of Milan (IT), Zagreb (HR), Warsaw (PL), Ptuj (SI) and Szeged (HU).
The oral presentation will focus on the three core dimensions of the NbS that were tested and refined across the five pilot cities:

1. Citizen engagement and co-creation models with key local stakeholders, aimed at increasing ownership and long-term sustainability of NbS;
2. Technical and tendering solutions, including design and procurement strategies adapted to complex urban contexts;
3. Financing models for the development and implementation of NbS/GI, from public and private funding to citizen-led initiatives.

These elements will be illustrated through concrete examples from the pilot cities, highlighting what worked, what didn't, and what can be adapted elsewhere. In addition, the conference will serve as an opportunity to present three key outputs developed within the project. These tools are targeted at public authorities, planners, and project developers, and are designed with replicability and scalability in mind for use in other urban contexts across Central Europe:

- Technical handbook for the implementation of NbS: offers practical technical guidance and key lessons from the pilot cities to support public authorities in replicating urban NbS.
- Handbook for financing NbS: presents financing strategies (public, private, and citizen-driven) across different project phases, based on real experiences from the pilot cities.
- Guide to co-creating urban NbS with citizens: provides local governments with tested tools and engagement models to involve citizens in the design and implementation of nature-based urban projects.

Together, these results contribute to a growing body of knowledge on how to implement NbS effectively, inclusively, and sustainably, supporting the transition toward more resilient, livable, and climate-proof cities.

172 - Survey of flooding hotspots in the municipality of Curitiba – Paraná (Brazil) through media monitoring

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Keywords: Urban flooding, Digital media, Citizen science, Georeferencing, Urban planning

Abstract Introduction: Urban flooding has intensified over recent decades, emerging as one of the principal environmental and social challenges faced by Brazilian cities. In Curitiba, despite its well-known history of urban planning, flood episodes have caused material losses, compromised mobility, and highlighted territorial inequalities in drainage infrastructure. The absence of a public, up-to-date, and georeferenced flood-mapping system, coupled with limitations in official data, underscores the need for innovative methodologies of monitoring and spatial analysis. Objectives: The primary aim of this study was to identify and map the principal flooding hotspots in the municipality of Curitiba between 2020 and 2024 by applying data-mining techniques to digital media. Specifically, the study aimed to conduct an integrative literature review, employ a standardized search string for collecting media data, organize and georeference flood records, and construct a thematic map of density and territorial recurrence. Materials and Methods: The research was structured in four stages. Initially, a literature review was conducted on urban flooding, risk management, citizen science, and data mining. Next, news items were collected using a structured search string with Boolean operators and inclusion criteria focused on local and national digital media. The extracted data were systematised in spreadsheets and subsequently geocoded using QGIS and API tools. The final stage involved the production of heat maps and interpretative graphs. Results: A total of 163 valid flood events were identified in Curitiba, with particular prominence in the districts of Cidade Industrial, Tatuquara, Centro, Boqueirão, and Pinheirinho. A concentration of events was observed during the summer months, and a tendency towards aggravation in 2023 and 2024. Territorial analysis revealed a strong relationship between the recurrence of flooding and valley-bottom areas, high soil impermeabilisation, and proximity to urban rivers. Media sources proved effective in covering the events, demonstrating potential to complement official databases. Conclusion: The study confirmed the feasibility of using media data as a support tool for urban planning and hydrological risk management. The approach enabled the construction of an empirical, georeferenced database with strong potential for replication in other cities. The incorporation of citizen-science practices and volunteered data has proven to be a promising avenue for producing more sensitive, rapid, and localized diagnostics, contrib-

uting to the development of more effective public policies.

182 - Climate adaptation strategies in small municipalities. A GISbased approach for the definition of priority actions

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Keywords: Adaptive Planning, GIS, Marginal areas, Composite indicators, Decision Support System (DSS)

Abstract This paper proposes an approach aimed at bridging the gap between the most advanced technological solutions (AI, digital twin) and the operational reality of peripheral local authorities, offering a practical and scalable framework.
In dealing with the effects of climate change, the most marginal areas, i.e. small municipalities, contribute the least to atmospheric emissions (compared to larger cities) but have the least capacity to respond effectively.
In these areas, the activation of adaptation strategies and actions is particularly complex due to the scarce availability of data, technical resources and adequate operational tools. In order to try to tackle this problem, a methodology was developed based on the construction of a DSS hinged on a Geographical Information System that makes it possible to elaborate a synthetic index for the identification of priority intervention areas.
This methodology was applied to the case study of the Neto Valley in Calabria, developing an integrated territorial decision support system (DSS) that combines official open data sources (ISTAT, ISPRA, CORINE Land Cover, Natura 2000 Network, EFFIS, etc.) and geospatial analyses on a sub-municipal scale (census sections). The thematic indicators, representative of socio-demographic fragility, environmental vulnerability, anthropic pressure and natural risk, were processed in a GIS environment and normalised to construct composite indices capable of supporting hierarchies of planning priorities.
The methodology employs a percentage or binary approach to structuring the indicators, with calculations performed using geoprocessing tools and Python scripting in an open-source environment, favouring replicability, even in the absence of proprietary software.
The results show how, with technically simple tools that are within the reach of even municipalities with limited resources, it is possible to produce spatial representations suitable for identifying priority areas of intervention for the launch of localised adaptation policies and for resource management in line with the aims of the PNACC.

188 - Beyond Outdoor Thermal Comfort: A Practical Co-design Process to Integrate Nature-Based Solutions in Bolzano Sud

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Keywords: Nature-based Solutions, Urban Heat Island, ENVI-met, Co-design, Urban Design

Abstract Cities are under increasing pressure to address environmental challenges driven by climate change, such as the urban heat island (UHI) effect and extreme heat stress. These issues pose a serious threat to human well-being. Nature-based solutions (NbS) have emerged as a promising strategy for mitigating these issues, enhancing urban microclimates, and providing multiple ecosystem services. Many studies have evaluated the cooling effects of NbS through microclimate simulations; meanwhile, others have demonstrated that actively involving stakeholders in the design process can further enhance the delivery of ES.
Building on these approaches, this study uses microclimate simulation and co-creation to develop a practical design for Bolzano Sud, an area severely affected by the UHI effect and extreme heat. Specifically, one building in this area has been equipped with a high-biodiversity intensive green roof and a biosolar roof (combining an extensive green roof with photovoltaic panels) as part of the JUSTNature project. ENVI-met simulations were initially employed to evaluate the potential thermal comfort enhancements provided by the NbS implemented on the building, as well as by additional NbS in open spaces—such as permeable pavements and urban trees—or a combination of both, to identify the most effective cooling solution. A co-design process was then proposed to incorporate stakeholder expectations and adapt the general strategies into a site-specific design.
By combining microclimate modeling and participatory design, this study aims to enhance cultural and societal values such as urban beautification and environmental awareness education, going beyond thermal comfort. The findings offer practical insights for policymakers, architects, and urban

planners, supporting the development of sustainable, climate-resilient urban landscapes that address the growing challenges of environmental change in cities.

215 - Promoting nature-based solutions in urban regeneration projects through climate-proofing of infrastructure

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Keywords: Nature-Based Solutions, Climate Proofing, Urban Regeneration, Adaptation

Abstract The implementation of EU sustainability guidelines, such as the Do No Significant Harm (DNSH) principle and the climate proofing of infrastructure, has become central to the governance of climate adaptation strategies under the European Green Deal and EU funding instruments.
This contribution critically examines the operationalization of climate proofing of infrastructure within EU funding instruments, highlighting its relevance and potential friction points in the support to the implementation of nature-based solutions (NbS).
NbS are increasingly recognized as key strategies for addressing urban sustainability challenges.
For their versatile and adaptive character, they are particularly well-suited to tackle challenges arising in ever-changing environmental and socio-political conditions. Moreover, NbS can provide a wide range of ecosystem services - from urban heat island reduction to rainwater run-off regulation and carbon sequestration.
This contribution reflects on insights drawn from ongoing consultancy work with regional public administration, to critically examine how the climate proofing of infrastructure required in the European Regional Development Fund (ERDF) programmes shapes, enables, or constrains the use of NbS for climate adaptation.
This study examines around 50 urban regeneration projects in Lombardy that have received European Regional Development Fund (ERDF) funding and undergone climate-proofing. These projects included interventions on buildings and in green and other public spaces, incorporating some nature-based solutions (NbS) as adaptation measures (e.g. green roofs, planting, depaving and greening of surfaces).
The analysis reveals opportunities to promote the wider adoption of NbS as adaptive solutions through actions at various levels. We argue that realising the potential of NbS requires coherent guidance and coordination between planning and design, as well as ecologically grounded assessment frameworks, the dissemination of best practice, and the measurement of results. These measures would facilitate the full integration of NbS into EU climate governance.

POSTER PRESENTATIONS

054 - Mapping the Flemish Garden: A lever for Climate Adaptation and Biodiversity

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Keywords: Flemish Gardens, Ecosystem Services, Garden Indicator, Climate Resilience, Nature-Based Solutions

Abstract Gardens cover more than 12% of the Flemish territory—an area comparable to that of all forests and nature reserves combined. This figure highlights the significant, often untapped potential of gardens as allies in the fight against climate change and as providers of ecosystem services such as water infiltration, cooling, biodiversity, and quality of life. However, the extent to which gardens fulfill these functions strongly depends on how they are designed and managed by individual owners.
To better understand and activate this potential, we have developed a detailed garden map. This map forms the basis for a new garden indicator, which is currently under development. The indicator will consist of a set of parameters that will allow for the systematic monitoring of the condition and ecological value of Flemish gardens. This information will support policymakers and planners in taking targeted actions to improve quality and increase greenery in Flemish gardens.
The indicator is expected to include, among other aspects:

- the average garden area per inhabited building,
- the total garden area,
- the extent and type of paving,
- and eventually also the share of different types of vegetation, linked to the detailed green map.

These parameters will be analysed at various spatial levels, including urban, peri-urban, and rural areas, as well as within coherent open space areas.
This approach aligns with the conference track "Transformative Strategies for Adaptive Regeneration," by viewing gardens as a form of decentralized green infrastructure. In this way, the initiative contributes to nature-based solutions that help mitigate

the urban heat island effect, promote biodiversity, and improve water management. Although the indicator is still under development, this initiative represents a promising step toward climate-resilient and biodiverse living environments, and a bridge between research and practice.

057 - Residual spaces,green infrastructure and adaptive architecture:ecological and social node in the Senigallia coastal strip

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Keywords: Nature Based Solutions NbS, Adaptive and Reversible Intervention, Nature Based Planning

Abstract The coastal strip of Senigallia, a city in the Marche region overlooking the Adriatic Sea, has been the subject of progressive building densification from the post-war period to the present day, despite the presence of landscape and environmental constraints. The project focuses on a 2,805 square meters area in the Ciarnin locality - one of the last undeveloped spaces in the coastal strip - recently acquired by the local parish for the construction of sports and community facilities. The proposal starts from a twofold observation: on the one hand, the inadequacy of the current urban planning tools in recognising the value of nature-based solutions; on the other hand, the need to safeguard and enhance the existing green space as an ecological and climatic infrastructure. The aim is to propose a replicable model of adaptive and reversible intervention, capable of integrating social functions and environmental strategies in a slow regeneration perspective.
The site, 250 m from the coast and along the Marignano ditch, represents a connection node between the hinterland and the coast, inserted in a well-defined ecological and hydrological network within the territorial quadrant. Its position makes it a potential cross-connection node between the sea and the inland territory. The methodology is based on:

- the analysis of local regulations and the PRG (G2 zone);
- the geomorphological and hydraulic study;
- the mapping of green areas and residual ecosystem functions;
- the elaboration of low-impact design scenarios inspired by Nature Based Planning.

The project shows how it is possible to meet the demand for collective facilities without compromising the natural balance of the area. The main strategies proposed are:

- active conservation of free soil and vegetation cover;
- integration of trees and artificial shading for the microclimate;
- use of light, multifunctional and reversible wooden structures;
- underground lamination tanks to manage rainwater;
- design of greenery as a service space, capable of generating climatic, ecological and economic benefits in the long term.

Ciarnin's experience highlights the strategic role of undeveloped marginal areas in the implementation strategy of urban resilience, if they are considered as structural infrastructures of the landscape and not as mere building reserve spaces. It is proposed:

- the introduction of reversibility criteria, use of natural materials, plant integration and SUDS (Sustainable Urban Drainage Systems) in municipal plans;
- local guidelines for the climatic design of collective spaces;
- regulatory recognition of the ecosystem functions of existing green spaces as a common good and urban infrastructure.

The project thus offers a scalable model for coastal cities that wish to reconcile sustainability, architectural quality and climate adaptation.

071 - From plastic use in agriculture to climate change: the research project ClimOO

Agnese Aguzzoni (1) - Giorgio Ubbiali (2) - Davide Don (3) - Massimo Donegà (1) - Francesco Iannone (1) - Jasmina Jusic (3) - Sarah Notarfrancesco (3) - Anna Rottensteiner (4) - Werner Tirler (1) - Ludger Jansen (2)

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Keywords: Microplastic, Agriculture, Sustainability, Clima Plan 2040

Abstract Plastic pollution is an urgent issue in today's scientific debate, but its connection to climate

change remains mainly unexplored. While plastic degradation into micro- and nano-plastics in the environment is a recognized threat, its release of greenhouse gases in the atmosphere is undercovered in the existing normative frameworks, with a lack of methods for defining and measuring the climate-related impacts of plastics. Among the different productive sectors, agriculture is not immune to the problem. Due to its heavy dependence on the use of plastic material, from irrigation pipes to anti-hail nets, it might face severe consequences in terms of sustainability in the near future. As in South Tyrol, agriculture shapes the landscape and drives the local economy, a comprehensive investigation of the current (micro)plastic pollution and plastic reduction strategies is needed.
ClimOO (Climate, Plastics and Sustainability: Ontology and Operationalisation) is a project funded by the Autonomous Province Bolzano–South Tyrol as part of the South Tyrol 2040 climate plan. Involving as partners the Philosophical-Theological College Brixen, Eco Research, Fraunhofer Italia, and Laimburg Research Center, ClimOO converges multiple competences, including agricultural technologies, environmental chemistry, sustainable operationalisation, and semantic modelling, into a transdisciplinary approach to address these gaps towards a more sustainable agriculture. Using farmer surveys and soil sampling, the project aims at quantifying the presence of (micro)plastics in the environment and identifying technical and cultural barriers to the transition towards a more sustainable agriculture. In parallel, it critically reviews existing guidelines and methods to analyse how sustainability and climate impacts are currently assessed in agriculture and suggest a more coherent approach to the issue. On this basis, a reference ontology will be developed to enable project data integration, thereby facilitating comparability across methods and disciplines.
This contribution will show how ClimOO intends to turn research into actionable knowledge, offering new perspectives into material use, environmental monitoring, and sustainable transition in agriculture. The results of this research will help policymakers and farmers adopt more sustainable decisions.

116 - High Resolution Tsunami Inundation Maps: Towards Multi-Hazard Risk Analysis

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Keywords: Tsunami Hazard, Inundation Maps, Risk Scenarios, Multi-Hazard

Abstract Coastal multi-hazard risk assessment requires the integration of high-resolution data and models for hazards, exposure, and vulnerability. While such detailed information is crucial for accurately evaluating threats like tsunamis, floods, and coastal erosion, it remains unavailable for many coastal areas, including the Friuli-Venezia-Giulia (FVG) region. This gap can lead to significant underestimations or overestimations of risk for coastal communities.
A critical component of tsunami risk assessment is the development of detailed inundation maps showing tsunami inundation extents and depths. For the Northern Adriatic, and particularly the FVG coast, such high-resolution maps have not been previously available. Our study addresses this need by producing accurate inundation maps using refined bathymetric and topographic data (~100- and 25-meter resolution) combined with comprehensive tsunami modeling. We employ the NAMI DANCE numerical code (Zaytsev, Yalciner, Chernov and Pelinovsky, 2019; "Tsunami Numerical Model Nami Dance GPU User Manual". METU - Middle East Technical University. https://www.metu.edu.tr/), to simulate tsunami propagation and inundation, building upon existing databases of tsunamigenic earthquake sources from DISS seismogenic source database. Special attention is given to correcting inaccuracies in lagoon bathymetry data and incorporating small-scale coastal features that significantly influence inundation patterns. The study includes a reappraisal of tsunami wave amplitudes and investigates tsunami scenarios specific to the FVG region.
The resulting high-resolution hazard maps provide the basis for multi-scenario hazard risk assessment in the Northern Adriatic, which can result from cascading events (e.g. earthquake ground shaking and related tsunami inundation), as well as from the simultaneous occurrence of independent events (e.g. tsunami and storm surge). When combined with detailed exposure and vulnerability data, the high resolution tsunami maps and the multi-hazard scenarios may significantly improve risk evaluations, supporting disaster preparedness and mitigation efforts. In addition, physically consistent multi-hazard scenarios may provide plausible basis for developing storylines, contributing to an improved and holistic impact assessment.
This research is a contribution to the RETURN Extended Partnership (European Union Next-Generation EU—National Recovery and Resilience Plan—NRRP, Mission 4, Component 2, Investment 1.3—D.D. 1243 2/8/2022, PE0000005).

118 - A citizen science approach to exposure data collection: analysis, understanding and awareness

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Keywords: Citizen Science, Exposure, Data Collection, Data Analysis, Risk Awareness

Abstract This study builds on past experience from the citizen science pilot project CEDAS (Censimento dell'Edificato per la stima del Danno Sismico), which involved more than 300 students from high schools in Udine (Italy) and allowed collecting more than 8000 building questionnaires (Peresan et al., 2023, http://dx.doi.org/10.3389/esss.2023.10088; Scaini et al., 2021, https://doi.org/10.1016/j.ijdrr.2021.102755) in different municipalities of the Friuli Venezia Giulia Region, including Udine and surrounding areas. The activity was carried out between January and May 2025, in the framework of the RETURN "Multi-risk Science for Resilient Communities under a Changing Climate" and the PRIN-SMILE (Statistical MachIne Learning for Exposure development) projects. It involved 60 students (3 classes) from the "Copernico" High School in Udine, Italy, and included general lectures on seismic hazard, exposure and risk, as well as interactive quizzes to evaluate risk awareness. Field data collection was preceded by a training lecture and was carried out through a dedicated online platform (https://smile.mi.imati.cnr.it). Participants were trained on exploratory data analysis of the collected data and the outcomes. They carried out multivariate and comparative analyses between the newly collected and existing datasets, including results interpretation. Finally, the results obtained by different groups of students were presented to an audience composed by: representatives of local institutions, regional Civil Protection personnel, engineers, OGS researchers, and students from past editions.
Compared to earlier experiences from the CEDAS project, the study emphasized the social dimension of this citizen science activity, enriching education content of the proposed experience, and quantitatively investigating the perceived improvement of the participants regarding the covered topics. To this end, a specific questionnaire was created, consisting of 38 items, defined across 9 dimensions and divided into 7 sections, with the purpose of creating a measurement tool that can quantify similar activities in a longitudinal perspective.
The questionnaire outcomes were analysed using statistical software such as RStudio and JASP. Internal consistency of the adapted scales was assessed using Cronbach's alpha, while the perceived improvement reported by respondents was analysed using ANOVA and multiple linear regression. This quantitative analysis allowed us a preliminary assessment of the possible changes in technical skills (e.g. the improvement in data processing skills and in the knowledge of the building heritage) determined by this citizen science experiment. The ultimate goal of the pilot project, in fact, was to actively contribute to seismic risk mitigation, by increasing citizens' understanding and awareness, particularly for young generations, of the territory in which they live.

167 - From Neglect to Balance: Adaptive Regeneration Through Cultural Spatial Logic of Five Elements Theory and Nature-Based Design in Scampia, Naples

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Keywords: Adaptive Regeneration, Nature-Based Solutions, Crime Prevention Through Environmental Design (CPTED)

Abstract This paper introduces a spatial regeneration approach rooted in cultural tradition, aimed at reframing urban vulnerability through interdisciplinary design.
Scampia has long been a symbol of neglect and isolation. It is a place where space, structure, and community have broken down. Because of this, it offers a strong example for testing new ways to improve cities. These strategies bring together physical design, social needs, and cultural meaning. The proposed model goes beyond physical design. It helps us better understand how culture-based planning can respond to deep problems in cities. In conclusion, these spatial practices aim to fix more than just what we see—they also address what people feel and experience in neglected places.
Furthermore, it introduces a spatial regeneration approach rooted in cultural tradition. It builds on the Five Elements theory from classical Feng Shui (Wuxing '五行'—Wood, Fire, Earth, Metal, and Water). It also draws from Crime Prevention Through Environmental Design (CPTED) and nature-based solutions (NbS). The strategy is applied to the La Vele housing and surrounding complex in Scampia, Naples. Since this site has long struggled with crime, social neglect, and physical isolation, it is obviously a ideal place for conceptual design project.

To be more specific, it redefines safety as more than a physical condition. It views safety as environmental, symbolic, and emotional. The study uses QGIS mapping, visibility analysis, and cultural interpretation. These tools help identify weak points in the urban layout. They highlight areas where safety and inclusion are lacking.
Additionally, the design solution brings together vegetation, water, lighting, stone, and flow. These elements follow the logic of the Five Elements theory. Together, they promote spatial balance, ecological comfort, and natural surveillance. The results show that cultural principles can support practical design. By combining CPTED and NbS with symbolic spatial programming, the project creates a new model.
It shifts the idea of safety from control to care. It transforms urban space from something enforced to something shared.
The findings show that linking environmental design with symbolic space can support renewal. This process helps improve how safe people feel and how safe the space actually is. At the same time, it begins to address deeper issues like exclusion and broken community ties.
In conclusion, this project sees vulnerability as the result of both environmental neglect and cultural disconnection. It shows that regeneration can start with local traditions. At the same time, it can respond to bigger challenges that many cities face today.

190 - Ecological connectivity potential of brownfields in the Global South: an analysis of the reclamation of former landfills in the São Paulo Metropolitan Region (Brazil)

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Keywords: Environmental Planning, Landscape Ecology, Greenway, Environmental Justice, Risk Management

Abstract In metropolises of the Global South characterised by accelerated and fragmented urbanization processes, brownfields can constitute obstacles to both urban development and ecosystem maintenance. Mainly located in urban areas with higher social vulnerability, brownfields are underused lands that, due to the extensive use of natural resources by former human activities (such as industries, gas stations, and landfills), now face changes in environmental quality and are potential sources of soil, groundwater, and surface water contamination. Given the necessary intervention and reclamation of these sites to contain risks to human and ecological systems, they represent opportunities for urban redevelopment and ecological connectivity. From the perspective of environmental planning and landscape ecology, the reclamation of brownfields requires a multi-scale approach integrated with green infrastructure, favouring the connection and expansion of vegetation fragments, gene flow circulation, and urban habitats restoration.
This study aims to analyse the potential of ecological connectivity through brownfields reclamation, specifically considering former landfills, and their integration with the green space system of the São Paulo Metropolitan Region (Brazil). Furthermore, it seeks to highlight challenges and opportunities of integrating brownfields with green spaces in a highly urbanised context, emphasising benefits to the population and the environment.
This investigation is based on a multi-scale cartographic analysis, through the mapping of former landfills and the green space system of the São Paulo Metropolitan Region, which encompasses protected green areas, remnants of native vegetation, and the water network. Thus, areas for prioritised actions and possible configuration of greenways are identified, considering the urban context of these brownfields and their connection with the green space system.
As a result, this research indicates the potential of reclaimed landfills in preserving and expanding vegetation fragments. The appropriate insertion of vegetation in these areas, with specific care taken to stabilise slopes and maintain drainage and collection systems for leachate and gases produced by solid waste disposal, not only contributes to the maintenance of ecosystems, but also has the capacity to increase urban resilience to climate change and promote environmental justice, as it redistributes ecosystem services in cities. It is expected that this contribution can broaden discussions on mitigation and adaptation strategies to climate change in Global South cities, towards a sustainable urban development.

237 - Food Forests in Italy: state of the art and emerging opportunities

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Keywords: Community Food Forests, Urban and Peri-Urban Agriculture, Community Engagement, Sustainable Planning

Abstract Within the evolving discourse on Nature-Based Solutions (NBS), food forests are emerging as multifunctional systems that integrate ecological restoration, sustainable food production, and social innovation. Inspired by the complexity of natural forest ecosystems, they combine layers of fruiting and non-fruiting trees, shrubs, herbaceous plants, mushrooms, climbing lianas, tubers, bulbs, and rhizomes in self-sustaining arrangements that require minimal external inputs. This nature-inspired design not only mirrors the resilience of natural habitats but also enhances ecosystem services such as biodiversity conservation, soil regeneration, and carbon sequestration.
The FOOD FOREST project, funded by EIT Food, focuses specifically on Community Food Forests (CFFs), collectively designed and managed spaces where local communities actively participate in planning, planting, and maintaining diverse edible landscapes. CFFs are more than productive green areas: they are inclusive meeting places that foster environmental stewardship, social cohesion, intergenerational learning, and a shared sense of ownership. By blending ecological complexity with participatory governance, they act as catalysts for both environmental and social resilience.
In Italy, several key questions arise: What is the current status of CFFs and other food forests across the country? Are they being integrated into urban and regional planning strategies? Which are the ecological and social functions of each of them? And which evaluation methods could best demonstrate their effectiveness and long-term sustainability (e.g. SROI and LCA)?
This poster presents an overview of existing Italian food forests, with a special focus on community-led initiatives. It outlines their typologies, design approaches, and management models, while illustrating the multiple benefits they generate, such as enhancing biodiversity and ecosystem resilience, providing access to fresh and local food, fostering environmental education, strengthening social cohesion, and supporting climate adaptation strategies.
By positioning CFFs within the broader NBS framework, they can be framed as strategic approaches to urban regeneration. In line with the EU Nature Restoration Law, they offer tangible opportunities to reclaim neglected urban and peri-urban spaces while delivering multiple benefits that support a more just and regenerative ecological transition.

Digital Poster Gallery: https://sspcr.eurac.edu/en/programme/digital-poster-gallery-2025

SPECIAL SESSION

SOIL MATTERS: SPATIAL PLANNING AND DESIGN WITH SOIL

Chair: Yoann Clouet (Institute for Urban Excellence - iUE)

As soil health faces mounting pressures from climate change, urbanization, and unsustainable land management, its pivotal role in delivering essential ecosystem services and achieving the Sustainable Development Goals (SDGs) comes into sharper focus. However, despite its direct and indirect impacts on land use, land cover, and ecosystem functionality, soil remained underrepresented in spatial planning and design frameworks.

This special session drew insights from research in soil sciences and spatial disciplines to investigate the integration of soil-inclusive strategies into spatial planning and design practices. It built on the ongoing research of the SPADES (Spatial Planning and DEsign with Soil) project, an EU-funded Horizon Europe initiative leveraging 17 European pilot projects across urban, peri-urban, and rural areas to co-develop soil-inclusive spatial strategies aligned with objectives such as land degradation neutrality and no net land take.

Contributions to the session examined the integration of soil health objectives into planning education and planning frameworks, as well as the tools and methodologies required to mainstream soil considerations into planning and design practices. They also addressed the dual impacts of infrastructure development on soil consumption, including case studies such as the Brebemi highway in Italy, which quantified both direct and induced land transformations.

The session also highlighted the need to further evolve spatial planning education by equipping practitioners with soil literacy and a systemic understanding of soil-related policy objectives and tools. From compact urban development to green–blue infrastructure, the strategies presented demonstrated how spatial planning could mitigate soil sealing, prevent urban sprawl, and enhance soil quality,

quantity, and performance. By bridging soil science and planning practices, the session aimed to foster collaboration, discuss capacity-building pathways, and provide practical instruments enabling planners and policymakers to prioritize soil health and restore the ecological and social balance of urban, peri-urban, and rural landscapes.

ORAL PRESENTATIONS

046 - Land use changes and local urban plans: a critical analysis along A35 highway (BreBeMi)

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Keywords: Land Take, Urban Plans, Supra-Local Transformations

Abstract Highways are among the major large-scale transformations that reshape the landscape, impacting the territory, through the direct changes they produce and the transformations they "induce". Understanding how local planning responds to such transformations is crucial to assess the awareness of these impacts by the different actors involved into the municipalities.
The A35 BreBeMi highway is the case study in this paper. Since 2014, the 62-kilometer road has crossed the Lombardy region and its four Regional Parks, connecting the cities of Brescia, Bergamo, and Milan. Its construction has had a strong impact on land in the municipalities it crosses, resulting in induced land take more than three times greater than that caused by its route (amounting to 750 ha versus 278 ha, considering only a 500 m buffer on both sides of the highway).
For this reason, it was conducted an analysis of the urban plans and the SEAs of the 27 municipalities crossed by the A35, each of which was drafted after the construction of the highway.
An initial qualitative analysis revealed that 70% of the sample did not openly express their opposition, despite concrete evidence showing that the highway has radically altered the landscape of the municipalities.
Then, a quantitative analysis showed that only one municipality provides precise land take data in his territory caused by BreBeMi. The omission of data prevents municipalities from defining a project vision and from developing a clear understanding of their own territories, an essential step to interpret and respond to the forces shaping them.
So, this study reveals a lack of awareness and capacity to assess the environmental impacts that have occurred, even though these are highly significant, both in their direct effects and in their influence on local dynamics.
The data on induced land take show the importance of calculating it to fully understand the effects generated by the infrastructure. For this reason, the final consideration is connected to the role of municipalities and the impact of new urbanizations carried out by each of them through its own planning tools. This suggests reviewing the management system of a large infrastructure project by defining a coordinated and shared method at a supra-municipal scale to design the territory adjacent to the future highway, avoiding the fragmentation of the local decision on land use changes.
Although these considerations stem from this case, they may well apply to other similar situations. This paves the way to explore alternative methods for improving planning in line with the requirements of the ecological transition.
This research is an integral part of the Horizon SPADES (Spatial Planning And DEsign with Soil) program, funded by the European Union (Grant Agreement No.101146122). It focuses on soil protection in spatial planning and urban development, within the framework of the Mission "A Soil Deal for Europe."

068 - Integrating soil into planning curricula: existing resources from soil science and soil-inclusive practices

Yoann Clouet (1) - Tannya Pico (1) - Teodora Todorcic Vekic (2)

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Keywords: Soil, Planning, Education, Literacy

Abstract Announced in 2011 and confirmed in 2020 with the Green Deal, the adoption of the No Net Land Take (NNLT) by 2050 objective at the EU level has prompted member states to integrate soil-related objectives into their planning frameworks, focusing on strategies to monitor land take and mitigate its impacts through measures such as limiting urban sprawl, preventing soil sealing, and enhancing soil quality. Despite the critical role of planning in organising human activities, and its direct impact on soil quality, quantity and performance, spatial planners

often lack the tools and specialised knowledge needed to address soil related issues effectively. This contribution reflects on how planning education must evolve to include a comprehensive understanding of soil-related policy objectives, regulatory frameworks, and practical tools for sustainable soil management.
The current spatial planning education and curricula focus primarily on sustainable planning and does cover concepts such as land use, land cover, artificialization, and soil sealing, but it fails to delve into the underlying reasons (ESS) and methodologies (preserving soil functions tied to quality and quantity) that are essential for soil conservation.
Spatial planners are key actors to address the anthropogenic drivers of soil degradation (unsustainable land management, soil sealing, contamination, over-exploitation, etc.); as such, current and future practitioners need to be trained to do so. Upgrading educational curricula is therefore key to ensure the next generation of planners is equipped with a systemic and proactive perspective on soil.
A critical review of knowledge from both soil science (tools and methods to perform soil assessment, soil monitoring, etc.) and existing soil-inclusive urban planning practices (sponge city concept, green-blue infrastructure, etc.) will contribute to identify the most relevant and useful resources for increased soil literacy of the next generation of planners.

093 - Linking Soil Properties, Functions, and Ecosystem Services to integrate Soil Quality into Urban Planning

Silvia Frezzi (1) - Chiara Cortinovis (1) - Davide Geneletti (1)

(1) University Of Trento, Dicam, Trento, Italy

Keywords: Soil Properties, Soil Functions, Ecosystem Services, Soil Quality, Urban Planning

Abstract Urban soils are often neglected in spatial planning and urban management, where they are frequently viewed as just a two-dimensional support surface or even as waste material. The limited awareness of soil functions and ecosystem services, and of their importance for the society, hampers their recognition into urban planning and management processes. The targets of “no net land take” and “no net soil sealing” set by the European Commission focus exclusively on quantitative restrictions, with no reference to soil quality, i.e. the ability of soil to function effectively within ecosystem and land-use boundaries, sustaining biological productivity, maintaining environmental quality, and supporting the health of plants and animals. However, an explicit consideration of soil functions and ecosystem services could support planning and management processes in limiting their negative impacts and promoting effective compensation and restoration measures.
This study aims at comparing frameworks that link soil properties (SP), soil functions (SF), and ecosystem services (ES) to support urban planning and management. The frameworks were identified through a review of the scientific literature. Four original frameworks relevant to urban planning and management, described in a total of 12 publications, were identified and analysed. The comparison focused on methods, indicators, and input data for the assessment of SP, SF, and ES. Moreover, it considered the approaches to describe the links between the different components and to construct soil quality indices.
SP were evaluated either in situ or in the laboratory, and used as input or proxies to determine SF. Two frameworks implemented pedo-transfer functions to connect SP with SF. Links between SF and ES were established based on either the literature or expert opinion. All four frameworks developed synthetic indices for evaluating SQ: three indices were based on SF, with one of them additionally linking SF to ES, while one index was derived directly from an ES assessment and considered SF only indirectly.
Our results provide an initial overview of existing frameworks to assess the quality of urban soils in support of planning and management and highlights their strengths and weaknesses. The findings can support the development of standardized urban soil quality assessments, although data availability remains a critical factor limiting their broader application.

104 - Biophysical and monetary valuation of ecosystem services: a semi-systematic review of theories and techniques for the Italian spatial planning

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Keywords: Ecosystem Services Valuation, SEEA EA, Monetary Valuation, Market-Values, Ecosystem Planning

Abstract Despite being acknowledged by the European Soil Strategy as a key resource in addressing major challenges such as climate change and

biodiversity loss, soil remains underrepresented in spatial planning and decision-making over territorial transformations. The European objective of "no net land take" (NNLT) by 2050 is far from being met—particularly in Italy, a "middle-of-the-road" country in aligning planning systems with NNLT goals (ESPON, 2024), largely due to fragmented land transformations and a highly dispersed administrative structure of small municipalities. These entities are often not required to fully integrate soil conservation strategies into local plans—as in the case of European Greening Plans, which apply only to cities with at least 20,000 inhabitants. This situation is compounded by widespread illiteracy regarding soil quality and the role of soil ecosystem services in supporting human well-being, economic stability, and environmental sustainability. Yet, in Italy small and medium-sized municipalities remain the main contributors to soil sealing (ISPRA, 2024).
In this context, the research investigates whether and how the concept of ecosystem services (being inclusive, multidisciplinary, and accessible to practitioners) can serve as a strategic tool to enhance the role of soil in territorial decision-making. Previous studies have shown opportunities for their partial integration into planning instruments in Italy (Richiedei, 2024; Geneletti & Cortinovis, 2021). However, new tools are needed to overcome the financial, regulatory and institutional constraints of local administrations. In this regard, recent literature increasingly supports the use of monetary ecosystem service valuation both as a practical planning tool and a communication instrument for policymakers. To explore this, a semi-systematic literature review was conducted, guided by two questions: (1) how can ecosystem services valuation be integrated into planning instruments, and which valuation frameworks and techniques have been proposed within the scientific literature? and (2) according to past researches, which monetary metric can ethically and effectively reflect the economic value of ecosystem services within planning frameworks? Both operative and theoretical studies were screened using thematic, temporal and geographical filters to ensure relevance to the Italian spatial planning system. The findings from this review are critically compared with the System of Environmental Economic Accounting – Ecosystem Accounting (SEEA EA) framework— the current international statistical standard for biophysical ecosystem service accounting and a key reference for monetary valuation – and culminate in a comparative reading grid that synthesizes the most effective tools and techniques for integrating ecosystem services into planning in resource-constrained small and medium municipalities.

252 - A conceptual framework for designing Healthy Soil Living Labs (HSLL) in urban environments

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Keywords: Urban Soil Health, Urban Planning, Living Labs, Governance, Ecosystem Services, EU Soil Mission

Abstract This proposal presents a conceptual framework for designing Healthy Soil Living Labs (HSLL) in urban environments, addressing the critical need to integrate soil health considerations into urban governance systems for resilient cities and sustainable urban ecosystems. While the EU Soil Mission advocates for sustainable soil management through Living Labs, significant gaps remain in integrating soil health, land use, and ecosystem services into them. Too often, soil is undervalued as merely a surface for development rather than recognized as a dynamic resource vital for ecological and urban resilience.
To address these gaps, this study introduces a comprehensive framework for healthy urban soil governance, informed by the NATI00S Horizon Europe project and developed for testing as a scientific framework within the ongoing URSOILL Horizon project. The framework comprises two key components: (1) ten considerations for cultivating soil-conscious mindsets among stakeholders—including policymakers, urban planners, and community members—and (2) ten design parameters that provide practical guidelines for establishing and operating future Urban Living Labs focused on soil health.
This framework aims to provide reflective and actionable tools to co-create urban ecosystems that prioritize and collaborate around healthy urban soils as essential infrastructure for sustainable urban development.

POSTER PRESENTATION

253 - Soil literacy and the challenge of integrating local soil knowledge into planning and design

Andrea Bortolotti (1) - Elena Luongo (1)

(1) Politecnico Di Milano, Dipartimento Di Architettura E Studi Urbani, Milano, Italy

Keywords: Off Campus Cascina Nosedo, soil literacy, urban planning, design practice

Abstract The presentation brings forward the preliminary findings of the research activities carried out at the Off Campus Cascina Nosedo, an offshoot of the Politecnico di Milano located in the south-eastern outskirts of Milan, serving as a laboratory for interdisciplinary research and pedagogy. Here, research is being conducted within the framework of Mission "A Soil Deal for Europe" to lead the transition to healthy soils by 2030, focusing on civic monitoring and soil literacy in society. Initial activities included interviews and co-creation round-tables with local stakeholders involved in the management of forestry and peri-urban agriculture. These discussions revealed widespread practical knowledge among these stakeholders regarding the legacy of soils compromised by past productive activities (such as terraforming, excavation, and backfilling). These soils prove highly heterogeneous, difficult to classify, and complex to manage both materially and in regulatory terms. The challenge remains to understand how to integrate this situated, site-specific knowledge into decision-making and planning visions for the Cascina Nosedo area. The research will seek to address this through further local exchanges and design experimental approaches.

Digital Poster Gallery: https://sspcr.eurac.edu/en/programme/digital-poster-gallery-2025

SPECIAL SESSION

HOLISTIC MULTI-RISK ASSESSMENT OF URBAN AND METROPOLITAN AREAS IN ITALY

Chairs: Massimiliano Pittore (Eurac Research - Center for Climate Change and Transformation), **Maria Polese** (Università degli Studi di Napoli Federico II), **Francesca Ferretti** (Università di Bologna), **Margherita Rago** (Università degli Studi di Genova), **Valeria D'Ambrosio** (Università degli Studi di Napoli)

This special session delved into a comparative analysis of diverse pilot test cases conducted across Italy within the RETURN project, focusing on climate and disaster risks specific to urban and metropolitan areas. Anchored in a holistic, multi-risk framework, the session fostered an in-depth dialogue on the commonalities, synergies, and key differences identified across the selected cases. By addressing these aspects, the session contributed to advancing the understanding of risk assessment methodologies and their adaptability to different urban contexts.

The featured test cases were analysed and documented using the impact chains methodology, which provided a structured approach to visualizing causal relationships between hazards, vulnerabilities, and impacts. This approach, combined with the capabilities of the RETURN platform developed by ALMAVIVA, ensured consistency in data representation while accommodating the specific characteristics of each target area.

Key discussion topics included shared challenges and opportunities identified across the test cases, as well as the diverse outcomes arising from differences in regional contexts, urban dynamics, and methodological approaches. Particular attention was given to the influence of localized factors—such as socio-economic conditions, governance structures, and environmental vulnerabilities—on risk assessment outcomes. In addition, the session explored how these findings could inform scalable and transferable solutions for urban resilience planning.

The session offered a valuable opportunity for participants to engage with cutting-edge research and tools integrating multi-dimensional risk considerations into urban planning. It welcomed contributions from researchers, practitioners, and policymakers interested in advancing holistic risk assessment practices. By bridging differences and identifying shared pathways, the session aimed to contribute to the development of resilient urban environments capable of addressing the complex challenges posed by climate and disaster risks.

ORAL PRESENTATIONS

080 - Heatwave impacts on human thermal comfort in the urban context: a case study in Bologna (Italy)

Andrea Faggi (1) - Tiziano Maestri (1) - Laura Tositti (2) - Alessandro Zappi (2) - Michele Martinazzo (1) - Giorgia Proietti Pelliccia (1) - Erika Brattich (1)

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Keywords: Heat Extremes, Thermal Comfort, Urban Areas, Urban Heat Island

Abstract Climate change is intensifying the severity of various types of extreme weather events, including heatwaves, droughts, heavy rainfall, and intense storms. Among these, heat extremes pose significant health risks, leading to heat exhaustion, heatstroke, and the exacerbation of pre-existing conditions like cardiovascular and respiratory illnesses and also impacting mental health and wellbeing. Southern Europe is facing increasing vulnerability to extreme heat due to climate change, with potential impacts on public health, infrastructure, and the economy. Additionally, several studies have demonstrated the synergetic effect between heat waves and the "urban heat island", further intensifying the magnitude of urban overheating globally up to 5–10 °C during heat waves.
This work presents a detailed characterization and analysis of an intense heatwave event impacting on the city of Bologna (Italy) during the period of 11-20 July 2023. After identifying the event based on two different indexes, i.e. the Warm Spell Duration Index (WSDI) and the Excess Heat Factor (EHF), the analysis of the geopotential pattern as well as of the satellite data pointed out the extension of African anticyclone over the Italian Peninsula, with the arrival of hot air masses to the Northern part of Italy, a phenomenon which is intensifying and often recognized as responsible of extreme heat in the Mediterranean region By integrating observations of essential climate variables collected by ground-based official reference stations with observations from amatorial meteorological stations, we created spatial maps of biometrical indexes in the metropolitan area of the city. The analysis of the spatial and temporal variability of such indexes points out very clearly the emergence of wide differences in the exposure of resident population to thermal stress, connected with the Urban Heat Island (UHI) phenomenon and its multiple scale intrinsic nature. The results thus showcase the usefulness of these indexes to support policy makers in the definition of measures and plans to mitigate the impacts posed by heat extremes.

109 - Building a Multi-Hazard Exposure Database for Urban Risk Assessment: the Case of Genoa

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(1) University Of Genoa, Department Of Civil, Chemical And Environmental Engineering, Genova, Italy

Keywords: Multi-Risk Assessment, Urban Exposure Data, Impact Chains, Urban Vulnerability, Resilient Cities

Abstract This contribution presents an integrated approach for the collection, classification, and spatial harmonization of exposure data in support of multi-hazard urban risk assessment, with the city of Genoa as a case study. Genoa is a complex urban setting affected by multiple hazards and characterized by densely built-up areas, steep orography, ageing infrastructure, and growing socio-demographic fragility. The work is part of the Extended Partnership RETURN initiative, which promotes multi-risk science for resilient urban communities in a changing climate. In the context of complex and overlapping urban hazards – such as heatwaves, floods, landslides, and earthquakes – comprehensive exposure datasets are critical to inform risk modeling, decision-making, and planning.
The methodology is guided by a multi-hazard impact chain framework, which structures the interdependencies between hazard, exposure, and vulnerability components. Data sources include national and municipal geoportals, open statistical datasets, satellite imagery, cartographic material, historical archive data, specialized publications and more. Special attention is given to the spatial resolution and thematic completeness of the data, ensuring compatibility with census sections and municipal planning layers. A key element of the ongoing effort is the extension of this dataset to the full territory of the municipality of Genoa. This allows a consistent citywide baseline for assessing both current and future risk scenarios. The resulting geodatabase, built upon open and interoperable formats, aims to become a tool for spatial risk analyses, adaptation and mitigation planning, and social vulnerability mapping. The process and structure of this work are replicable and can serve as a reference for other urban contexts facing similar multi-risk challenges.

137 - Holistic and Multidimensional Approaches to Assessing Systemic Vulnerability in Urban Settlements

Cristina Visconti (1) - Sara Verde (1) - Martina Bosone (1) - Pasquale Galasso (1) - Pasquale De Toro (1)

(1) University Of Naples Federico Ii, Architecture, Naples, Italy

Keywords: Systemic Vulnerability, Social-Ecological-Technological Systems, Indicator-Based Assessment

Abstract Urban and metropolitan areas in Italy are increasingly exposed to multiple and interacting hazards, including natural disasters and climate change-induced events such as heatwaves, flood-

ing, and storms. These challenges are intensified by structural and interlinked dynamics, such as rapid urbanization, socioeconomic inequalities, and fragmented governance systems that stress urban resilience and require systemic thinking. In this context, there is growing consensus in the scientific literature on the need for a comprehensive and integrated conceptualization of vulnerability in multi-risk scenarios that is based on a holistic understanding of how different hazards interact and how urban populations, infrastructures, and governance systems respond to these complex risks. Systemic vulnerability of urban settlements in multi-risk scenarios, focusing - unlike traditional notions of vulnerability - on the interdependent nature of urban systems and their propensity to cascade functional failures across domains, is increasingly recognized as a critical yet underexplored factor of urban resilience. The contribution presents a multidimensional framework for assessing systemic vulnerability to multiple hazards in urban settlements, advancing theoretical discourse and practical applications in environmental design and building technology for urban resilience. The study presents intermediate results from research conducted within Task 5.3.3 of the extended partnership "RETURN: Multi-risk Science for Resilient Communities under a Changing Climate", focusing specifically on systemic vulnerability. Based on a comprehensive literature review and rooted in social-ecological-technological systems (SETs) theory, resilience thinking, and risk governance, the proposed approach conceptualizes systemic vulnerability as dynamic, context-dependent, and multi-scalar. The results identify key vulnerability dimensions, such as socio-spatial inequalities, urban form, and environmental characteristics, along with their necessary criteria and indicators for risk assessment and to orient transformative responses. The methodology emphasizes multi-dimensionality and interconnection: rather than isolating vulnerability into separate silos, it considers the interactions between social fragility, ecological features of the urban environment, and spatial configurations.The framework is tested through an indicator-based assessment of climate vulnerability at the district scale in Naples, Italy. Preliminary results demonstrate its potential to capture systemic interactions and inform policy-relevant strategies for risk reduction, resilient planning, and design. Ultimately, this work contributes to advancing holistic approaches and integrated tools for vulnerability assessment, supporting the development of adaptive and anticipatory governance mechanisms in the face of complex multi-risk scenarios.

149 - Multi-Source Observations and High-Resolution Modeling to Investigate the Urban Heat Island in the City of Bolzano (Italy)

Gaspard Simonet (1) - Claudio Zandonella Callegher (2) - Alice Crespi (1) - Massimiliano Pittore (1) - Lorenzo Giovannini (3)

(1) Eurac Research, Climate Change and Transformation, Bolzano, Italy - (2) Eurac Research, Institute for Renewable Energy, Bolzano, Italy - (3) University Of Trento, Department Of Civil, Environmental And Mechanical Engineering, Trento, Italy

Keywords: Urban Heat Island, Complex Terrain, Satellite, Mobile Sensors, High-Resolution Models

Abstract The ability to accurately describe urban climate and the role of urban environments in determining heat conditions and hotspots is key to informing risk assessment, planning climate change adaptation measures, and developing mitigation strategies for cities. However, the characterization of Urban Heat Islands (UHI) still presents unique challenges from both observational and modeling perspectives, especially in complex mountainous terrain. This is due to the different scales of the features involved in the redistribution of the temperature field and the significant amount of data required to correctly capture the local specificities of both the city and its valley environment.
This study presents a novel approach integrating multi-source meteorological information to investigate the UHI in Bolzano, a city located in the south-eastern Alps and one of the Italian cities most exposed to high temperatures during summer months, especially during heatwave episodes. Specifically, we combine an extensive mobile measurement network with fixed observations, remote-sensing data, and high-resolution climate modeling. A unique distributed mobile measurement network, consisting of up to 25 meteorological sensors (MeteoTracker) installed on public buses, provides continuous spatial and temporal coverage of meteorological parameters (temperature, humidity, and pressure) across the urban area. The buses' fixed routes, including transitions between urban and rural areas, enable systematic quantification of UHI intensity across different temporal scales.
To bridge observational gaps and provide continuous spatial coverage, we employ two modeling approaches: (1) 100-m resolution urban climate simulations provided by the UrbClim model, resolving mesoscale features – such as thermally driven winds – for the recent period, the mid-term and the far future, and (2) weather predictions from the Weather Research

and Forecasting (WRF) model at 1-km resolution covering the past 6 years. Temperature patterns described by the two model datasets, run over an extended area centered on the city, are compared and evaluated against observations, aggregated spatially and temporally to match model grid points.
To complement in-situ observations and model simulations, we generated high-resolution Land Surface Temperature (LST) images by fusing thermal data from Landsat and MODIS. This allowed for an analysis of the relationship between LST and urban morphology to assess the built environment's impact on surface heating and to identify urban hotspots. The multi-source approach is first tested by considering recent heatwave episodes recorded in Bolzano, including the summers of 2022 and 2023. Preliminary results demonstrate the effectiveness of combining multiple observation types with high-resolution modeling to characterize UHI patterns in complex terrain.

152 - Integrated multi-risk assessment for resilient cities: The case study of Bologna

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Keywords: Multi-Risk Assessment, Seismic Risk, Heatwave, Storyline, Impact Chain, Urban Resilience

Abstract In recent years, due to the intensification of climate change, unexpected extreme events have affected many urban environments around the world. In order to mitigate the risk and implement climate change adaptation strategies, it is crucial to conduct multi-risk assessments of urban areas. A multi-risk assessment is aimed at evaluating the impacts that multiple natural disasters may have in a specific area, by investigating the vulnerability and exposure, based on physical, social, and economic parameters. To improve multi-risk assessment, in the framework of the RETURN project (Multi-risk science for resilient communities under a changing climate), the storyline methodology is proposed to analyze different possible scenarios, where the occurrence of single- or multiple-hazardous events, interacting with one another, may affect urban environments. Based on these scenarios and through specific models, it is possible to assess the socio-economic impacts of all the exposed urban assets and human factors. To better understand the interrelationships between hazard, exposed assets, vulnerability and/or mitigation measures, a graphical representation of the storyline, i.e., the impact chain, is also developed. In this framework, the objective of this study is to visualize the sequence of different natural events that can occur in a urban area. The city of Bologna is selected as a case study and earthquake, flooding, and heatwaves are considered as hazardous events. Indeed, the city is situated in a seismic region and it has been subjected, in recent years, to increasing temperatures and precipitation due to climate change. Storylines and impact chains, considering one or multiple events, have been developed and will be presented, together with the characterization of the exposed assets of a portion of the city, considering a specific taxonomy, and the evaluation of social vulnerabilities. The main results of the study have been mapped in a GIS environment for the upload on the RETURN web platform, on which the input and output data of multi-risk assessment procedures can be visualized and compared

165 - A simplified approach for urban multi-hazard hotspot identification: a case study of heatwave and earthquake risks

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Keywords: Multi-Hazard Risk, Urban Vulnerability, Urban Hotspot, Risk Index, Seismic And Heatwave Risk

Abstract Assessing multiple risks in urban environments is a complex task, given the intricate interplay among infrastructure systems, geological and geomorphological conditions, and socioeconomic factors. The coexistence or simultaneous occurrence of multiple hazards can amplify overall risk levels, making their assessment even more challenging. Within this context, index-based methodologies are widely used as simplified yet effective tools for investigating multi-hazard risk and supporting risk-informed decision-making.
This study introduces a multi-risk index designed to integrate multiple hazards along with physical and social dimensions of vulnerability and exposure. The proposed index is a mathematical aggregation of normalized indicators representing hazard intensity, physical vulnerability, social vulnerability, and exposure, with the aim of identifying urban multi-hazard

hotspots, i.e., areas where the combined impact of different hazards is potentially high. Recognizing these hotspots is crucial for disaster risk reduction, as it enables targeted mitigation, efficient resource allocation, and informed land-use planning. By highlighting zones where hazards converge and interact with vulnerable populations and infrastructure, authorities can prioritize actions to enhance resilience and reduce losses.
An application of the methodology is presented for the municipality of Naples, focusing on seismic and heatwave risks. Residential buildings and the local population are considered as the exposed elements. For each census tract, hazard intensity and physical vulnerability are combined to assess individual potential risk levels, which are then integrated with social vulnerability and exposure data to derive a composite multi-hazard risk index. The results highlight areas where the impacts of both hazards could be particularly severe, due to a combination of high hazard levels, dense exposure, and significant physical and social vulnerability. These findings are especially relevant for identifying locations where integrated seismic and climate proof retrofitting interventions would be most effective. The proposed index-based approach may be also extended to include the effects of risk mitigation measures, by adjusting the contributing indicators accordingly. As such, it also serves as a practical tool for evaluating the potential benefits of policies aimed at reducing urban multi-hazard risk.

217 - Thermal Resilience of Social Housing in Bolzano: A Microclimate-Informed Simulation Approach

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Keywords: Thermal Resilience, Urban Microclimate, Microclimate-Informed Building Simulation, Urban Greening

Abstract Climate extremes, such as heatwaves, are becoming more frequent and severe, directly impacting how people live in cities and buildings. Building energy simulations (BES) typically rely on typical meteorological year dataset for outdoor boundary conditions, which overlook localized urban climate effects, leading to underestimated overheating risk of indoor environments. This study presents a multiscale simulation framework to assess the thermal resilience of a typical social housing apartment in Bolzano, Italy, by integrating urban microclimate modelling with BES under both current and future climate conditions.
The approach involves generating microclimate-adjusted weather files using ENVI-met for two urban configurations: one with minimal vegetation and one incorporating enhanced vegetative cover. These are compared with both present-day and future weather scenarios to evaluate the combined effects of urban greening and climate change on the evaluation of indoor thermal conditions. The building model, developed in EnergyPlus via Rhino–Grasshopper with Ladybug and Honeybee plugins, represents one of the apartments within the Casette Inglesi neighbourhood of Bolzano and is calibrated against monitored indoor temperatures over a 3 week period in August 2024.
Simulations across all scenarios assess key performance indicators under extreme heat events. Preliminary results reveal substantial differences in predicted indoor conditions when using microclimate-informed inputs, particularly in scenarios with urban greening.
This study emphasizes the importance of high-resolution, context-specific weather data in evaluating thermal resilience of buildings. By isolating the effect of urban vegetation on building performance, the framework highlights the risk of oversimplification in conventional BES workflows. The results lay the groundwork for a more comprehensive assessment of heat mitigation strategies in future work, supporting informed urban and building adaptation planning under climate stress.

257 - Research activities of the UNIGE RETURN Team on pluvial flooding hazard and risk assessment in urban area

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Keywords: Urban Flood, Flood Models, Exposure, Remote Sensing, Deep Learning

Abstract This presentation outlines the research activities carried out by the University of Genoa within the RETURN project, focusing on the assessment of the components of the risk equation for urban floods triggered by intense rainfall. These events, commonly referred in the literature as pluvial flooding, are

characterised by rainfall-generated overland flow and ponding before the runoff enters any watercourse, drainage system or sewer, or cannot enter it because the network is full to capacity.
The study addressed both the sources of uncertainty in hazard estimation and the potential for improving exposure assessment—and thus damage estimation—under specific hazard scenarios. Concerning hazard-related uncertainties, the analysis investigated the effects of different representations of precipitation forcing and topography.
Because the spatial and temporal scales of precipitation associated with pluvial flooding are extremely small, reproducing the impacts of a specific event, particularly the flooded area, becomes challenging. A case study shows that the absence of rainfall measurements within a few kilometres of the affected area can lead to substantial discrepancies in the simulated flood extent, with direct implications for damage evaluation. Topography in flood models is represented through digital terrain models (DTMs), available for urban areas at varying resolutions and accuracies. The presented case study demonstrates how model resolution can influence the representation of flood hazard magnitude, again affecting damage and risk estimates. The choice of numerical parameters used to solve model equations can introduce comparable effects.
To quantify the implications of inaccuracies in hazard mapping, a detailed characterisation of exposed elements is required. The case study explored the classification of specific exposure categories, such as vehicles. Identifying the location of such vehicles was addressed as a problem of object detection from input remote sensing imagery of the considered scene. For this purpose, deep learning models from the YOLO (You Only Look Once) family were trained and applied to an extremely high-resolution orthophoto (5 and 20 cm of resolution). The performance of such techniques in the study area was evaluated for this purpose. The resulting datasets were then employed to quantitatively assess the impact of variations in hazard scenarios associated with differences in precipitation forcing.
Overall, the findings reveal that, in contexts where validation data for model outputs are scarce—as is common for pluvial flooding—the choice of input data, topographic representations, and model parameters becomes highly critical. Approximations acceptable for larger-scale flood events can lead to significant inaccuracies when modelling pluvial floodings. This underscores the need to collect information at the highest possible level of detail, including comprehensive databases on meteorological forcing, historical flood and damage records, and high-resolution planimetric and altimetric descriptions of urban areas.

SPECIAL SESSION

EVALUATING URBAN GREEN INTERVENTIONS: FRAMEWORKS, TOOLS AND CROSS SCALE IMPACTS

Chairs: Sara Torabi Moghadam (Politecnico di Torino - Interuniversity Department of Regional and Urban Studies and Planning), **Sara Biancifiori** (Eurac Research - Institute for Renewable Energy), **Eugenio Morello**, **Asef Ayatollahi** (Politecnico di Milano - Department of Architecture and Urban Studies)

This special session focuses on the evaluation of urban green intervention through a multidimensional lens, emphasizing how assessment frameworks can guide transformative adaptation on micro and urban scales. As the challenges of climate change, social equity, and sustainable development become increasingly interconnected, evaluating the processes and outcomes of urban green interventions has never been more critical.

The session brought together researchers, practitioners, and policymakers to explore innovative digital and participatory tools, KPIs frameworks, multicriteria analysis, and decision support tool metrics. The aim was to investigate adaptive interventions from context-specific to theoretical developments. It also addressed both established and emerging themes in evaluating urban green interventions and regeneration, ranging from using nature-based solutions (NbS) and ecosystem services (ES) to the use of innovative processes.

ORAL PRESENTATIONS

041 - Towards a City-Adaptive Evaluation Framework for Urban Greening: Supporting Implementation and Demonstrating Impact

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Keywords: Urban Greening, Evaluation Framework, Impact Assessment, Co-Development

Abstract As urban greening becomes a key strategy for climate mitigation and adaptation, cities increas-

ingly need robust and adaptable ways to evaluate the effects of their interventions. This paper presents early insights from ClimaGen (2025–2029), a Horizon Europe project supporting nine European cities in designing, implementing, and evaluating targeted greening efforts.
Central to the project is the co-development of the ClimaGen Impact Model, an evaluation framework to be developed by addressing the specific partner cities' needs. The challenge is to integrate inputs that are context-dependent (geography, climate, urban layout, goals, etc) in a coherent and flexible framework to support cross-case comparison and shared learning.
The model builds on and extends existing frameworks by aligning local priorities with national and European policy goals. Relevant Key Performance Indicators (KPIs) are defined from what cities already monitor, supplemented where needed by new indicators developed within the project. The process begins by establishing a preliminary evaluation of the status of selected intervention areas (baseline) to which the impact of the actions is evaluated by means of identified KPIs.
This is followed by a methodological discussion on how to meaningfully assess, weight, and compare urban greening efforts across cases. Key issues include balancing standardization and flexibility, integrating quantitative and qualitative indicators, and aligning with cities' existing monitoring practices.
We reflect on the practical and conceptual challenges of creating an umbrella framework that is both adoptable and useful across heterogeneous urban realities, and how such a framework can provide practical support for city practitioners and help bridge the gap between strategic ambitions and operational decision-making in climate-resilient urban development.

051 - Forecasting the quality of the thermal urban environment based on morphological parameters and climatopes: an approach to sustainable planning in a temperate climate

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Keywords: Urban Thermal Comfort, Climatopes, LCZ, UHI, SVF, Green Infrastructure, Urban Planning, GIS

Abstract Rising urbanization and climate change are exacerbating overheating in cities, especially in the summer, raising risks to the health and sustainability of the urban environment. Despite the presence of global models — LCZ to reduce the UHI effect — there are no engineering and applied solutions adapted to the national conditions of the temperate continental climate and urban planning standards.
The paper proposes an integrated approach to forecasting the quality of urban thermal environment (UTE), based on the adaptation of LCZ/UHI theories to local climatopes, morphological parameters of development and remote sensing data. The scientific novelty of the study is as follows:

— Express methods for assessing the quality of UTE;
— Grid model (100×100 m) of temperature calculation by morphological variables;
— Enabling the Sky View Factor (SVF) to take into account the density of tree crowns;
— Analysis and adaptation of urban planning standards to the tasks of thermal comfort.

The model is based on the leveling of multiple linear regression with variables: building density, landscaping (trees, shrubs, grasses), road and soil pavements (based on GIS data). Temperature characteristics were obtained on the basis of remote sensing data. It was found that landscaping with trees has the greatest impact on temperature reduction. The lack of multicollinearity and MAE, MSE, RMSE metrics confirmed the high accuracy of the model. Verification performed in Envi-Met, data reliability confirmed
Full-scale SVF measurements for various tree species (oak, maple, elm, poplar) made it possible to clarify their influence on the heat balance. A formula has been developed for calculating the effective proportion of landscaping, taking into account the area and density of the crown. It was integrated into the model.
A numerical experiment was carried out with various types of buildings and landscaping scenarios (0-30%), depicting that an increase in the proportion of trees to 30% allows to achieve a high class of UTE. A map of the distribution of climatopes by classes of thermal urban environment (UTE) was created, on the basis of the model. An express method for assessing the quality of the projected territory is proposed.
The analysis of urban planning standards revealed that the current standards do not provide the required level of thermal comfort.
Recommendations:

— Increase the standard of landscaping by trees to 30% for cities with a temperate continental climate;
— Specify the type of vegetation in the regulations;

— Include the indicator of thermal comfort in the quality index of the urban environment.

The proposed approach is scalable and applicable in the practice of sustainable planning and contributes to the achievement of the UN SDGs (Goal 11).

155 - The role of private green spaces in urban greening plans and policies: Evidence from Italy

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Keywords: Urban Greening Plans, Private Green Spaces, Biodiversity, Ecosystem Services

Abstract Urban nature is increasingly recognised as essential for biodiversity and ecosystem service (ES) provision. The EU Biodiversity Strategy for 2030 calls on cities with over 20,000 inhabitants to develop Urban Nature Plans to integrate nature into urban environments, improve ecological connectivity and limit biodiversity-harmful practices, ideally providing a strategic framework to align ecological objectives with mobility, building, and climate policies. Moreover, the EU Nature Restoration Regulation sets targets to increase the total national area of urban green space and the tree canopy cover of all European cities. Such targets include both public and private green spaces, such as residential yards, private parks, and green areas associated with commercial properties. Local policies and regulations in several cities already acknowledge the importance of private green spaces as a key component of urban green infrastructure and their role in ES provision. For example, Berlin, Helsinki, and Vienna have introduced binding ecological standards that target private plots, requiring minimum green coverage, species selection, and de-sealing measures as part of the building permit process. However, besides single policy instruments, there is no systematic evidence on how private green spaces are incorporated into urban greening strategies and green regulation frameworks. This study investigates how private green spaces are addressed in urban greening plans and policies by focusing on (i) what objectives, strategies, and actions are included; and (ii) what data and indicators are used to define the baseline and to monitor the implementation. A sample of Italian cities was selected as the unit of analysis. For each city, we considered a broad set of documents related to urban green planning and management, from the more strategic ones such as urban green plans, biodiversity, and urban forestation strategies, to the more operational ones such as guidelines on public space and tree management and regulations for public and private green areas. We also considered documents not strictly focused on urban green spaces but addressing them as part of broader planning provisions, such as general/comprehensive urban plans and building regulations. Through a content analysis of the documents, we assessed to what extent they acknowledge the biodiversity and ES contributions of private spaces, whether targets and actions specific to private green spaces are formulated (and if they align with the Nature Restoration Regulation targets), and how their implementation is going to be monitored. Results are discussed in terms of how cities can adapt their greening plans and policies to systematically incorporate private green spaces, thereby supporting effective urban nature strategies to achieve biodiversity and restoration goals.

211 - Integrating Climate Adaptation and Heritage Values in Urban Areas: A climate-legibility assessment of blue-green interventions in Aachen

Lailly Vaz De Miranda (1) - Timurul Hoque Kazi (2) - Leah Versluis (2) - Axel Timpe (1)

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Keywords: Climate Adaptation, Heat Stress, ENVI-met, Urban Heritage, Blue-Green Strategies

Abstract Historic city centres are increasingly exposed to intensifying heat stress, yet most climate adaptation assessments overlook heritage layers that make these places unique (ICOMOS, 2011). Responding to the European Commission's call for smarter adaptation (European Comission, n.d.), this research develops an integrated quantitative-qualitative framework that couples ENVI-met simulations with an assessment of urban heritage values. The framework introduces the Narrative Clarity Index (NCI), a qualitative evaluation that supports context-sensitive design strategies in historically complex environments.
The city of Aachen, with thermal springs used since Roman and Carolingian times and chosen by Charlemagne as the political centre of the Frankish Empire, provides a historically layered context well-suited to testing the framework.

To this day, Aachen preserves historical street orientations, along with medieval street layouts, public spaces, and a network of piped brooks. Together with post-war redevelopments that significantly increased surface sealing (Curdes, 1999) these spatial layers contribute to intensifying urban heat stress.
To operationalise the framework, case studies of blue-green scenarios in the inner-city will be used: The "Altstadtquartier Büchel", a redevelopment replacing a demolished car park and nearby plots close to the UNESCO world heritage cathedral; and the "Kaiserplatz" corridor, which follows underground piped brooks. Studies of context-based blue-green strategies will complement the framework.
ENVI-met simulations will be used to assess how built form and materials influence urban heat and human thermal comfort for baseline and for the blue-green scenarios. Physiological Equivalent Temperature (PET) is the primary indicator; a strategy is considered successful if it achieves a PET reduction of 4° to 6° Kelvin, depending on and in relation to baseline values.
The NCI evaluates heritage compatibility through a rubric distilled from ICOMOS criteria (ICOMOS, 1964, 1987, 2011), focusing on three indicators: (i) legibility – the preservation and clarity of spatial patterns, forms, materials, and visual corridors; (ii) authenticity – compatibility of new uses with tangible fabric and spirit of place; and (iii) engagement – communication of historical narratives, accessibility, and community acceptance. The NCI applies a matrix (Classes A–D) for qualitative comparison among blue-green scenarios.
Each intervention must meet both benchmarks: a successful PET reduction and attainment of Class B or higher in the NCI based on all indicators. If not achieved, iterative refinements are conducted. This structured process reveals case-specific trade-offs and provides insights for climate-adaptive design in complex heritage contexts. Further developments and adaptations of the framework will be presented at the conference and detailed in the full paper.

246 - A hands-on Evaluation of the Environmental Impact and Efficiency of Urban Nature-based Solutions

Boud Verbeiren (1) - Santiago Romo Di Vivar (2) - Nora Van Cauwenbergh (1)

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Keywords: NbS, Blue-Green Infrastructure, Environmental Monitoring, Evaluation, Efficiency

Abstract Within a context of climate change urban green interventions are set forward as a solution to mitigate possible negative effects linked to increased occurrences urban flooding, heat waves and drought, loss of biodiversity, etc.
The increased implementation of these urban green interventions, often also called blue-green infrastructure (BGI) or nature-based solutions (NbS), also brings a demand regarding the efficiency and mitigating impact these interventions/solutions can have in an urban context.
Within the frame of the GREEN-INC project (https://green-inc.eu/) an interdisciplinary team (POLITO and VUB) has developed a monitoring and evaluation framework that helps to measure the performance of Inclusive Climate Actions, including a broad range of urban green interventions/nature-based solutions. The framework consists of several general Key Performance Indicators (KPI) based on desk research, and has been verified in stakeholder workshops in three partner cities with local partners (Brussels, Skelleftea, Turin). These workshops have resulted in additional 'context-specific' KPIs that have been added for each city.
In this contribution we focus on the selected environmental KPIs, strongly related to ecosystem services covering water (runoff production and re-use), health (air quality and thermal comfort), biodiversity (number of species and ecological connectivity) and environmental quality (soil and carbon sequestration). The main aim is that these KPI can be used to evaluate the efficiency and environmental impact of NbS for each of these different aspects, after implementation or even during the design phase, for of by city administrations.
For each of the environmental KPI a detailed hands-on approach is described based on available (open data) or data to be collected during the evaluation process, enabling a mostly quantitative and reproducible approach to evaluate the environmental impact of a NbS. As an example, the 'biodiversity - number of species' KPI is assessed using an existing App (iNaturalist). Apart from administrations or other organisations responsible for the data collected (in space and time), also citizens can be invited to engage to actively contribute. As such a 'monitoring & evaluation' template has been developed for each KPI , filling the need for a reproducible approach to evaluate the effectivity and impact of selected urban green interventions (such as NbS).

SPECIAL SESSION

TOWARDS ATTRACTIVE, SUSTAINABLE, AND INCLUSIVE CITIES: INSIGHTS FROM THE NEW EUROPEAN BAUHAUS

Organisers: Elvira Romano (European Commission - JRC), **Adriano Bisello, Silvia Tomasi**, **Chiara Pellegrini** (Eurac Research - Institute for Renewable Energy), **Denia Kolokotsa** (Technical University of Crete)

As European cities advance toward climate neutrality, it becomes essential that the transition is not only sustainable but also attractive, inclusive, and rooted in local quality of life. The New European Bauhaus (NEB) initiative, launched by the European Commission, seeks to intertwine sustainability, aesthetics, and social inclusion, providing a cultural and creative dimension to the European Green Deal.

This special session explored how NEB principles could be operationalized within urban transformation processes, with a particular focus on supporting practitioners and local governments in aligning projects with NEB values. The New European Bauhaus Self-Assessment Handbook (JRC139118) offered a structured methodology to evaluate projects across three dimensions—sustainability, beauty, and inclusiveness—at multiple spatial scales (building, neighbourhood, and urban). Through a hierarchy of indicators and key performance indicators, together with an accompanying online tool, the handbook encouraged continuous improvement, stakeholder dialogue, and shared learning throughout the project lifecycle.

The session addressed two central questions: (1) how cities and project promoters could leverage NEB principles to create more desirable, resilient, and inclusive living environments while ensuring measurable progress across complex and context-dependent sustainability targets; and (2) how the NEB self-assessment process could be made feasible for practitioners facing time and resource constraints, while remaining scalable and suitable for city-level evaluation without losing the balance between sustainability, beauty, and inclusiveness.

Directly connected to SSPCR 2025's thematic tracks on sustainable transitions, community resilience, and governance innovation, the session invited contributions that critically examined the application of NEB principles through practical examples, discussed the operational challenges of multi-dimensional project evaluation, and proposed solutions to streamline the self-assessment process without oversimplifying it. Ultimately, the session aimed to encourage a shift in perspective in which sustainability was framed as an opportunity to enhance the beauty, accessibility, and social vibrancy of European urban spaces, making the transition not only necessary but also genuinely desirable for all.

INVITED SPEAKERS

INCLUSIVENESS

Inclusiveness in urban transformations and public spaces

Thomas Maloutas *- Researcher emeritus at National Centre for Social Research (EKKE) and Professor Emeritus at the department of geography of the Harokopio university in Athens (Greece)*

BEAUTY

Why sustainable beauty matters: how the New European Bauhaus inspires climate-resilient cities and communities

Barbara Widera *- Associate Professor at the Faculty of Architecture of Wroclaw (wrozuaw) University of Science and Technology (Poland) and Board Member of the EU Mission for Adaptation to the climate change*

How to assess spatial coherence in urban planning and design

Giancarlo Cotella *– Professor of Spatial Planning at Politecnico of Torino (Italy) and Secretary General of the Association of European Schools of Planning (AESOP)*

Designing and measuring high-quality environment, architecture and aesthetic experience of users

Amra Salihbegovic *– Assistant Professor of Architectural and Urban Design at the Department of Architecture, Built Environment and Construction Engineering (DACB) of Politecnico of Milano (Italy)*

SUSTAINABILITY AND PRACTICAL APPLICATIONS

Sleeping Beauty Project: unlocking NEB and NBS values for a more sustainable, inclusive and resilient society

Gudrun Haindlmaier *- Vice Director of Studies for Spatial research and spatial planning at the University of Wien (Austria)*

Application of the NEB self-assessment method to a renovation building project

Stefania Gerli *- European Commission - JRC*

ORAL PRESENTATIONS

122 - Complex and context-dependent project evaluation across multiple spatial scales: Exploring the spatial dimension of urban regeneration in Lombardy, Italy

Sara Bianchi (1) - Anna Richiedei (1)

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Keywords: Urban Regeneration, Spatial Scales, Sustainability Assessment

Abstract Urban regeneration is a vital planning tool to foster inclusive, resilient, and sustainable cities by addressing climate change, urban health, and spatial inequalities. Aligned with New European Bauhaus (NEB) principles, it drives built environment transformation, contributing to climate goals and enhancing quality of life. Current definitions of urban regeneration lack explicit references to spatial dimensions, typically focusing on already urbanised, degraded or underutilised areas. Urban regeneration is, in fact, a complex, multi-scalar phenomenon, spanning from small-scale projects to large urban initiatives. However, understanding the spatial dimension is crucial for effectively planning these initiatives. This encompasses not only physical size (m^2, hectares) and scale (district, neighbourhood), but also the coverage area, including factors like affected population, surrounding areas, and governance levels. Efficient regeneration strategies require considering cities' morphological organisation and the systemic relationships of their urban units. Studies on elementary urban units trace back to Howard's Garden Cities, Perry's "neighborhood unit" theory, Mumford's thought, and Columbo's "Organic Urbanism". The relevance of dimensional implications for urban regeneration is evident in the effects stemming from differences in size, scale, and coverage area, influencing policy formulation, stakeholder engagement, and the extent of benefits and impacts. Furthermore, dimensional aspects significantly impact how we evaluate the sustainability performance of alternative regeneration solutions. Accordingly, the NEB Self-Assessment Method integrates three spatial scales – building, neighbourhood, and urban – to accommodate diverse project sizes. Despite its importance, the spatial dimensions of urban regeneration remains underexplored in literature, and even the NEB Self-Assessment Handbook lacks detailed distinctions within its proposed spatial scales, particularly concerning existing transformation areas. To address this gap, we explore the spatial dimensions of urban regeneration by analysing the physical size and scale of provisional regeneration areas within the Italian Lombardy Region, asking: "What is the spatial extent of current regeneration initiatives?" and "Are there recurring sizes and scales?". We examine Urban and Territorial Regeneration Areas, and Urban Transformation Areas primarily occurring on built land, quantifying regional and sub-regional planning efforts by their spatial dimensions. Our main findings identify six dimensional classes for clustering regeneration areas in Lombardy. These classes, supported by a developed abacus of indicators, also serve as a sustainability assessment framework. While tailored to Lombardy, this methodology offers significant value for cities globally, enabling them to navigate the complex challenge of multi-scalar project assessment.

243 - Bridging NEB principles and medium density housing in Melbourne

Ani Landau-ward (1)

(1) Rmit, Sustainabilty And Urban Planning, St Kilda East, Australia

Keywords: Six-Pack Apartments, Low Rise Density, Retrofit; Sustainability, Affordable Housing

Abstract 20th century Australia experienced unprecedented migration and urban growth. Much of this occurred in suburban sprawl and single-family dwellings – however alongside this were a number of notable experiments in density – particularly in the inner city. This housing stock includes a range of European and Bauhaus inspired apartment typologies– including a great diversity of urban forms and layouts – often family oriented, and context responsive low rise. Colloquially these became known as 'six-packs'. Predominant in immigrant areas established by Mediterranean migrants, and reminiscent of southern European volumetrics they typically consist of 4-8 apartments, across 3 stories, brick or concrete construction. A mixture of rental and owner tenures with a strata arrangement and body corporate management. Internal proportions are at times generous – a typology often with 3-bedrooms, and higher ceilings than new developments, often located on generous blocks. The stock is culturally iconic, important in the affordability mix, and in significant decline, at times maligned or in disre-

pair. Often located in inner city suburbs that have experienced significant growth and development in recent years, amidst rapid financialisaton and price inflation. As such 'six-packs' have become a key form of affordable dwelling – but are under significant development pressure in the context of land scarcity, and urban development pressures. They are also under significant pressure due to block size in the context of pressures to move to denser cities, and walkable neighbourhoods. Many of these pressures bought into reality by planning and urban development approaches inspired by success across the Mediterranean and Europe - such as in Barcelona's super blocks - yet fostering forms of density that perhaps do not inspire the kinds of socially oriented layouts, and context responsive volumetrics that the six-pack epitomises, and that reflects its conceptual origins in the European city. There is much to be learned from the quiet successes of the 'six-pack'. There are significant questions about the social, and environmental implications of replacing them with higher density and potentially poorer quality design and layout. We know little about opportunities to retrofit, preserve, or develop further these iconic and disappearing typologies in Melbourne. We value them little as they fall through the cracks of our heritage controls. This paper outlines the results of an initial exploration (through narrative, literature, policy, and photographic modes of analysis), the lessons that might be drawn from: a) the experiences of redevelopment of older low rise apartments in a series of Mediterranean contexts where the original Bauhaus was influential, as well as b) the extent to which the frameworks of the New European Bauhaus framework might be made relevant to an antipodean policy approach.

256 - Assessing Environmental Implications from Constructions beyond Energy

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Keywords: Construction Waste, Demolition Waste, Water, Air Quality

Abstract Key discussion points:

- Minimizing waste from constructions
- Water as a valuable resource
- Air quality importance in outdoor and indoor environment

SPECIAL SESSION

BEYOND THE PAVEMENT: A DATA DRIVEN BLUEPRINT FOR CLIMATE-RESILIENT CITIES WITH NATURE-BASED SOLUTIONS

Chairs: Israa Mahmoud (Politecnico di Milano - Department of Architecture and Urban Studies), **Nicola Colaninno** (Politecnico di Milano), **Rocco Pace** (Eurac Research - Institute for Renewable Energy)

Cities and regions worldwide face escalating climate pressures, ranging from worsening heat waves to record rainfall events. Rapidly evolving climate stresses require frontier research and new insights into how cities could transform vulnerability into opportunity. This special session explored how nature-based solutions (NbS), innovative urban design, and spatial analysis could foster resilient and equitable futures for urban planning and policy.

By highlighting interdisciplinary research at the intersection of environment, design, data science, and policy, the session helped chart potential transformative pathways for urban regeneration. Transformative change was framed as systemic shifts in urban design and governance aimed at creating more adaptive and inclusive cities. NbS, such as green roofs and urban wetlands, were presented as scalable approaches to improving microclimates and reducing urban heat island effects; however, their integration into the built environment faced challenges, including regulatory barriers and limited resources.

The session emphasized the role of data science in advancing these solutions through advanced geospatial analysis, machine learning, and climate modelling, enabling cities to mitigate climate impacts while improving decision-making and resource allocation. Ultimately, the session highlighted the social and equity dimensions of NbS, focusing on how these approaches could provide underserved communities with access to green spaces, improved air quality, and increased resilience to climate stresses.

ORAL PRESENTATIONS

056 - Photosynthetic Systems in Architecture (PhoSA): a design|build|research approach

Axel Timpe (1) - Harald Lesan (2) - Anna Matuszynska (3) - Tim Nies (3) - Yuxia Luo (1) - Lailly Vaz De Miranda (1)

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Keywords: Green Walls, Monitoring, Interdisciplinary Teaching, NBS Benefits, Microclimate Sensors

Abstract Green facades are a nature-based solution gaining importance for reducing the urban heat island effect under the conditions of climate change. They are making their way from visionary designs into the architectural mainstream in practise as well as in architecture schools. Many designs however lack the understanding of vegetation as an ecosystem and would neither stand the tests of feasibility and longevity, nor would the authoring students or practitioners be able to quantify the actual effects of the greening. Integration in a human ecosystem of users and caretakers for such green element is often missing as well.
To enable future practitioners from architecture, biology and engineering to integrate green wall systems into their designs and projects, institutes from different faculties at RWTH Aachen University have created a series of teaching modules that rely on a design|build|research approach with RWTH campus as a living lab.

— design: 14 students developed 7 designs for a modular Green Kit to be applied at university buildings. A winning proposal was selected by an expert jury and a student jury.
— build: the group then over one summer semester developed the proposal towards a prototype that has been implemented with the special challenge of becoming part of a listed building constructed in 1977. Specialised development teams have been formed for different tasks like the structural design and building integration, the vegetation composition, the production of the textile planters, the water and nutrient supply and the creation of a guideline for replication.
— research: in the following summer, a student group has monitored the prototype concerning its contribution to heat island and noise reduction. After a reflection on ecosystem services provided by a green façade the Green Kit Observer has been designed to measure different parameters among them heat radiation through infrared cameras, air temperature and noise reflection and comparing them to the data of an adjacent non-greened wall.

While the first iteration had been carried out in consecutive teaching modules, the approach has now been integrated into a new teaching module for architecture and biology students. The interdisciplinary groups have the task to optimise and locally adapt the prototype, to implement it on a new site, to monitor it and to analyse the harvested data. The initial focus on the benefit of greening has been extended to the sensor-based monitoring of the system for automated maintenance.
The presentation will detail the experience made with the interdisciplinary and integrative teaching approach. It will reflect on the quality and analysis of research data on the benefits of green wall systems collected in cooperation with students and the impact small greening systems can have.

070 - OPEN SPACE CLIMATE Towards a Holistic Climate-Impact Classification of Urban Open Spaces

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Keywords: GIS, Classification, Climate Performance, Holistic Accounting, Urban Open Space, Climate Adaptation

Abstract Urban Open Spaces significantly influence the urban climate. Depending on their morphology, they can contribute to cooling or exacerbate heat stress, thereby affecting thermal comfort, public health, and overall urban liveability. While the role of singular specific types of Open Spaces for urban climate is widely studied, there remains a lack of holistic approaches that address the full spectrum of Open Spaces types and their interlinkages to the urban system.
To deepen our understanding of the complex interactions between urban climate and Open Spaces, we are developing a Holistic Accounting Matrix to assess the climate impact of urban Open Space. This matrix evaluates 11 climate impact indicators structured in three steps (Form, Climate, Connectivness) and applies them to all Open Spaces within the case study area of Salzgitter, Germany.
Firstly, the indicators are used to define the Climate Sphere of each Open Space, revealing its role and connectivity within the urban morphology. Based on this analysis, we calculate a Climate Performance Index that allows for clustering Open Space according to their climate function. This results in a new climate impact based classification system for urban Open Space that reflects their specific contributions to the urban climate.

This research is part of the Urban Climate Future Lab (UCFL), a multidisciplinary project investigating the nexus of urban development and climate change in Lower Saxony and beyond. UCFL holistically assesses climate impacts and risks within the urban system of Lower Saxony and works with stakeholders to co-develop holistic implementation paths for the sustainable transformation and increased resilience of the Lower Saxony urban system.
The Holistic Accounting Matrix is designed as a practical tool for landscape architects and urban designers, aiming to strengthen the knowledge for the climate friendly transformation of urban Open Space. By providing systematic and comparable insights into the Climate Performance of different Open Space types, it supports evidence-based decision-making in design and planning processes, and enables a climate impact classification for the whole spectrum of urban Open Space.

112 - Urban Design as a platform to promote biodiversity, green infrastructure and equality in cities with nature-based solutions

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Keywords: Nature-Based Solutions, Data Analysis, EU Biodiversity Strategy 2030, Urban Design, Climate Change

Abstract In the light of several urban regeneration projects that use nature-based solutions (NBS) as a possible instrument for accelerating climate resilience pathways, this research investigates the link between urban design as a platform for NBS experimentation in cities. Several researchers have linked the role of nature-based solutions in supporting multi-scalable tools and policies with which cities advance their urban planning practice to comply with the Kunming Montreal Global Biodiversity framework (CBD, 2022). However, little attention is paid to how urban design contributes to enabling the delivery of social, and ecological co-benefits of nature-based solutions.
In this research, we develop a potential framework on understanding of how urban design can work as a platform for advancing the experimental stages of nature-based solutions in cities. Historically, the promotion of NBS came from urban ecology perspective to restore green and blue infrastructure, hence addressing environmental hurdles. lately, a more integrated approach for including socio-ecological aspects in the policy alignment of NBS would be likely increasing the strategy relevance and lever of urban adaptation and mitigation (Diep & McPhearson, 2025).
Our notion to focus on NBS from an urban design approach is to be developed conceptually by building on a synthesis of case studies with empirical data collected from cities that have progressively advanced urban nature plans in the last 3-5 years and in which urban design elements were pivotal in making nature-based solutions co-beneficial for biodiversity, (nature itself) and people. We will also provide early reflections on the innovative methods or tools that cities employed or have used to advance their renaturing policies and conclude with which new research questions emerge when elucidating the role of urban design for 'making' nature-based solutions more inclusive in place.
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142 - Mainstreaming Nature-based Solutions in adaptation plans: designing and applying an evaluation framework

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Keywords: Nature-based Solutions, Sustainable Energy and Climate Action Plan (SECAP), Effective Mainstreaming

Abstract Meeting global sustainability goals requires shifts in the ways societies respond and adapt to climate change. Nature-based Solutions (NbS) are increasingly recognized as a key driver of such transformation, offering integrated benefits for climate resilience, biodiversity, and social well-being. Despite growing recognition, the integration - or main-

streaming - of NbS into local adaptation planning remains uneven and often not sufficiently effective. The research provides a comprehensive evaluation framework for assessing the degree of NbS mainstreaming in adaptation plans. It is based on 4 dimensions: social challenges, inclusion and equity; governance and participation; economic management; capacity building and implementation infrastructure.
The framework enables systematic assessment, allowing to identify common strengths, recurring gaps, and enabling conditions for better performing comprehensive adaptation plans, moving forwards long-term urban resilience and recognizing cities as complex socio-ecological systems where human and natural components are deeply interdependent.
The methodology developed focuses on the above-mentioned dimensions corresponding to a set of indicators that are combined together to compose a representative synthetic index. This reflects the overall performance of each adaptation plan in terms of effectively integrating NbS.
The proposed evaluation framework is then applied to all available Sustainable Energy and Climate Action Plans (SECAPs) from Italian medium-sized cities, chosen for their representativeness within the European urban landscape. Based on these findings, the study highlights best practices and offers targeted key recommendations to guide the development of future local adaptation plans.
The results contribute to a more effective integration of NbS into adaptation processes, paving the way for the pursuit of greater climate resilience in cities.

176 - Beyond the Heat: Revealing Socio-Spatial Inequities Patterns in Milan during Heatwaves

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Keywords: Urban Heat Stress, Socio-environmental Inequity, Cooling Poverty, Urban Health, Climate Adaptation

Abstract As climate extremes intensify-particularly heatwaves, the spatial distribution of human vulnerability in urban environments becomes increasingly critical. The study starts from the hypothesis that heat stress does not affect the city equally. The condition in which individuals or communities lack adequate access to affordable and effective cooling solutions to protect their health and well-being during extreme heat was recently identified as cooling poverty. In this context, we investigate the role of urban form (primarily building density and presence of greenery) and socio-demographic variables in shaping differentiated exposure to heat-related health risks across neighbourhoods.
Specifically, this study uncovers socio-environmental inequities linked to heat-related health risks in Milan, Italy. Emergency calls for cardiovascular and respiratory diseases recorded during summer periods, were analysed in relation to urban morphological indicators, and socio-demographic variables. The meso-scale mapping is based on a hexagonal grid to take into account and emphasise the level of communities.
The analysis reveals a correlation between call volumes and both population density and built density. However, significant outliers indicate that vulnerability cannot be explained by density alone. In particular, reporting values on quadrant plots comparing call density to population and urban density, expose distinct risk patterns, underscoring the need for tailored interventions. The results suggest that emergency service planning, social outreach, and urban retrofit strategies should move beyond temperature or density metrics to include indicators of social vulnerability.
This study highlights the value of meso-scale spatial analysis at the scale of neighbourhoods in uncovering 'invisible' urban heat inequities and supports data-informed decision-making in urban planning and public health. These findings can guide both short and long term action for the planning, design and management of heat-resilient cities. To achieve equitable urban adaptation, public authorities must address the multiple dimensions of human fragility, including urban morphology and green infrastructure, in addition to welfare provision and access to services.

198 - Governance Pathways for Implementing Nature-based Solutions: from the Legal Framework to the Participatory Approach of the Italian NATALIE Case Study

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Keywords: Nature-based Solutions, Governance, Thematic Analysis, Legal Framework, Participation

Abstract In the Veneto region (Italy), rising temperatures and increasingly frequent extreme precipitation events—potentially up to +120% under high-emission scenarios—intensify the vulnerability of agricultural landscapes (ARPAV, 2023). Agriculture occupies around 60% of regional land (Regione del Veneto, 2021) and contributes to over 15% of pressures on the Venice Lagoon's water bodies. Traditional consortia have long been responsible for the safeguarding and managing the water in extensive canal systems (L.R. 12/2009), but between 2021–2023, their maintenance required ~95.5 kT/year of raw materials (CBAR, 2024), demonstrating incompatibility under climate urgency.
Nature-based Solutions (NbS) offer viable alternatives. Within the Horizon Europe NATALIE project, pilot interventions in the Venice Lagoon basin are testing selective maintenance of riparian vegetation riverbank extension and vegetation-based restoration, aiming to reduce material impact and enhance ecosystem services. Ambition to scale such solutions, besides proving the economic benefit, requires navigating a multi-level governance system to ensure long-term viability. This study investigates the feasibility of NbS in CBAR-managed canals, focusing on the legal framework from the specific context of water management (eg. Piano di Tutela delle Acque e Piano Gestione Acque) and participatory insights from two Transformation Labs (TLs).
The legal framework recognizes climate challenges and pressures on water bodies, supported by socio-environmental data. It aligns with broader goals like the EU Habitat Directive, relevant for NbS targeting ecological restoration. TLs complemented unaddressed climate impacts—such as seasonal unpredictability and reduced planting windows. Although it identifies key stakeholders for water safeguarding, it overlooks the socio-political challenges crucial for NbS uptake—such as fragmentation of responsibilities, limited stakeholder engagement, and public resistance that were collected as inputs from the TLs. The legal measures lack direct mention of NbS, referring only to related terms (e.g., renaturalization, retention basins), that would be pertinent to align regulations with EU strategies and help mainstream its adoption. The participatory activities also identified and co-designed insightful context-specific solutions including multifunctional green spaces, accessible monitoring tools, and the strategic visibility of pilot projects.
Incorporating top-down regulatory instruments with participatory governance illustrates the potential of governance models to foster more inclusive, efficient and resilient NbS implementation and ensure long-term viability from the constructed stakeholder awareness and cooperability. It offers a pathway towards scalable implementation of NbS in the CBAR-managed canals, addressing the climate urgency.

SPECIAL SESSION

REGENERATING MOUNTAIN VILLAGES: NATURE AND CULTURE, HERITAGE AND LANDSCAPE

Chair: Li Fan (UN-Habitat)

The UNESCO approach to the Historic Urban Landscape provides a conceptual framework to understand and preserve cultural heritage, particularly applicable to rural villages in mountainous regions. In these areas, a single technical term cannot fully capture the complexity of the landscape. As a form of cultural heritage within a mountainous context, mountain villages are deeply rooted in the integration of cultural and natural landscapes, an integration that is often more visible than in metropolitan heritage contexts.

As a result, the regeneration of mountain villages present distinct challenges, including the management of water and forest systems, the development of vertical transportation networks, economic revitalization, and the preservation of local intangible heritage. Addressing these challenges requires interdisciplinary research aimed at developing strategies to support rural mountain areas in adapting to contemporary life.

This special session envisioned and discussed cases of rural regeneration across different geographical contexts, including the mountain village of Songyang in the hinterland of Shanghai, China; Nyamira in the hinterland of Nairobi, Kenya; and a mountain village in the Alps. Songyang and Nyamira were partner counties engaged in the development of value-added tea plantations, which represented an integral component of both the cultural and natural landscapes.

The session explored how cultural and natural landscapes were conserved, adapted, and transformed in different parts of the world while maintaining heritage values, local traditions, and the well-being of local communities.

ORAL PRESENTATIONS

053 - Regenerating Mountain Villages through Hydropower Infrastructure. A Case Study from Central Italy

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Keywords: Hydropower Infrastructure, Regeneration, Design-driven approach

Abstract This contribution is part of an ongoing PhD research in Architecture, Urban and Interior Design, focusing on the regeneration of the built heritage in mountain villages of Mediterranean Europe. Specifically, it investigates hydropower heritage as a system of interconnected artifacts that have transformed the mountain from a natural to a cultural landscape, as argued by Michael Jakob (2021).
In contemporary times, hydropower heritage has gained renewed relevance for several reasons. Firstly, it is widely diffused across mountain territories, as a result of the intense exploitation of water streams and rivers between the late 19th and early 20th centuries. Secondly, numerous studies underline its strategic role in the global energy transition, positioning mountain areas as privileged laboratories for experimenting with new development models (Quaranta et al. 2023; Perpiña Castillo et al. 2024). Moreover, these areas often suffer from socio-economic fragility (Carrosio and Faccini 2018), making reflections on their future development increasingly urgent.
Within this framework, the research explores territorial regeneration strategies by reactivating the relationships between space, energy, and natural resources. The Roveto Valley, an Apennine area in the Abruzzo region, Italy, serves as the main case study. Since 2015, the "Liri River and Landscape Contract" has promoted the reactivation of the river corridor and its hydropower infrastructure as a starting point for broader territorial regeneration.
The analysis is conducted across three scales — territory, village, and object — in order to recognise the material consistency and networked value of hydropower infrastructure. Building on this cross-scalar reading, the paper presents a blueprint for the enhancement of the Torlonia hydropower plant, located in the municipality of Canistro. The proposal envisions the building as a catalyst for new cultural, social, and economic practices beyond energy production, reactivating latent dynamics already present in the area.
The ultimate goal is to define a design prototype for similar contexts, emphasising the relevance of the relationship between energy, space, and natural resources in the regeneration of small mountain villages.

097 - Rural revitalisation in Songyang

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Keywords: Rural Revitalisation, China, Policy, Mountain

Abstract Rural revitalisation in China has traditionally involved the demolition of old housing, construction of new developments, and the relocation of original residents. Since the beginning of Xi Jinping's leadership in 2012, however, national policy has shifted toward a pro-conservation model of urban and rural regeneration. Central to this transformation is the Excellent Traditional Culture policy (2013), which promotes balanced development across urban-rural divides and regional disparities. This policy reframes rural areas not as impoverished backwaters, but as valuable cultural and ecological landscapes. Initiatives such as the Beautiful Countryside programme reflect this reorientation by emphasising infrastructure improvement, environmental quality, and the aesthetic and cultural preservation of rural settlements.
Zhejiang Province exemplifies this policy shift through its early implementation of the Project for Thousands of Villages (2003), which placed cultural heritage at the core of rural development. In Songyang County, a targeted village conservation programme aligns with this agenda, integrating rural heritage into the broader revitalisation strategy. This paper applies UNESCO's Historic Urban Landscape (HUL) approach—which considers built heritage, natural environment, local communities, and intangible culture—to analyse the revitalisation of mountain villages in Songyang. The study argues that the HUL framework offers a robust methodology for understanding rural conservation practices in contemporary China, particularly in mountainous regions where the natural environment is inseparable from settlement identity.

169 - Landscape as Governance: South Tyrol's Holistic Management of UNESCO Heritage in Mountain Territories

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Keywords: UNESCO Heritage Governance, Integrated Spatial Planning, Adaptive Landscape Management, Landscape

Abstract In South Tyrol, unlike in many other Alpine regions, mountain villages are not places of decline but rather sites of dynamic transformation - shaped by shifting economic roles, evolving tourist and social patterns, and climate-related challenges. The key question is not regeneration, but rather how to govern change without compromising the deep interconnection between cultural and natural landscapes. With the adoption of Provincial Law 13/2023 on the "Coordinated management of UNESCO-recognised sites and elements in the province of Bolzano", the Autonomous Province of Bolzano–South Tyrol has formalised a comprehensive and anticipatory approach to UNESCO heritage governance. The law integrates the management of the Dolomites World Natural Heritage Site and intangible cultural practices such as the traditional "Waalwege" irrigation systems, alpinism and transhumance. It also establishes a framework to support future inscription processes, ensuring consistency and strategic alignment across sectors. More than a protection mechanism, the law provides the foundation for embedding UNESCO values into spatial planning, environmental policy and local development strategies.
This paper presents the law as a territorial application of the UNESCO Historic Urban Landscape (HUL) approach, adapted to the specific context of mountain regions. Drawing on case studies from the Upper Vinschgau and Dolomites, we explore how interdisciplinary coordination and integrated heritage management inform spatial decision-making processes. South Tyrol's experience offers a forward-looking governance model that treats heritage as an enabler of long-term landscape continuity and adaptive capacity, rather than a constraint. It demonstrates how mountain territories can transition from reactive preservation to strategic, heritage-informed planning, offering a broadly relevant contribution to rural regions worldwide.

259 - Forest bathing as a tool to revitalize mountain areas: an example in the Italian Alps

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Keywords: Forest Bathing, Forest Therapy, Nature-based Wellbeing, Local Development

Abstract In the last years, the concept of forest bathing–originated in the early 1980s in Japan–has spread worldwide as a practice to improve the human well-being. In literature, many studies have investigated the benefits of forest bathing as well as of other forest-based wellbeing activities from a physiological and psychological poinst of view, while the socio-economic dimension is still neglected by scientific literature. The present study - conducted in the context of "The role of forests for wellbeing improvement: advances from psycho- physiological analysis and technologies (FOR. WELL)" project - focused on the role of forest bathing in revitalizing mountain and marginal areas in Italy through two steps: (i) exploring the perspectives and points of view of different stakeholders towards the key characteristics of forest bathing activities (i.e. psycho-physical effects on human health, site and stand characteristics of forest bathing trails, and socio-economic impacts); (ii) estimating the economic impact at the territorial level in a case study in the Italian Alps (Parco del Respiro in Trentino-Alto Adige region).

260 - Heritage, Landscape and Social Cohesion Structures in Tadami Biosphere Reserve: the Tonari Gumi System

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Keywords: Community Resilience, Social Cohesion, Disaster Risk Reduction (DRR), Climate Change Adaptation

Abstract Tadami is a municipality in Japan's Fukushima Prefecture, consisting of 27 settlements in a mountainous valley. This study explores the cultural expressions of social cohesion identified in Tadami, and their contribution to community resilience to natural hazards, and in response to climate change and rural outmigration-related challenges.
Using anthropological methods, the research found that disaster management in Tadami relies on three interdependent approaches: self-help (jijyo), mutual help (kyoujo), and governmental aid (koujo), with

tonari gumi playing a key role in mutual support and disaster preparedness. The tonari gumi system is a neighborhood-based mutual assistance network, recognized by local residents as having a key role towards disaster risk reduction.
The study has however also revealed existing challenges posed by rural outmigration and aging population, threatening the continuity of the tonari gumi system. These changes impact social cohesion-based disaster preparedness, increasing vulnerabilities to natural hazards and climate change. Findings contribute to a deeper understanding of how social cohesion and cultural heritage influence disaster risk reduction strategies, offering valuable insights for policymakers and practitioners involved in community resilience and disaster management.

261 - Co-production of knowledge on water scarcity risks using Impact Chains: Insights for Regenerating Mountain Watersheds

Adem Esmail, Blal (1) - Albert, Christian (2) - Bertoldi, Giacomo (3) - Geneletti, Davide (4) - Romagnoli, Federica (1) - Teklemariam, Medhanie (5) - Tesfamariam, Solomon (6) - Yemane, Tecle (7) - Schneiderbauer, Stefan (1,8,9)

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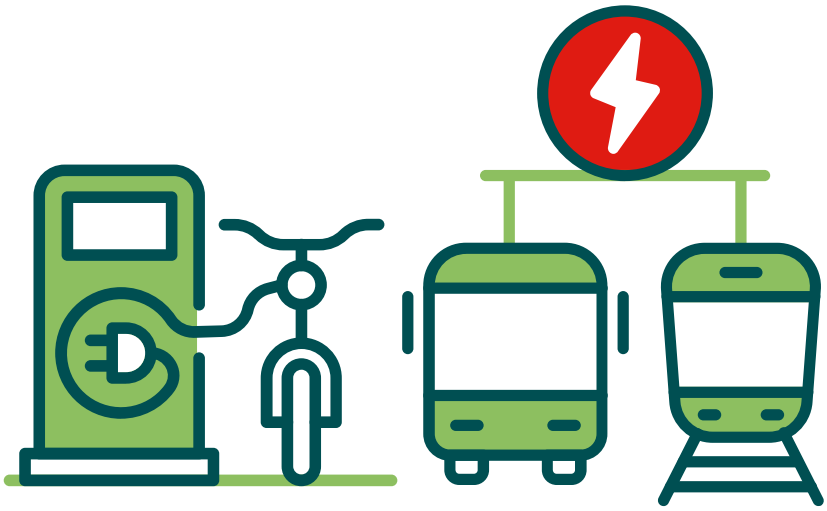
Keywords: Impact Chains, Urban water management, Climate resilience, Knowledge co- production, Watershed degradation, Infrastructure vulnerability, Mountain regions, Eritrea

Abstract Water scarcity is a growing challenge in mountain regions, where climatic variability, land degradation, and aging infrastructure interact with social and institutional vulnerabilities. The Greater Asmara Area in Eritrea exemplifies these issues, with its plateau topography and densely populated settlements facing watershed degradation and water insecurity. Addressing such risks is vital not only for urban resilience but also for the regeneration of mountain villages, where water management is deeply linked to the preservation of nature, culture, and heritage.
This study applied a two-component methodology: (1) co-producing an Impact Chain for urban water scarcity risk through desktop analysis and a multi-stakeholder workshop; and (2) evaluating the co-production process using criteria of scientific credibility, policy salience, and procedural legitimacy. The participatory approach enabled diverse knowledge holders— including local communities—to collaboratively map cascading impacts and vulnerabilities across watershed, infrastructure, and user levels, integrating context-specific insights related to micro-dams, informal water access, and gendered household burdens.
Results show that drought and extreme rainfall hazards trigger major impacts—reduced water availability, soil erosion, infrastructure stress, and local contamination—amplified by structural vulnerabilities such as degraded catchments and uneven access. These findings underscore the value of co-production and boundary work in developing locally grounded, systemic representations of water scarcity risks. By bridging scientific and local knowledge, the study supports more informed and actionable pathways for water security planning, contributing to the sustainable regeneration of mountain villages and the preservation of their natural and cultural landscapes.



TRACK 3

Mobility Systems: Backbones for Smart and Sustainable Cities and Regions

TRACK 3
Mobility Systems: Backbones for Smart and Sustainable Cities and Regions

Efficient, resilient, and sustainable mobility systems are fundamental to shaping smart and livable cities and regions, ensuring accessibility, efficiency, and environmental sustainability. Well-integrated public transport networks, active mobility, and digital innovations are reshaping urban and regional mobility, contributing to reduced congestion and lower emissions. Expanding the use of electric mobility, optimizing urban logistics, and enhancing multimodal transport infrastructures have been identified as key strategies for creating low-carbon and people-centered mobility systems.

This track explored the evolution of mobility systems as key drivers of smart and sustainable cities and regions. It focused on enhancing regional mobility through integrated transport networks, multimodal hubs, and smart infrastructure to improve connectivity across urban and rural areas. The track also emphasized the promotion of soft mobility, such as walking, cycling, and active transportation, to create healthier and more livable environments while reducing congestion and emissions. In addition, it examined the role of electric mobility in the decarbonization of transport, with a focus on charging infrastructure, vehicle integration, and the policy frameworks required to support sustainable adoption.

REGULAR SESSION

MOBILITY SYSTEMS: BACKBONES FOR SMART AND SUSTAINABLE CITIES AND REGIONS

Chairs: Fabio Giussani (Eurac Research - Institute for Renewable Energy), **Adelin Lazar** (Urbasofia)

Efficient and sustainable mobility systems are essential for creating smart and livable cities and regions that prioritize accessibility, environmental sustainability, and quality of life. This session examined how integrated public transport networks, active mobility, and digital innovations are transforming urban and regional transportation by reducing congestion and emissions.

Key focus areas included enhancing regional connectivity through multimodal hubs and smart infrastructure, promoting soft mobility such as walking and cycling to foster healthier environments, and advancing electric mobility through expanded charging infrastructure and supportive policy frameworks. By exploring these strategies, the session addressed how mobility systems could drive the transition toward low-carbon, people-centered urban development, strengthening connections between urban and rural areas while responding to future sustainability challenges.

ORAL PRESENTATIONS

065 - Assessing the Impact of Pilot Actions for Travel Behaviour Change and Street Redesign within the CityWalk 2.0 Project

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Keywords: Sustainable Urban Mobility, Travel Behaviour Change, Pilot Actions Assessment, Street Redesign

Abstract As societies undergo concurrent green and digital transitions, urban mobility emerges as a key domain for systemic transformation (Schipper et al., 2020). This shift extends beyond transport mode choices to influence individual behaviour and guide urban planning and policy development (Van Acker et al., 2016), including in peri-urban and regional contexts, where connectivity gaps remain a critical challenge. The accelerating growth of urban populations reinforces the urgency of promoting sustainable urban mobility, given the negative externalities associated with car-dependent systems, including environmental degradation, public health challenges, and the depletion of accessible, high-quality public spaces (Schipper, 2002).
In this context, the CityWalk 2.0 project, funded by Interreg Danube Programme, seeks to advance the energy transition in urban transport. The project aims to significantly reduce the energy consumption of urban mobility systems while improving the overall liveability of cities (Anciaes and Jones, 2020). Pilot cities within the project are tasked with implementing interventions focused on modifying travel behaviour and reconfiguring public spaces to support and sustain these changes.
To systematically evaluate these interventions, an assessment methodology has been developed. The framework is designed to enable cities to measure the impacts of mobility-related actions targeting citizen's travel behaviour, perceptions of public spaces, and overall orientation towards sustainable mobility. The methodology also identifies key implementation challenges and proposes adaptive strategies for future replication and scalability. The evaluation framework is structured around two core areas of interventions: (1) street redesign initiatives aimed at fostering safer, more inclusive, and accessible public spaces; and (2) behavioural change initiatives intended to reduce private car use and promote active or shared modes of mobility.
This paper presents the methodological framework and associated tools designed for the assessment process, detailing their applicability across various stakeholder groups. Preliminary insights derived from pilot city evaluations are discussed to show the dynamics of local mobility transformation triggered by the small-scale experimental interventions, responding to context-specific challenges, including reduced emissions, increased active mode share, or improved connectivity. The findings offer transferable lessons and methodological guidance to other small and medium-sized cities interested in promoting sustainable and active mobility strategies. By grounding future mobility planning in empirical evidence, the assessment will play an essential role in supporting more targeted, effective, and inclusive urban mobility transitions.

083 - Small Vehicles, Big Potential: Assessing the Potential of Light Electric Vehicles to Replace Car Trips in Germany and Switzerland

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Keywords: Light Electric Vehicles, Microcars, car reduction, Transformation

Abstract Urban mobility systems are under increasing pressure. Growing traffic volumes contribute not only to greenhouse gas emissions but also to congestion, noise, air pollution, and a massive demand for space—both in motion and at rest. These problems exacerbate land use conflicts, and quality-of-life concerns in urban areas. Addressing them requires more than just technological innovation: it calls for changes in mobility behavior and vehicle concepts. A key challenge is how to reduce these negative impacts without giving up the benefits of individual mobility, which remain essential for many people. Light Electric Vehicles (LEVs) offer a promising answer. They enable flexible, personal transport while significantly lowering environmental and spatial burdens. LEVs are energy-efficient, lightweight, and require less battery capacity and infrastructure than conventional cars, thereby reducing emissions, resource consumption, and occupation of space. This study estimates the theoretical potential of LEVs to substitute car trips in two countries: Germany and Switzerland. The German analysis is based on the national travel survey "Mobilität in Deutschland" (MiD 2017) with about 960,000 trips; the Swiss case uses data from the "Mikrozensus Mobilität und Verkehr" (MZMV 2021) with more than 200,000 recorded trips. Considered LEV types include e-scooters, pedelecs,

cargo bikes, and lightweight three- and four-wheeled electric vehicles. The findings reveal that in Germany, up to 76% of car trips and 50% of car kilometers could theoretically be replaced by LEVs. For Switzerland, the potential is even slightly higher: 82% of car trips and 57% of kilometers could be covered by LEVs. The substitution potential is particularly pronounced for short urban trips and varies by trip purpose and age group. The study compares both national cases and discusses enabling conditions for realizing this potential, such as infrastructure improvements, regulatory frameworks, and behavioral incentives. It also highlights the limitations of a purely technical substitution model and points to further research needs on real-world acceptance and system integration.

107 - Governing the V2G Transition: participatory insights for smart and sustainable urban mobility

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Keywords: Citizens' Perceptions, Electric Vehicle, Mobility Transition, Participatory Methods, Vehicle-To-Grid

Abstract Urban mobility systems are central to achieving climate neutrality and energy resilience. Electric vehicles (EVs) and Vehicle-to-Grid (V2G) technology represent key enablers of this transition, allowing cities to reduce greenhouse gas emissions while supporting flexible energy management. However, large-scale adoption depends on societal acceptance and governance frameworks that ensure inclusivity.
This study explores citizens' perceptions, needs, and expectations regarding EVs and V2G in Aradas, a peri-urban district in Aveiro, Portugal. A participatory mixed-methods approach was employed: (i) a questionnaire (n=32) assessing mobility habits and familiarity with EVs/V2G; (ii) three focus groups (n=34) to capture concerns and social acceptability; and (iii) scenario-based discussions exploring three alternative mobility futures, from continued fossil fuel dependency to full integration of smart energy systems.
Findings reveal a strong reliance on private vehicles (97%) and internal combustion engines (94%), despite short daily travel distances (<5 km). Awareness of V2G is minimal (76% had never heard of it), yet attitudes became positive after deliberation, with perceived benefits in energy efficiency and cost savings. Participants identified current conditions as a mix of "fossil fuel dependency" and "early electrification" (Scenarios 1 and 2), and anticipated a future combining transition challenges with elements of an intelligent energy system (Scenarios 2 and 3). Key concerns include battery degradation, infrastructure gaps, and regulatory uncertainty, but willingness to adopt V2G was expressed under clear technical, financial, and legal guarantees.
The results underscore the need for adaptive governance and phased planning, supported by locally tailored engagement strategies that combine technological innovation with social readiness. Inclusive adoption of V2G requires policy frameworks that build trust, anticipate socio-territorial inequalities, and align infrastructure planning with citizens' expectations, turning smart mobility into a lever for just and sustainable energy transitions.

163 - The Role of Digital Technologies in EU R&I for Smart Regional Transport

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Keywords: Smart Mobility, Digital Technologies, Regional Transport, EU R&I Projects , Artificial Intelligence,

Abstract Digital technologies are playing an increasingly central role in shaping the future of regional mobility systems. As cities and regions strive to become more connected, sustainable, and resilient, the integration of digital innovation into transport planning and operations is becoming essential. This paper explores how transversal digital technologies are being leveraged in EU-funded research and innovation (R&I) projects to support the development of smart regional transport systems.
Drawing on insights from the Transport Research and Innovation Monitoring and Information System (TRIMIS) and CORDIS databases, the paper highlights how technologies such as Artificial Intelligence, Internet of Things, Blockchain, Digital Twins, and Edge/Cloud Computing are contributing to the digital transformation of mobility. These technologies offer new opportunities to enhance multimodal integration, improve infrastructure efficiency, and enable more responsive and inclusive transport services across urban and rural areas.
The analysis focuses on selected EU R&I projects that demonstrate the relevance of digital innovation for regional transport, and discusses key challenges

and enablers for implementation. It is grounded in a structured and replicable methodology combining keyword-based searches, relevance filtering, and both manual and automated project evaluations. Projects were selected using criteria such as budget thresholds, start dates, and the centrality of digital technologies to the project objectives. A tiered classification system was applied to assess the role of digital technologies within the projects, distinguishing between central, important, and supplementary roles, ensuring a focused review of the most impactful and representative initiatives. This approach enabled a comprehensive yet targeted exploration of EU-funded innovation trends in the transport sector. The paper concludes with policy recommendations to support the effective deployment of digital solutions in regional mobility systems, contributing to the broader goals of the European Green Deal and the Sustainable and Smart Mobility Strategy.

200 - ImAFUSA Framework – An Innovative Air Mobility (IAM) Impact and Capacity Assessment Framework and Toolset

Margarida Santos (1) - Sofia Kalakou (1) - Fernando Ferreira (1) - Sotirios Xydis (2) - Anna Palaiologk (3) - Raffaello Mariani (4) - Antonio Torija Martinez (5) - Irene Dedoussi (6) - Panagiotis Eleftherakis (2) - George Anagnostopoulos (2)

(1) Bru-iscte, Lisbon, Portugal - (2) Iccs, Athens, Greece - (3) Future Needs, Nicosia, Cyprus - (4) Kth, Stockholm, Sweden - (5) Usal, Salford, United Kingdom - (6) Tu Delft, Delft, Netherlands

Keywords: ImAFUSA Framework, Innovative Air Mobility (IAM), Social Acceptance, Urban Mobility

Abstract The populational growth and consequent expansion of urbanization represent an increased pressure on urban transportation systems. Therefore, current mobility systems face several constraints arising from these phenomena, such as traffic congestion, environmental pressures and, overall, an intensified demand for mobility. In this context, Innovative Air Mobility (IAM) has the potential to offer solutions to cope with these challenges, being a feasible and environmentally friendly option to complement the existing transportation modes in urban areas. Notwithstanding, social acceptance is a key aspect to take into consideration since public trust and support (or their absence) will transversally impact the integration of these services into urban mobility. Moreover, while IAM technologies and technical aspects have been regularly addressed, the societal aspects, which are going to ensure the viability of the ecosystem, are still lacking to be properly developed. In addition, coordinating IAM services with existing mobility planning activities is vital for their successful employment. To this end, it is required to implement planning frameworks and tools to manage air and ground activities. Nevertheless, current frameworks have proven to be insufficient to address these aspects broadly and in-depth, which raises the necessity for the conception of an integrated framework that adds new dimensions and offers more comprehensive insights concerning these novel types of services. In this context, the ImAFUSA Framework was developed. This is an IAM impact and capacity assessment framework and toolset for enhanced trade-off between airspace capacity levels of IAM and social acceptance, which will support local authorities and other IAM stakeholders with smart and sustainable planning, and decision-making processes to guarantee beneficial and socially acceptable IAM deployment. More specifically, the framework focuses on the socio-economic, environmental, perceived safety, security and spatial impacts of IAM, simplifies the identification of IAM services that are socially acceptable and facilitates the determination of the airspace capacity for IAM operations, both inside and outside U-space. In turn, the toolset can support the development of socially acceptable applications in U-space (air and ground integration), providing eight validated tools that quantify visual pollution, noise, perceived safety, citizen acceptance, affordability, welfare, accessibility and trade-off between U-space capacity and impacts through simulations, and two tools that quantify citizens' willingness to pay, air quality impacts, and impact trade-off with simulations. Overall, this toolset aids local authorities and other policymakers to assess the impacts of IAM before its implementation inside or outside U-space and to monitor these impacts.

222 - Sustainable Active Transportation Infrastructure for Urban Heat Adaptation and Mitigation: A Systematic Literature Review

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Keywords: Urban Heat Island (UHI), Active Transportation Infrastructure, Urban Climate Adaptation, Thermal Com

Abstract Cities around the world are increasingly confronting the challenges posed by rising temperatures and the intensification of Urban Heat Islands (UHIs), which threaten public health, reduce outdoor comfort, and diminish the overall livability of urban environments. As global temperatures rise and heatwaves become more frequent, there is an urgent need for integrated urban strategies that can simultaneously address climate adaptation and support sustainable mobility. Active transportation infrastructure, comprising walkable and bikeable street networks, shaded pedestrian corridors, greenways, and interconnected public spaces, has gained prominence in recent years; however, its interface with heat resilience, mitigation, and adaptation has not been studied sufficiently.
This systematic literature review (SLR) explores the intersection of sustainable active transportation and urban heat resilience by analyzing a curated set of 180 peer-reviewed journal articles. The review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Through a combination of bibliometric analysis and detailed thematic content analysis, the study examines how active transport infrastructure can serve both as an adaptation mechanism and a mitigation strategy in response to urban heat. The review identifies critical characteristics and design elements of infrastructure that contribute to cooling effects, and integrated microclimate-sensitive urban design. In addition, the review delves into analysing enablers and barriers that influence the implementation and success of such interventions. A diverse set of case studies and pilot projects, ranging from large-scale green corridor planning to small-scale neighborhood interventions, are reviewed to extract lessons on successful implementation, public acceptance, and policy integration. Furthermore, it examines the co-benefits of such infrastructure, which include improved thermal comfort, increased physical activity, social cohesion, and equitable access to public space. Trade-offs are also discussed, such as land use constraints, upfront costs, and potential gentrification effects.
The findings of this review underscore the potential for sustainable active transportation infrastructure to act as a nexus between urban climate adaptation and sustainable mobility planning. By integrating environmental, social, and technical dimensions, this research provides a comprehensive synthesis of the state of knowledge and highlights practical pathways for embedding heat-resilient active mobility systems into urban planning frameworks. The insights generated are intended to support urban planners, policymakers, and researchers seeking to design inclusive, climate-responsive cities that prioritize both human well-being and ecological resilience.

244 - Transport in Mountainous Areas: A Digital Twin Methodology for Public and Private Mobility

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Keywords: Smart Mobility, Urban Digitalization, Transport Electrification, Digital Twin

Abstract The transition towards sustainable mobility in alpine regions presents unique challenges, requiring advanced tools capable of capturing complex transport dynamics while supporting evidence-based policymaking. This research introduces a proof-of-concept methodology for developing a digital twin framework addressing daily mobility flows in a mountain valley of South Tyrol, with the objective of identifying electrification opportunities for both public and private transport.
The proposed approach combines Activity-Based Modelling (ABM) for behavioural analysis, transport infrastructure analysis, and energy demand profiling through continuous validation processes integrating real-time data from traffic sensors and monitoring stations in the valley. Through SUMO and SAGA frameworks, the methodology uses ABM to simulate mobility chains involving different vehicle types and travel purposes, incorporating both local commuting patterns and seasonal tourist flows while validating against empirical data.
Origin-destination matrices and traffic count data are integrated with ABM outputs to model internal and external connections across the territory, enabling evaluation of multimodal transport dynamics and identification of current service gaps. The continuous validation methodology requires multiple cycles over several years to evolve from this proof-of-concept toward a fully operational digital twin.
Policy integration focuses on testing scenarios through ABM simulations, such as modifications to public transport schedules within the valley's mobility context and evaluating optimised expansion strategies including zero-emission vehicle fleet transitions. Charging infrastructure deployment scenarios are developed based on activity-based behavioural patterns and energy consumption profiles.
Key findings include identification of optimal charging station locations, quantification of potential emission reductions, and mitigation of traffic congestion during high-tourism periods. The methodol-

ogy employs a formalisation approach for knowledge transfer, enabling replication to other alpine or rural contexts. This transferable framework offers a replicable proof-of-concept model for regions seeking integrated mobility systems aligned with smart region objectives.

POSTER PRESENTATION

096 - A Backcasting Approach to Sustainable Urban Mobility: Empowering Shared Mobility for Systemic Change

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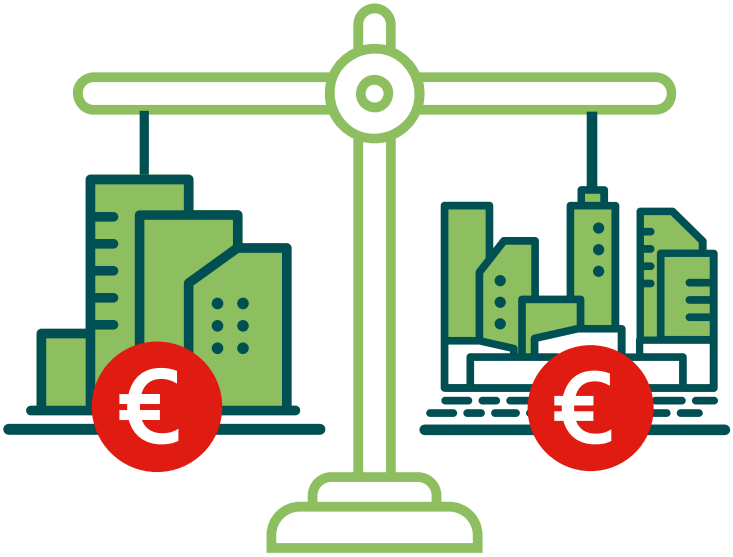
Keywords: Sustainability Transitions, Niche Innovation, Urban Mobility, Shared Mobility, Niche Empowerment

Abstract There is an urgent need for a sustainability transition in the current mobility system because of the various problems it causes, such as climate change, congestion, and pollution. One of the possible solutions that can help reduce the negative externalities of urban mobility is shared mobility, which can help reduce kilometers traveled, vehicle emissions, and ownership. Shared mobility includes shared micromobility, car-sharing, and ride-sourcing. In this paper, the focus is on two different shared mobility services present in Tallinn: car-sharing and shared micromobility.
This work combines the multi-level perspective (MLP), which explains how systemic change happens, with the sociotechnical imaginaries (STI) framework, which helps to explore desirable and feasible futures. As transitions are multi-actor processes with different perspectives about their desirable pathways, this study looks for a collective vision among various actors related to shared mobility services in Tallinn.
Tallinn was chosen as a case to study because there is a need for a sustainability transition in its mobility system, and there are at least nine shared mobility services present in the city. This makes Tallinn an important and interesting case to study from the perspective of niche innovation acceleration and the governance of a sustainability transition.
The focus of the study is on exploring what kind of a future service providers and policymakers desire for shared mobility services, how they can achieve that future, and what obstacles are on the way. By learning about the ways to achieve the desired future, different ways to empower the niche innovations and destabilize the current regime can be explored. Furthermore, by studying the barriers, it is possible to reveal the bottlenecks regarding the transition.
To answer the research question “how do service providers and policymakers perceive the role of shared mobility in the sustainability transition of Tallinn’s mobility system?”, semistructured interviews with the actors were held, and the thematic analysis method was used to analyse the gathered data.
The findings of this study provide insight for both policymakers and service providers on how to empower shared mobility, destabilize the dominant mobility regime, and achieve sustainability goals in the mobility system. As this study looks for a collective vision, it is possible to give the decision-makers in the „cockpit“ feasible and desirable ideas about what changes are needed to transform the system and achieve a more sustainable future in mobility.

Digital Poster Gallery: https://sspcr.eurac.edu/en/programme/digital-poster-gallery-2025



TRACK 4

The Just City: New Transformative Pathways on Governance and Practices

TRACK 4
The Just City: New Transformative Pathways on Governance and Practices

As cities and regions experience growing challenges related to rapid urbanization, climate change, and socioeconomic disparities, there is increasing recognition that overlooking justice in sustainability efforts could undermine their effectiveness, perpetuating or even exacerbating social inequalities—particularly in marginalized and disadvantaged urban communities. At the same time, the field of urban planning face a growing body of research on spatial justice, highlighting the need for equitable distribution of benefits and burdens, procedural fairness, and the recognition of diverse social needs. A critical question remains: how urban spaces can be ensured to be equitable, inclusive, and responsive to the needs of all communities, especially marginalized groups.

This track critically examined governance structures and participatory planning processes to assess their effectiveness in fostering inclusive decision-making and empowering marginalized communities. It explored how urban design could move beyond physical accessibility to actively recognize and respond to diverse social needs, incorporating considerations of gender, cultural identity, and social inclusion into the built environment. Ultimately, the track interrogated the relationship between urban sustainability and justice, questioning whether existing approaches were capable of fostering genuinely inclusive cities that promoted social equity and environmental resilience for all.

REGULAR SESSION

THE JUST CITY: NEW TRANSFORMATIVE PATHWAYS ON GOVERNANCE AND PRACTICES

Chairs: Isabella Siclari, **Grazia Giacovelli**, **Chiara Pellegrini** (Eurac Research - Institute for Renewable Energy)

As cities have been experiencing rapid urbanization, climate change, and socioeconomic disparities, sustainability efforts that overlook justice risk perpetuating inequalities, particularly in marginalized communities. This session critically examined the intersection of urban sustainability and spatial justice, exploring how governance structures, participatory planning, and urban design could foster truly inclusive and equitable cities.

Key questions included how to ensure a fair distribution of benefits and burdens, empower marginalized voices in decision-making, and design built environments that recognized diverse social needs related to gender, cultural identity, and social inclusion. The session aimed to identify pathways toward cities that achieved both environmental resilience and genuine social equity for all communities.

ORAL PRESENTATIONS

048 - Beyond the Hype: Are Hydrogen Strategies Democratic?

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Keywords: Hydrogen, Energy Democracy, Participatory Democracy, Just Transition, Comparative Policy Analysis

Abstract Because of its versatility and low-carbon potential, hydrogen has been dubbed the 'rockstar' of the energy transition. Most international organisations and governments recognise that clean hydrogen, produced through renewable energy, plays a key role in achieving net-zero economies. As of 2025, almost all OECD members have published a hydrogen national strategy that outlines ambitious energy goals, complex policy plans, and short timeframes to implement them. Many governments have also committed substantial public funding to develop the hydrogen infrastructure and de-risk private investment. However, the social and cultural impacts of hydrogen are often ignored by policymakers. Top-down energy polices have led to highly mediatised protests, such as the 'hydrogen villages' in the UK, that increase social resistance towards renewable energies. Participatory processes like co-planning and citizen assemblies may offer a way to avoid the unintended social and cultural impacts of energy transition by including citizens' views in the policy-making process. Yet, the literature on energy democracy and just transition has not considered whether the democratic values of participation, inclusion, voice, and equity are being incorporated in national hydrogen strategies.
The paper attempts to fill this gap by comparing the current national hydrogen strategies of the four countries that are part of the HyPT project: the UK, Australia, Canada, and the USA. Utilising a theoretical framework based upon the tenets of participatory democracy, this study provides insights into the role of citizens and communities in shaping the transition towards clean hydrogen. Despite mentions of bottom-up policies and community inclusion in all four strategies, the results suggest a tokenisation of participatory processes and an enduring imbalance in decision-making power between strong economic interests and underprivileged social and economic groups.

086 - The housing crisis in Europe: the long absence of planning

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Keywords: Housing Inequalities, Housing Vulnerability, Social Housing, Marginalized Groups, Energy Poverty

Abstract According to the most recent report by the EU's Joint Research Centre, "House prices have surged by more than 50% since 2015, and rents have risen by more than 13% across the EU": a dramatic increase triggered by economic factors which, the study claims, include increasing land prices and speculative pricing in high-demand areas (Ozdemir & Koukoufikis 2025).
Some of these economic factors may indeed seem out of the control of urban authorities – the increasing pressure of urbanization, demographic transitions and the growing demand for short-term rentals have presented cities with grand and sometimes unprecedented challenges (Egidi et al. 2021). These challenges, in turn, have resulted in a growing share of the European population living in a condition of housing vulnerability, with housing cost-to-income ratios continuing to grow.
Housing vulnerability, however, is not simply the result of uncontrollable market forces, but also of the shrinking role of public authorities at different levels (European, National and local) and of their planning efforts in explicitly addressing the housing crisis (Freemark & Steil 2022): a contraction in social housing sector, an unregulated market for short-term rentals and the lack of balanced agreements with private estate developers are matched with poor planning choices at the local level in most EU contexts (Lee et al. 2022). This planning deficiency is disproportionately perceived by vulnerable populations: though part of the policy discourse around housing, in most EU countries they face stigmatization and socio-spatial barriers to access to housing (Ozdemir & Koukoufikis 2025).
Yet, this scenario is slowly changing, with 2024 bringing about a wave of change in the European Commission's planning approach to housing: a European Energy and Housing Commissioner was appointed, a dedicated Task Force will attempt to bring coherence in the fragmented scenario of EU housing policies and (Housing Europe 2024) and a Committee was formed in December 2024 to focus solely on Housing. How this will translate into national and local policies is, however, still hard to determine.

The research will thus present the preliminary results of a research effort conducted within the framework of the HouseInc European projects, focusing on the drivers of housing vulnerabilities of different marginalized groups in Czech Republic, Germany, Italy and Romania. It will specifically present an overview of housing policies at the National level, followed by a description of the planning (or lack thereof) of housing strategies in four respective countries. After an analytical comparison, conclusions will be drawn on the need to coordinate the different governance and planning levels, bearing in mind the changing EU policy framework on housing.

102 - Norwegian retired electric vehicle batteries for rural energy transitions: Sharbazher District in in Iraqi Kurdistan region

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Keywords: Circular Battery Economy, Rural Electrification, Energy Communities, Regional Energy Transitions

Abstract The aim of this research is to explore the role of Norwegian retired electric vehicles (EV) batteries in contributing to energy transitions in developing countries. Due to the increased adoption of electric vehicles, the number of EV batteries for the end-of-life (EoL) management is projected to raise enormously, especially in Norway in which the EVs stand for 92% of all new cars sold in 2024. The literature on the EoL phase of EV batteries takes a particular focus on 'recycling' strategies to reduce the reliance on extracting new raw materials for manufacturing batteries (M. Wang et al. 2022:10). There is very limited research on 'reusing' strategies. Cusenza et al. (2019:340) state "reuse is preferable to recycling", which is consistent with circular battery economy principles.
This study takes a global market perspective on circular battery economy (Geissdoerfer et al. 2018) by exploring the opportunities and challenges to reusing the Norwegian retired EV batteries for storing solar energy in Iraqi Kurdistan region, contributing to the emergence of off-grid energy systems. The latest development in the region, e.g., the agreement of the Kurdistan Regional Government with the US companies on oil and natural gas resources and the emergence of solar power might shape the future energy system in the region. The main focus is on onsite decentralised renewable energy systems, which will demand a particular sociotechnical regime including governance and institutional arrangements, actor constellation and technological artefacts. An off-grid energy system based on renewable energies bring about many benefits. As relatively independent systems, they are less vulnerable to external threats, cyberattacks and blackouts, are more appropriate for remote areas and cause less geopolitical conflict with national grid system.
This research targets the rural district of Sharbazher in the Sulaymaniyah governorate in the region, which was targeted for the author's PhD fieldwork. The territorial factors in the Sharbazher district would provide both potential for producing renewable energies and an enabling environment for citizen participation in creating energy communities. In this way the twin objectives will be achieved: to decrease the climate change impacts and to reduce the reliance on national grid which is currently incapable to generate adequate electricity required by households and business entities in the region. The key research questions are:

- How can local governance and institutional arrangements enable stakeholder participation for creating energy communities towards regional energy transitions? What are the obstacles to coupling between EV batteries and solar PVs?
- What kind of organisational form might enable local communities in the Kurdistan region to plan and implement their own energy visions?

123 - Assessing the strategic role of Renewable Energy Communities in local energy systems: a study on the municipality of Tito in Southern Italy

Senatro Di Leo (1) - Carmelina Cosmi (1) - Ikechukwu Ikwegbu Ibe (2) - Antonio D'angola (2)

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Keywords: Renewable Energy Communities, ET-SAP-TIMES, Local Energy Planning, Energy Transition, Decarbonization

Abstract Renewable energy communities are a key pillar of the European strategy to promote the energy transition and combat energy poverty in Europe, with the aim of promoting self-consumption and sharing of energy from renewable sources. These communities offer a new perspective for the development of energy production and consumption

models, favouring a decentralised approach that reduces dependence on unsustainable energy sources, with economic, social and environmental benefits. Renewable energy communities are well known for the technological solutions and social innovations they offer in promoting public engagement, local economic development and a fair energy transition. In this context, modelling tools based on a multidisciplinary approach can be used to assess the potential benefits and concrete advantages of implementing renewable energy communities and to support the role of stakeholders, such as residents, companies, businesses and municipalities, as prosumers in the production and consumption of electricity. The ETSAP-TIMES model generator, based on an energy system cost optimisation approach, is one of the most widely used tools for medium- to long-term energy planning on various spatial scales. It allows for the detailed representation of local energy systems and the identification of the most effective energy strategies by integrating technological, economic, environmental and social aspects.
The work aims to model a Renewable Energy Community using the ETSAP-TIMES model generator and to analyse its role in meeting electricity demand in the energy system of the municipality of Tito, in southern Italy. The TIMES-Tito REC model was therefore implemented to analyse the effects of a Renewable Energy Community over a 30-year time horizon, with a particular focus on energy supply, local electricity production and final consumption in the residential and tertiary sectors.
The operational framework of the Renewable Energy Community was therefore implemented in accordance with the latest national regulations, taking into account both technological and economic aspects. The results were compared with the ones of a reference scenario, highlighting how the size of a Renewable Energy Community can affect the energy costs. In addition, a sensitivity analysis was carried out by varying the economic incentives (sold, shared and purchased energy tariffs) to understand the economic, social and energy benefits of creating a Renewable Energy Community in a small local area.

135 - Towards a Synthetic Indicator of Housing Pressure: Mapping Affordability by Income Bracket in Milan and Turin

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Keywords: Housing Pressure Indicators, Affordable Housing Policies, Real Estate Market, Urban Land Rent

Abstract This work compares the housing markets of Milan and Turin—two metropolitan areas that differ significantly in size, economic structure, and real estate dynamics. While Turin maintains relatively stable housing costs and a more accessible market, Milan has experienced a sharp rise in property values, driven by international investment and large-scale urban redevelopment. This has led to widening affordability gaps and spatial inequalities, raising concerns about the city's capacity to remain inclusive and socially sustainable.
The aim is to use a synthetic yet intuitive indicator to assess the economic effort required to access housing. Unlike previous approaches that estimate the number of affordable square meters by salary category (Bricocoli and Peverini, 2023), this work uses income brackets and maps the areas of each city that are affordable for each bracket. The benchmark used is a Debt-to-Income Ratio (DTI) threshold of 30%, a widely accepted standard for housing affordability and already applied in recent work on the Florence metropolitan area (Battisti et al., 2025).
The DTI is operationalized by integrating income data from the Ministry of Economy and Finance with real estate values from the OMI database, harmonized at the postal code (CAP) level through spatial join techniques. This enables the construction of a housing pressure index that is both territorially sensitive and analytically robust.
The study contributes to the broader debate on urban land rent and the need for redistributive mechanisms to counterbalance the effects of market-driven urban development. Capturing and reallocating the value generated by urban transformations is essential to ensure equity and support inclusive housing policies (Camagni, 1993).

140 - Use and avoidance of public green spaces and implications for inclusive urban planning

Claudia Romelli (1) - Carl C. Anderson (2) - Nora Fagerholm (3) - Christian Albert (2)

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Keywords: Urban Planning, PPGIS, Green And Blue Infrastructure, Public Green Spaces

Abstract Public green spaces (PGS) are critical components of urban resilience strategies, supporting climate adaptation, public health, and social well-being. However, ensuring that all residents can equitably access and benefit from these spaces remains a persistent challenge. Understanding how different groups use —or avoid— PGS is essential to shaping inclusive, just, and responsive urban environments. Public participation methods offer valuable insights into the diverse and nuanced ways residents experience PGS, and they can reveal dynamics that conventional planning metrics overlook.
This contribution is based on a 2022 public participation GIS (PPGIS) survey conducted in Bochum, Germany (n=807), and provides a detailed analysis of how people engage with PGS in their city. Findings show that, regardless of sociodemographic background or specific profiles of PGS —whether frequently visited, avoided, or used in both ways— the most consistent drivers of both visitation and avoidance relate to universal factors such as availability, accessibility, connectivity, and maintenance. These insights underscore the need for urban planning approaches that address not only physical provision, but also the lived and perceived quality of urban green and blue infrastructure. Building on this work, future research will investigate how spatial configuration and the perceived quality of PGS relate to patterns of satisfaction and dissatisfaction among residents.
Our research offers clear implications for urban planning and policy. Enhancing universal qualities can reduce barriers to use, while targeted interventions can address the needs of specific communities. Systemic design and management factors are essential for achieving equitable access, and call for cross-sectoral collaboration to create multifunctional, inclusive PGS that advance public health, social cohesion, and climate resilience.

144 - F.AIR: Fragile AIR - Unfair Health. An Urban action-research assessing socio-environmental inequalities and access to healthy school environments

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Keywords: Environmental Justice, Air Pollution, Children's Health, Urban Living Labs, School Settings, Policy

Abstract The F.AIR research (Fragile AIR, Unfair Health) investigates the production and distribution of socio-environmental inequalities associated with air pollution in rapidly evolving urban contexts. Focusing on Milan's municipalities 4, 5, and 6, the project adopts a multidisciplinary action-research framework, bringing together universities, technological partners, and environmental activism associations. Supported by the Cariplo Foundation's Inequalities Research Call, F.AIR is grounded in the recognition that urban air quality is both an environmental and an equity challenge, with children in school settings representing a particularly exposed and under-recognized group.
The research addresses three main questions: (1) How are air pollutants (PM, NO_2) spatially distributed in school environments, and what territorial differences do they reveal? (2) In what ways can participatory methods and distributed sensing, through citizen science, enhance the capacity of school communities to understand, and respond to local environmental risks? (3) How can Urban Living Labs contribute to more inclusive and adaptive forms of urban governance, supporting healthier, and more just environments?
F.AIR develops a four-phase research process:

1. Critical Mapping: High-resolution analysis of air quality across the three municipalities, revealing patterns of environmental inequality
2. Identify Areas of Response-Ability: identification of school contexts requiring transformative interventions through Place-based inquiry
3. Adopt Design Strategies: Activation of Urban Living Labs to enhance access to healthy educational spaces through co-creation and policy dialogue with school communities and institutions
4. Extend Granular Sensing Ability: Development of distributed monitoring capacity using open-source sensor networks

By linking spatial analysis with participatory processes, F.AIR advances methodological innovation at the intersection of environmental science, urban planning, and social justice. The research project aims to generate new evidence on the mechanisms underlying urban environmental injustice, while testing scalable models for collaborative mitigation and local governance. The anticipated outcomes include actionable guidelines for integrating (urban) health equity into territorial planning and public

policy, as well as transferable practices to other urban areas facing similar challenges.
F.AIR offers an empirically grounded approach to advancing urban justice, prioritizing child health and the right to a healthy city environment. More broadly, it demonstrates a replicable model of engagement pathways and collaborative governance, transforming urban research from a purely scientific production into a dynamic platform that connects science with policy, society, and future generations.

174 - Redefining Business to Enable Justice-Driven and Human-Centered Urban Futures

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Keywords: Just Urban Transition, Redefining Business, Human-Centered Development, Urban Equity

Abstract The dominant definition of business as a for-profit entity aimed at generating continuous financial returns has become a structural barrier to inclusive, equitable, and sustainable urban development. This definition, rooted in industrial-era economic paradigms, drives a logic of extractivism, short-termism, and spatial inequality. In doing so, it undermines the ability of cities to plan for justice, to meet the needs of marginalized communities, and to foster human-centered environments that support decent living.
This paper calls for a radical rethinking of the concept of "business" within the context of urban planning and governance. Drawing on case studies and ongoing research conducted at the Research Institute for Sustainability (RIFS), it introduces a revised definition of business: an entity that solves social problems and creates social value in a financially sustainable way. This shift aligns with broader goals of just urban transitions by embedding recognition, participation, and sustainability at the core of economic activity. Rather than perpetuating inequality, this redefinition positions businesses as essential actors in the co-creation of equitable urban ecosystems.
Through comparative analysis of social enterprises, mission-driven cooperatives, and purpose-first urban initiatives across diverse contexts, including Europe and Asia, this paper examines how alternative business models can support policy interventions in housing, climate adaptation, and inclusive governance. Particular attention is given to how such models redistribute power, support community agency, and enable public-private-civic partnerships that prioritize the common good.
Ultimately, the presentation asks: What happens when business is no longer the opposite of public interest, but an active steward of it? By reimagining business as a vehicle for justice and regeneration, we can unlock new pathways toward cities where dignity, participation, and belonging are not exceptions but foundations.

185 - From Principles to Practice: Operational Tools for Climate Justice in Urban Planning and Design

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Keywords: Climate Justice, Co-Design, Co-Production, Participatory Planning, Community Engagement

Abstract Recent scholarship increasingly positions urban climate justice as a guiding framework for spatial interventions, emphasizing its application to diverse urban contexts. This perspective advances understanding of procedural, distributive, recognitional, and restorative justice and explores their translation into practices of urban planning, design, and architecture. Within this discourse, the Planning, Urban Design, and Architecture for Climate Action chapter of the Third Assessment Report on Climate Change and Cities (ARC3.3), coordinated by the Urban Climate Change Research Network (UCCRN), examines strategies for embedding environmental and climate justice in urban development. It introduces evolving definitions and practices while outlining pathways for implementing climate-resilient design that integrates principles of recognition, rights, responsibilities, equity, and fairness in decision-making.
Building on ARC3.3 findings, this study draws on experiential evidence from Urban Climate Design Workshops (UDCWs)—a participatory methodology initiated by UCCRN to foster climate action through knowledge exchange, co-production, and collaborative planning. Central to this approach is the UDCW Facilitation Toolkit, which operationalizes climate justice concepts via participatory design processes. Applied in different geographical and institutional contexts, the toolkit enables multi-actor engagement, collective learning, and integration of local and scientific knowledge. Case studies from Naples and Thessaloniki illustrate its capacity to spatialize community priorities, uncover tacit knowledge, and

situate justice concerns within local socio-spatial dynamics. Used alongside the UDCW Simulation Toolkit, which quantifies climate impacts (e.g., heat stress, flooding) and co-benefits, this approach addresses core justice dimensions: procedural justice through inclusive participation, distributive justice via prioritization of interventions, recognitional justice by exposing vulnerabilities and amplifying marginalized voices, and restorative justice through community-driven solutions and equitable urban imaginaries. Collectively, these tools offer actionable pathways for embedding climate justice in urban planning and design, advancing both resilience and equity.

223 - Supporting Just Transitions with Welfare-Based Decision-Making for Nature-Based Solutions: A Participatory Framework

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Keywords: Just Transition, Nature-Based Solutions, Welfare Economics, Decision-Making, Equity, Participation

Abstract As urban climate risks escalate, adaptation strategies must prioritize equity and fairness to support just transitions. Nature-Based Solutions (NBS) enhance resilience but require decision-making frameworks that ensure benefits that meet the idea of justice prevailing in the context where they are applied. This study presents a participatory approach to assess and guide NBS implementation, integrating welfare economics with ethical principles such as Rawlsian justice (Rawls, 1971) and Sen-Nussbaum capabilities (Sen, 1999; Nussbaum, 2000), to align with just transition goals. The methodology empowers equitable decision-making through community engagement through participatory techniques and surveys that incorporate diverse voices, ensuring NBS address local priorities, particularly for underserved groups (Arnstein, 1969). Alternative welfare approaches are used to prioritize the least advantaged (Rawlsian), enhance individual freedoms (capabilities-based), maximize total welfare (Utilitarian), or for other ethical purposes, tailoring NBS to ethical and social contexts (Robeyns, 2017). In this line, a multi-objective optimization model can be used to evaluate alternative NBS portfolios, balancing efficiency and equity to inform governance decisions (Pareto, 1906).

In a hypothetical urban case, the framework directs NBS investments to vulnerable areas, improving equity under Rawlsian calibration, while hybrid models optimize trade-offs for broader welfare gains. The proposed method supports inclusive governance by embedding community input and ethical considerations into NBS decision-making, offering policymakers a replicable tool to mitigate climate risks while advancing social justice and empowerment. It aims to ensure that NBS not only bolster resilience but also foster fair transitions in urban planning. We propose a methodology and some preliminary results based on local application to climate strategies framed in Lombardy (Italy) where alternative welfare scenarios are considered.

226 - Citizen Science in Urban Water Resources Management: A Systematic Review of Terminologies and Global Applications

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Keywords: Citizen science, Urban water management, Participatory environmental governance, Mixed systematic review

Abstract The intensification of extreme climatic events in recent decades has posed new challenges to urban planning, particularly in contexts characterized by unequal access to water infrastructure and pronounced socio-environmental vulnerability. Within this scenario, citizen science has been employed as an instrument for generating territorially explicit data, integrating lay knowledge into decision-making processes concerning environmental resources. Although this approach has been adopted across various fields of knowledge, its deployment in urban water management remains diffuse and fragmented, with multiple definitions, methods, and forms of application. Such heterogeneity hampers comparative analysis between studies and constrains the incorporation of these practices into public policies aimed at urban water governance. This study undertakes a mixed systematic literature review to map the terminologies, foci, and applications of citizen science in urban water resources management, with an emphasis on connections to sustainable planning and to mitigation and adaptation strategies for climate change. The initial stage

comprised an exploratory, qualitative approach to identify the diverse terms employed within the scientific literature. A scoping review focusing on environmental science articles in urban contexts was conducted, resulting in the identification of 42 terms associated with citizen science. These terms were subsequently used in cross-referenced searches in the Scopus and Web of Science databases, considering seven thematic centralities: water management, urban drainage, SDGs/Agenda 2030, urban management, Sustainability, Flooding, and Climate change. The PRISMA-ScR protocol was adopted to structure the processes of searching, filtering, selecting, and systematising data. The initial corpus consisted of 167,494 documents, which were reduced to 28,632 after refinement. The final screening, conducted with the aid of EndNote and Rayyan, resulted in an analytical set based on inclusion criteria related to the urban scale and participatory approach. The results reveal a recent expansion in scientific production on the topic, with particular emphasis on applications in flood monitoring, land use, water quality, and urban climatic mapping. Citizen science was identified as a supporting element in digital platforms, participatory remote sensing, and voluntary data collection. Methodological challenges were also observed, including data validation, continuity of actions, and institutional coordination. The systematic review confirms the structuring role of citizen science as a component of environmental urban planning strategies anchored in collaborative approaches.

245 - Developing the Polish Community Resilience Scale (PCRS) for Measuring Community Resilience in Cities and Communities

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Keywords: Resilience, Local Governance, Scale Validation, Strategic Management, Social Capital, Poland,

Abstract Contemporary cities and local communities face unprecedented challenges requiring robust resilience – the capacity of communities to survive hardship and thrive amid climate change, economic shocks, and social disruptions while maintaining their identity. While international measurement tools exist, they predominantly reflect Anglo-Saxon cultural frameworks and fail to capture the specific dynamics of Central and Eastern European cities, shaped by diverse historical legacies, trust patterns, and civic engagement traditions. This research, funded by the Norwegian Financial Mechanism (2023–2024), addresses this gap by developing and validating the Polish Community Resilience Scale (PCRS), a quantitative instrument adapted to capture urban social resilience in the Polish and Central European context. The instrument was developed through interdisciplinary workshops and literature review, resulting in a 54-item questionnaire tested on a nationally representative sample of 440 residents from all 16 Polish regions. Exploratory Factor Analysis (Promax rotation) revealed a three-factor solution explaining 55.2% of variance, with excellent internal consistency (Cronbach's α = .97 overall; factors ranging from .88 to .97). Convergent validity with the Conjoint Community Resiliency Assessment Measure (CCRAM) confirmed 86% thematic overlap despite independent development. Three empirically grounded dimensions emerged: Integrated Governance and Crisis Preparedness (e.g., "Local authorities listen to residents' concerns to better prepare for crises"), Local Identity and Civic Belonging (e.g., "I feel rooted in the city/municipality where I live"), and Formal Participatory Engagement (e.g., "I have actively participated in public consultations on local issues"). Findings show higher organizational strength and social involvement in smaller cities compared to metropolitan areas, and stronger civic identity among long-term residents. These patterns reflect Central Europe's diverse historical and cultural legacies while aligning with universal resilience elements. PCRS provides a culturally adapted, psychometrically validated tool to benchmark resilience across diverse urban contexts. It enables planners and policymakers to identify at-risk communities, strengthen social capital, and design interventions that respect local cultural contexts rather than imposing one-size-fits-all solutions.

POSTER PRESENTATIONS

077 - Rethinking the Boundaries of Energy Justice in Demand-Side Flexibility across Europe: A Critical Review

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Keywords: Urban Transitions, Energy Justice, Demand-Side Flexibility, Dominant Narratives, Discursive Power

Abstract As urban transitions towards decarbonised energy systems accelerates, demand-side flexibility (DSF) has become a key strategy for integrating variable renewable energy sources and promoting more sustainable energy consumption behaviours. These strategies are often framed as win-win solutions, enhancing grid stability while empowering consumers. However, they tend to prioritise technological and market-based incentives, often overlooking everyday motivations and barriers that shape consumer behavior and influence individuals' ability to participate in and benefit from DSF initiatives. Shifting and changing energy demand requires not only technical solutions but also societal and lifestyle changes that can raise important questions of energy justice, particularly for vulnerable and marginalised groups, in the design and implementation of DSF.
This research responds to this gap by bringing a critical interpretive perspective to the societal challenges and ethical dimensions of DSF. Within the Consumer energy Demand Flexibility (CoDeF) project, this study explores the question: how do dominant narratives shape the way in which energy users, scientists and policymakers understand and experience energy justice in DSF? It analyses user, academic and policy discourse to examine who DSF is designed for, by whom, and for what purpose. Instruments such as time-based tariffs, dynamic pricing, smart metering and demand-response programmes are assessed to determine how justice considerations are embedded. Using an intersectional lens, the study explores how energy justice is conceptualised and pays special attention to assumptions behind prevailing narratives that often simplify identities, overlook diverse needs, and exclude certain perspectives.
A systematic literature review first evaluates how energy justice is framed and operationalised in DSF debates, identifying over- and under-represented narratives and revealing gaps between research, policy and practice. Special attention is given to less visible expressions of power that influence consumption and may reinforce systemic injustice. Empirically, the project conducts a comparative case study of the Netherlands, Norway and Italy. All three recognise DSF as essential for aligning consumption with supply, yet differ in geographic, demographic, socio-economic and cultural contexts, generating distinct narratives and justice concerns.
The next phase will use participatory methods, such as interviews and focus groups with researchers, policymakers, providers, consumers and associations, to explore both the intentions of those setting the "rules of the game" and the lived experiences and perceived burdens of those affected. Findings will inform fine-grained, context-specific policy recommendations to co-create more inclusive and diverse approaches to addressing energy (in)justice.

132 - Exploring Governance Approaches and Civic Engagement in Municipality-Led Renewable Energy Communities in Italy

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Keywords: Renewable Energy Communities, Local Governments, Interactive Governance

Abstract Renewable Energy Communities (RECs) are increasingly recognized as innovative tools for advancing the energy transition while delivering social and economic benefits at the local level.
In Italy, since the approval of Legislative Decree 199/2021, which transposed the EU Renewable Energy Directive (RED II), the development of RECs has gained significant momentum. Notably, more than half of REC initiatives have been initiated or promoted by local governments, particularly in small towns. Despite the growing prevalence of this model, the specific characteristics of municipality-led RECs remain underexplored. Existing research has largely focused on grassroots initiatives, with limited attention to cases where municipalities take a leading role, often in collaboration with citizens, civic organizations, and private actors. This study addresses this gap by investigating how municipalities govern RECs and how citizen participation is integrated into these processes. Adopting a qualitative multiple-case study approach, it draws on REC statutes, project materials, and semi-structured interviews with public officials and staff involved in REC development across various Italian municipalities. The study has three objectives: (1) to classify governance approaches emerging in public-driven RECs; (2) to explore how municipalities perform governance roles through formal and informal practices; and (3) to identify contextual factors that shape civic engagement in municipal-led initiatives. This study contributes to academic debates on participatory and interactive governance in local energy transitions, with a particular focus on the strategic role of municipalities in enabling citizen participation. In addition, the findings are relevant to public managers and practitioners engaged in the REC sector and participatory local governance.

213 - The public space as a vector of social cohesion

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Keywords: Social Cohesion, Participatory Design, Urban Planning Model, Public Spaces

Abstract Public spaces and their potential to foster social cohesion have become a key topic in contemporary urban planning, especially in contexts affected by social and ethnic segregation. In this regard, co-participation between urban planners and local communities emerges as a highly effective tool in addressing these issues by enhancing the quality and inclusiveness of the urban environment. This paper explores how public spaces can be designed to support community engagement and shared activities, with the ultimate goal of strengthening social cohesion.

The paper focuses on the specific case of Miercurea-Ciuc, a city in Harghita County, Romania, characterized by ethnic segregation, with a Székely (Hungarian-speaking) majority of over 70% and a Romanian minority. Additionally, the city's cold, foggy climate contributes to reduced outdoor activity and limited social interaction, further challenging community cohesion. The research is structured around two main components: (1) an assessment of the current state of public spaces in relation to observable levels of social interaction, and (2) the development of design proposals that incorporate participatory tools to actively involve community members in the shaping and activation of public space.

The main objective is to understand and illustrate how spatial strategies can be used to promote interaction, a sense of belonging, and inclusive community identity. The methodology combines multi-criteria analysis of existing urban environment with the development of a intervention model, ranging from a system of city-wide public spaces to the micro-scale of individual public spaces. The proposed approach is built on three core stages: Gather – Connect – Build.

— Gather: Create inclusive spaces that attract and bring together people from all social and ethnic backgrounds.
— Connect: Encourage interaction among users once they are present in the space, through shared activities.
— Build: The creation of spaces that support a sense of belonging and communication among local residents, aiming to foster a shared local identity.

The outcome consists of an urban design solution that responds to the needs of residents by creating a coherent system of public spaces, diversified in terms of the activities they support. This demonstrates how the public space can become an effective instrument in the process of strengthening social cohesion.

Digital Poster Gallery: https://sspcr.eurac.edu/en/programme/digital-poster-gallery-2025

SPECIAL SESSION

TOWARD DECENT LIVING: JUSTICE-DRIVEN AND HUMAN-CENTERED URBAN FUTURES

Chair: Bahaa Bou Kalfouni (Gdansk University of Technology)

As cities and regions grapple with rapid urbanization, climate change, and widening socioeconomic gaps, the question of justice became central to the pursuit of sustainability. This issue is particularly urgent in the Global South, where degraded urban environments such as slums and informal settlements are characterized by physical deterioration, inadequate infrastructure, and systemic neglect. Often home to vulnerable communities, these areas bear the consequences of critical events and planning decisions that overlook the embedded injustices within the built environment.

This special session critically explored how planning, governance, and participatory design practices could address these challenges. It invited contributions examining how human-centered and justice-based approaches could transform degraded urban environments into inclusive, equitable, and resilient settings. The session also sought to explore how planning could move beyond technocratic solutions to tackle historical and structural inequalities, and which tools and processes were needed to foster procedural justice, spatial redistribution, and recognition of diverse community needs, particularly in relation to gender, cultural identity, and lived experiences.

Key theoretical frameworks shaped the session's exploration of spatial justice and urban transformation. Henri Lefebvre's concept of the Right to the City emphasized the democratization of space and the right of all urban inhabitants to shape their

environment. David Harvey linked urban injustice to capitalist urbanization, arguing that economic systems producing inequality had to be addressed. Susan Fainstein proposed the framework of The Just City, centered on equity, democracy, and diversity in planning. Edward Soja, through his concept of Spatial Justice, highlighted how urban spatial arrangements reinforced inequalities. Ananya Roy focused on Southern urban theory, showing how planning both marginalized and empowered urban poor communities. Loretta Lees addressed the exclusionary impacts of gentrification and urban renewal policies, advocating for more inclusive planning approaches. Finally, James Holston examined how residents in marginalized urban areas of the Global South challenged exclusionary governance through forms of insurgent citizenship.

Through these theoretical lenses, the session aimed to contribute to the development of new pathways toward the Just City, where even the most neglected urban spaces could become environments of empowerment, dignity, and sustainable transformation.

ORAL PRESENTATIONS

084 - Which Justice in the Energy-Biodiversity Nexus: Exploring the Recognitional and Restorative Potential of Integrated Nature-based Solutions in Cities

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Keywords: Urbanisation, Nature-based Solutions, Ecological Justice, Energy

Abstract Urbanization is transforming landscapes, reshaping the lives of both humans and more-than-humans. While cities have driven economic growth and well-being, they have also deepened socio-economic inequalities and contributed to biodiversity loss through the expansion of the built environment. Moreover, meeting the growing energy needs of urban populations places additional pressure on ecosystems. Yet, cities also offer potential for coexistence, providing opportunities to support both human well-being and biodiversity through integrated approaches to conservation and urban design. For many years, biodiversity conservation received limited attention in urban planning and policy. This began to shift in 2024,when the European Union introduced the Nature Restoration Law (NRL), aiming to ensure the long-term and sustained recovery of biodiversity also in urban areas. The NRL also suggests that restoration of biodiversity should be considered in renewable energy strategies to address the dual challenges of biodiversity loss and climate change. To accomplish this goal, the NRL promotes Nature-based Solutions (NbS) as key instruments to restore degraded ecosystems and enhance biodiversity, also in synergy with renewable energy production. However, while their positive contribution from an environmental perspective has never been questioned, there has been criticism regarding the anthropocentric lens used in their application. This perspective recognized only the several benefits that nature provides to humans in term or economic, health, recreation and well-being without recognizing the role of more-than human as subjects of justice. This study adopts an ecological justice lens to examine the role that NbS planning can play in restoring and improving biodiversity in urban areas. It also explores, through the dimension of recognitional justice, whether NbS can address the needs and rights of both more-than-human nature and socio-economic vulnerable groups. To this end, this study employs Q-methodology, a mixed method approach that allows to investigate diverse individuals' perspectives on human-nature relationship. Indeed, in a first phase, literature review and semi-structured interviews lead to the creation of a series of statements which comprehend all the recognitional and restorative justice potential of NbS. In a second phase, a subset of selected stakeholders will sort and rank the statements based on their preferences, adding further explanation for their choices. The NbS case study focuses on community gardens, municipally owned land made available to citizens for urban agriculture, and to be integrated with PV systems, enabling the simultaneous restoration of biodiversity, food cultivation, and renewable energy production. The renewable energy generated would be allocated to socio-economic vulnerable groups, exploring how such multifunctional NbS can contribute to both ecological and social justice in urban settings.

138 - Assembling Environmental Sustainability in Refugee Camps through Refugees' Home-making Practices

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Keywords: Refugee Camps, Sustainability, Environmentalism of the Poor, Assemblage Theory

Abstract Much of the existing research on sustainability in refugee camps often examines the concept through the lens of institutional change that overlooks the potential of refugees' actions and initiatives as crucial in achieving sustainability. In this work, I aim to broaden the scope of the drivers of sustainability, within this context, by incorporating the active participation of refugees themselves. More specifically, I seek to explore the extent to which refugees' home-making practices, aimed at securing their livelihoods, promote environmental sustainability. In this study, I focus on two kinds of home-making practices: dwelling adaptations and home economics practices. In examining the survival strategies of marginalized populations, the concept of Environmentalism of the Poor (EOP) (Guha, 2002; Nixon, 2011) is of particular relevance. EOP investigates how the poor tend to adopt more sustainable practices out of necessity, as a means of struggling to survive. Refugees, despite not necessarily being poor, often lack certain social and economic privileges/rights held by non-refugee citizens. Drawing on Environmentalism of the Poor (EOP) and assemblage theory (Deleuze & Guattari, 1987; De Landa, 2006; McFarlane, 2009; Dovey, 2010), this article aims to explore a bottom-up perspective on sustainable practices, while acknowledging their inherently political nature. Through empirical analysis of three Palestinian camps in Jordan, Al-Husn, Baqa'a, and Talbiyeh, this study examines the flows and networks of contestation and collaboration within and beyond the camps' boundaries. The research argues that refugees' survival home-making practices, conceptualized as assemblages, play a pivotal role in promoting environmental sustainability in the camp. To investigate these practices, I employ a methodology that incorporates archival and empirical research. This includes methods of site visits, direct observation, interviews with camp residents and officials, and handmade graphic journaling.

159 - Building Bridges in municipal Governance: The Würzburg Council for the Future as a model for urban sustainability transformations?

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Keywords: Urban Transformation, Citizen Assembly, Experimentation, Mid-Sized City, Sustainable Transformation

Abstract Amid growing social polarization and need for better knowledge-integration in policymaking, so-called 'mini-publics' or 'citizen's assemblies' have gained increasing popularity as deliberative approaches towards sustainable transformations in cities. While most local mini-publics are initiated and implemented by civil society groups, others have been set up by local authorities. Researchers have studied bottom-up versus top-down processes related to mini-publics in cities but we know little about the mini-publics initiated by academic institutions as transdisciplinary urban projects. These mini-publics are characterized by unique expectations and perspectives among their participants and within their organizational structures, therefore we also expect a unique contribution to just cities and urban sustainability transformations.
Taking the need to better understand the potential of transdisciplinary mini-publics for sustainability transformations as a starting point, our research is centered around the citizen assembly Würzburg Council for the Future on the topic just mobility. It was conducted as cooperation between the "Bündnis Zukunftsklima" and various scientists, primarily from social sustainability science and under the umbrella of a transformation experiment of the sustainability lab ("WueLAB") of the university of Würzburg. As such, it represents a special case in which scientists had a dual role as organizers and researchers, and in which members of the university – as the main initiator and main supporter of the project – intended to contribute not only to knowledge production but explicitly also to sustainability transitions in the city.
To analyze the potential of such a mini-public, we cover the entire process of the conceptualization and implementation of the Würzburg Council for the Future from its inception to the presentation of its recommendations in the city council. For that, we use an exploratory approach based on qualitative methods, such as participatory observations of the sessions, semi-structured interviews with team members and participants, and reflexive methods, such as a collaborative evocative autoethnography on the process of the preparation in implementation of the council. We identify and study the factors determining the success of deliberative platform like the citizen assembly Würzburg Council for Future for sustainable urban transformation. Thereby, the paper contributes to the broader discussion about whether citizens' assemblies are a suitable form of participation to foster urban sustainability transfor-

mation that goes beyond traditional direct-democratic instruments.

SPECIAL SESSION

URBAN RESEARCH FOR JUST CITIES: PATHWAYS TOWARD SUSTAINABLE TRANSFORMATIONS AND TRANSITIONS

Chair: Pia Laborgne (Karlsruhe Institute of Technology - Transformation Centre for Sustainability and Cultural Change)

The Urban Europe Research Alliance (UERA) has invited urban researchers to engage in exchange with a focus on equitable urban transformation that address and integrate "left behind" territories and populations. The rapid acceleration of urbanization, together with geopolitical and climate crises, continued to call for sustainable and equitable urban transformations.

While strategic synthesis models—such as the 15-minute city for mobility, Positive Energy Districts for energy, and Circular Urban Economies (CUE) for circularity—are gaining recognition across Europe, their translation into practice remains uneven. These models are often implemented in well-resourced metropolitan regions, while socio-spatially marginalized or "left behind" urban areas continue to face barriers to sustainable transformation.

This special session sought to explore the role of urban research in advancing experimental approaches to sustainable and equitable urban transitions, for example through living labs, with a focus on learning in action, knowledge exchange, capacity building, and equitable transformation pathways. Drawing on implementation experiences from diverse contexts, the session provided a platform to present and discuss the challenges and opportunities associated with framing and adapting sustainability within real urban settings.

ORAL PRESENTATIONS

069 - Co-Creating Transformative Capacity: The Tandem-Based Urban Lab in Würzburg as a Model for Just Transitions in Mid-Sized Cities

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Keywords: Urban Transformation, Co-Creation, Experimentation, Mid-Sized City

Abstract Experimental project designs have become a cornerstone of contemporary approaches to just urban sustainability transformation. However, the majority of such initiatives remain concentrated in well-resourced metropolitan areas. The project Transformationslabor Stadt und Universität Würzburg, funded by the initiative "Transformationslabor Hochschule" (Stifterverband) and embedded within the WueLAB Sustainability Lab at the University of Würzburg, presents a novel approach tailored to the specific needs and capacities of a mid-sized city. It builds on the idea that sustainable urban transformations require not only innovative solutions but also lasting collaboration infrastructures and shared cultures of knowledge production.
At the heart of the Würzburg model is a tandem-based structure: four interdisciplinary teams—each with one representative from the city administration and one from the University of Würzburg—collaborate for one year on urban transformation topics. In professionally facilitated workshops, they develop a shared vocabulary, mutual understanding of institutional logics, and a co-creative space for scientifically grounded planning proposals. The project aims to create an environment for the most equitable transformation possible, acknowledging that such processes tend to produce both winners and losers (Duncan et al., 2018).
This talk shares insight into a research project examining the Würzburg model and its potential for driving urban sustainability transformations. It contrasts this with the transformation experiment 'Würzburger Zukunftsrat', which investigates the participatory format of the 'Bürgerrat'. The roles of central institutions, stakeholders and the four tandem teams in connection to building transformative capacity at the science-policy interface are essential for the research project. Drawing on current insights from sustainability and transformation research—including notions of co-production (Mauser et al., 2013), transdisciplinary knowledge integration (Lang et al., 2012), and trust-based experimentation (Wolfram, 2016)— qualitative methods are used focussing on the core dimensions: (1) how structured tandems can overcome systemic barriers, (2) which challenges exist for transformative sustainability projects, (3) how mid-sized cities can adapt urban lab models, and (4) which competencies are essential to foster inclusive experimentation networks.

Early outcomes from experimental projects at the WueLAB show that relational infrastructures, such as tandem partnerships & facilitated dialogue formats, are not auxiliary but central to transformative urban governance. They open up new pathways for collaborative learning, legitimation, and sustained innovation. By bridging disciplinary, institutional, and cultural divides, the "Transformationslabor" offers a replicable model for peripheral or mid-sized cities striving for just sustainable urban futures.

173 - Citizen Science and Spatial Representation of Urban Flooding: A Case Study in Curitiba, Paraná, Brazil

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Keywords: Citizen science, Urban flooding, Participatory cartography, Urban resilience, Climate vulnerability

Abstract The rapid growth of Latin American cities, combined with the increase in extreme hydrological events caused by climate change have intensified urban flooding incidents, especially in areas with inadequate infrastructure. Although Curitiba (Paraná, Brazil) is recognised for its history of urban planning, episodes of recurrent flooding have caused material losses, compromised mobility, and exposed socio-spatial inequalities. The absence of real-time public monitoring systems, updated and georeferenced, limits institutional response capacity and reveals deficiencies in the provision of adaptive urban infrastructure. In this context, citizen science serves as a supplementary and strategic instrument, facilitating the participatory collection of up-to-date, territorially relevant data that is sensitive to local realities. This study aimed to map flood points in the municipality of Curitiba based on voluntary data collected between January and December 2023. A digital form containing 20 questions was widely disseminated via social media (WhatsApp, Instagram, and community groups) and the media, yielding 1,330 responses. After data verification and cleaning, 1,200 valid records were georeferenced individually using specialized tools, allowing the creation of heat maps, neighborhood-based graphs, and integrated cartographic visualizations. The methodology adopted an exploratory and applied approach, based on the principles of citizen science and participatory cartography. The geographical coordinates were validated through visual inspection with the aid of Google Maps and Street View. Official data were geocoded, converted into KML files, and integrated with primary layers in GIS software. Spatial analysis was organised into three blocks: (i) a map of popular perception; (ii) a map of official records. Moreover, (iii) flood risk maps provided by the Municipal Government. The superposition of these layers enabled the identification of convergences, gaps, and critical recurrence areas. The results revealed that this comparative analysis between voluntary and official data showed convergences, reinforcing the reliability of citizen data as a technical resource. Drainage issues are currently recognised as a chronic global problem, and the findings of this study demonstrate how citizen science strategies can disclose hidden patterns of urban water vulnerability, often overlooked by traditional institutional systems. The integration of these data sources, combined with geoprocessing, provides a replicable and effective strategy for improving adaptive city planning in the face of climate change.v

221 - Urban Regeneration and Just Energy Transition: Lessons from Disadvantaged Neighbourhoods in the Apulia region, Italy

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Keywords: Energy Justice, Urban Regeneration, Energy Transition, Disadvantaged Neighbourhoods, Apulia Region

Abstract Urban regeneration strategies are paying increasing attention to energy transition goals, in line with the decarbonisation imperative and the main EU and global policies for sustainable urban development and climate change mitigation. This is reflected in the growing inclusion of energy efficiency measures and the development of renewable energy sources. However, this integration often takes a technocratic and market-driven approach to energy transition, paying little heed to the complex social, institutional and cultural dynamics that shape access to energy. This oversimplification is particularly problematic in disadvantaged neighbourhoods, where long-standing vulnerabilities and multiple forms of energy poverty can intersect to hinder just transitions.

Since 2005, the Apulia region, in Southern Italy, has promoted regeneration policies and programmes with a clear focus on disadvantaged neighbourhoods and social justice, as well as an increasing emphasis on green and energy transition objectives. Nevertheless, recent reflections are revealing critical tensions between these objectives and actual implementation

capacities. While their integrated and place-based approaches have at times fostered transformative practices and more just outcomes, their contribution to just transitions remains partial and uneven. Adopting the multidimensional and intersectional lens of energy and spatial justice, encompassing distributive, procedural, and recognitional dimensions, this paper examines how regeneration programmes and projects in the Apulia region have addressed, or failed to address, disparities in energy access through integrated and place-based approaches. The analysis draws on a review of regeneration practices in urban areas where various attempts to integrate energy-related objectives have produced mixed results. Both positive and problematic examples are discussed, paying attention to the governance arrangements that enable or constrain more just outcomes.
Findings suggest the need to reframe regeneration not merely as a vehicle for decarbonisation, but as a driver of transformative change guided by the justice principle. This requires acknowledging local specificities, enabling meaningful community involvement, and designing strategies that redistribute not only resources, but also voice and agency. Only through such a reframing can urban regeneration genuinely support just and sustainable transitions in Europe's most fragile territories.

238 - Awakening Neglected Places through Inclusive Urban Experimentation: The Role of Local Identity in Sustainable Transformations

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Keywords: Place-Based Identity, Transformative Placemaking, Experimentation, Reframing

Abstract Urban transformations toward sustainability and resilience are increasingly framed through strategic or policy paradigms such as the 15-minute City, Circular Economy, or Positive Energy Districts. While these models provide coherent visions, their application usually does not address socio-spatially marginalized or symbolically "left behind" territories continue to face structural barriers to transformation—both material and cultural. This raises critical questions about the epistemologies, values, and spatial assumptions underpinning mainstream urban sustainability discourses.
This paper contributes to debates on just urban transitions by centering attention on neglected spaces and the role of place-based identity in driving inclusive, locally grounded experimentation. Drawing on interdisciplinary placemaking and urban identity theories—especially notions of place attachment, place meaning, and relational place-making—it repositions identity not as static heritage but as a transformative resource for urban futures. Rather than treating neglected places as passive recipients of top-down innovation, the approach foregrounds them as sites of latent potential, rich in social memory, cultural symbolism, and ecological value.
Conceptually, the paper synthesizes emerging literature in urban studies, sociology, environmental psychology, and planning theory to argue that spatial justice is inseparable from symbolic recognition and participatory co-creation. Neglected spaces often suffer not only from physical decay but from representational exclusion, lacking visibility within dominant narratives of progress. Transformative placemaking thus becomes a tool not just for ecological restoration but for re-narrating place identities, renewing civic imagination, and fostering collective ownership. Besides theoretical grounding, the paper also draws upon empirical insights from recent innovation actions in different European pilot sites of R&I projects (covering diverse socio-spatial contexts) as well as geographical research on urban identity in Vienna, Austria.
Experimentation—understood as a political and epistemic practice—is proposed as both method and ethos for achieving these goals. When embedded in inclusive co-governance structures, these experiments can realign local values with sustainability agendas and build long-term capacity for transformation.
Ultimately, the paper calls for a reframing of urban sustainability to account for relational, symbolic, and affective dimensions of place, highlighting how placemaking, identity, and experimentation intersect to form equitable pathways for change—especially in areas previously deemed peripheral or obsolete.

240 - Community-Driven Innovation for Inclusive Urban Energy Transitions

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Keywords: Urban Energy Transitions, Innovation Community, Just Transitions

Abstract Urban transitions towards sustainability demand transformative changes that are both effec-

tive and just. Strategies to achieve a just transition in urban settings must address key dimensions of justice: distributional justice (the equitable allocation of costs and benefits), procedural justice (inclusive and participatory decision-making), and recognitional justice (the respect for and acknowledgment of diverse cultures and perspectives). In cities, realising these principles entails e.g. fostering inclusivity, sharing resources equitably distributing profits and burdens fairly, and encouraging open public dialogue to include and balance diverse interests and needs.
Community-driven innovation that builds on existing resources and engages society in driving transitions is key to success as the energy transition represents a societal challenge that must be widely embedded and broadly supported. This is the starting point of the presentation. It draws upon insights from the transdisciplinary project 'Strengthening and Consolidation of Innovation Communities to Implement the Recommendations of the Climate Citizens' Council of the Freiburg Region' (ICN 2024–2025). Initiated by civil society, this project examines how researchers, civil society organisations, policymakers, and businesses can work together to promote participatory and socially just urban energy transitions. Central to this is the concept of innovation communities—open, self-organising groups in which stakeholders jointly develop solutions (e.g. von Hippel, 2005; Franke & Shah, 2003; O'Mahony & Lakhani, 2011). While these communities have traditionally been applied in business, they are also promising for sustainability transitions by enabling community-led collective commitment, trust-building, and resource mobilization at the local level.
This presentation sets out to address all three dimensions of justice, drawing upon data generated throughout the project via questionnaires, interviews, and workshops. It explores questions such as: How can innovation communities help to activate local actors and resources, thereby embedding the energy transition more deeply and inclusively across society? In what ways can researchers and civil society actively initiate and sustain these communities? What forms of support and interventions do urban innovation communities require in order to thrive? Based on experiences in the Freiburg region, we argue that innovation communities can act as catalysts for broad public engagement and equitable urban energy transitions. Such bottom-up, community-based approaches help embed sustainability within the local urban fabric, making transitions more inclusive, democratic, and resilient.

SPECIAL SESSION

LEADERSHIP AND STAKEHOLDER COLLABORATION AS ENABLERS FOR ENERGY TRANSITION: PEOPLE, PROCESSES, PRACTICES

Chair: Micol Pezzotta (University of Stavanger - Department of Petroleum and Energy Technology)

The transformation of energy systems is imperative to reduce greenhouse gas emissions. However, the shift toward more decentralized energy systems, the integration of diverse energy sources, and the increasing share of renewables require the involvement and coordination of actions across multiple levels of governance, as well as among different organizations—including public and private actors, for-profit and non-profit entities, and civil society organizations—and experts with diverse competencies, such as technical, financial, and regulatory expertise. As a result, leadership and stakeholder collaboration have become central to the development of effective solutions.

Leadership occurres at different levels (e.g. institutional and operational) and is exercised through various roles, including interpersonal, informational, and decisional roles. While organizations have different motivations for leading or participating in Energy Transition initiatives, their involvement need to be aligned with internal goals and designed to harmonize with existing practices, structures, and activities.

Cities contribute significantly to greenhouse gas emissions, but they also offer opportunities to reduce energy consumption, for example by improving energy efficiency. The integration of urban and energy planning is therefore considered essential. Given the complexity of the challenges involved and the solutions to be developed, municipalities are required to adopt more innovative approaches and to seek collaboration with partners beyond their organizational boundaries, developing new forms of partnerships. This also requires rethinking municipal practices both within and outside the organization.

New tools and methods for planning and collaboration are needed to support practitioners, and planning processes have to be redesigned to enable collaborative innovation. The planning of sustainable neighbourhoods—such as Zero Emission Neighbourhoods and Positive Energy Districts—was presented as an example of complex energy transition projects involving a diverse constellation of stakeholders

and calling for changes in organizational roles and relationships.

Energy Communities (ECs) emerged as new actors in the energy sector, representing innovative solutions for shifting power dynamics and supporting a Just Energy Transition. The success of these organizations depended on innovative ways of involving, motivating, and organizing members and stakeholders. Industry, particularly small and medium-sized enterprises, was also seen as a potential leader in the Energy Transition, transforming sustainability challenges into market opportunities.

ORAL PRESENTATIONS

033 - Exploring how leadership and collaboration in multi-stakeholder energy initiatives are aligned with overarching sustainability challenges

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Keywords: Leadership, Collaboration, Energy Initiatives, Holistic Sustainability

Abstract Multi-stakeholder energy initiatives are often promoted as contributing to sustainability. However, little is known about how leadership and collaboration in the initiatives align with holistic sustainability, such as across planetary boundaries. Our study addresses the research gap on complex energy initiatives' impact on overall sustainability through 2 cases of community-based energy initiatives in Sweden and Greece. These energy communities (EC) were studied in 2025 through 9 semi-structured interviews of around 1–1.5 hours each. The Swedish EC is in a semi-central area in a major urban area and includes solar panels, heat pumps, and battery storage, connecting around 1000 flats. The Greek EC is in a region containing a major urban area, and the EC uses a virtual system to connect around 50 members, mostly households, to solar panels. Both ECs are since the last few years officially registered, non-for-profit organisations.
Our preliminary results indicate that leadership and collaboration in complex energy initiatives can face challenges in but also support addressing sustainability holistically. Creation of economic value for the members is the found starting point in the studied ECs. Sustainability is also an identified value for members, but its definition is unclear. This limited definition can be conditioned by four aspects. First, the leaderships are found to have a general struggle in keeping creating value for members. Second, leading persons with personality traits that enables the needed community building can typically move on to other projects. Third, leadership is found to need to create vague goals due to varying interests across members. Fourth, considerable policy landscape changes are identified to be difficult for the self-trained leadership to foresee and well address. However, the second and the fourth aspects may also be partial reasons for multi-stakeholder energy initiatives to be promising in addressing sustainability holistically. In the Swedish case, a socially engaging key person was at the time of the study considering considerably spreading the EC concept by assisting other emerging EC initiatives. For the Greek case, a drastic policy change may be the catalyst for transforming the EC from focusing on change of energy supply to energy efficiency, with more absolute sustainability improvements since also renewable energy has environmental and social challenges from for example a supply chain perspective.
The results provide indications of sustainability effects stemming from leadership and collaboration in complex energy initiatives, but the overall impact is found difficult to assess. Therefore the policy and research recommendation so far is to be aware of this difficulty and be open for unexpected effects, while acknowledging that leadership and collaboration in general can be challenging in ECs and comparable initiatives.

055 - Social Capital and New Institutionalism: A Governance Perspective on the Clean Energy Transition

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Keywords: Social Capital, Relationships, Clean Energy Transition

Abstract In a context marked by accelerating climate change and the urgent need for sustainable innovation, understanding how institutional frameworks adapt to complex governance challenges has become increasingly crucial. This article employs the concept of social capital as an analytical lens to explore the multifaceted nature of neo-institutionalism, with a particular focus on governance dynamics. Through a comparative analysis of two case studies related to the Clean Energy Transition (CET), the study highlights how institutions influence coordination between public and private actors. Special

emphasis is placed on the formal and informal relationships that develop within institutional and interorganizational contexts, which are seen as central to the processes of information exchange and circulation. Social capital plays a key role in building these ties, affecting access to knowledge, mutual trust, and the adaptability of decision-making structures.
The analysis is framed within the context of multilevel governance, showing how shared norms, social networks, and trust-based interpersonal relations can facilitate—or hinder—the effectiveness of decision-making processes. By integrating the three main strands of neo-institutionalism—historical, sociological, and rational choice—the article offers a nuanced interpretation of the institutional mechanisms underlying European energy and climate policies.
Drawing on two case studies (Navarra in Spain and Skåne in Sweden), the findings suggest that social capital plays a crucial role in adapting governance arrangements to the challenges posed by sustainable innovation. Survey results reveal that social capital is a key lever in energy transition governance processes. Informal relationships, especially among colleagues and local actors, prove essential for effective information exchange, at times compensating for the rigidity of formal channels. Trust, frequency of contact, and shared cultural values strengthen collaborative networks and promote coordination between public and private actors. Social capital—through its relational, cognitive, and structural dimensions—thus helps explain how institutional configurations adapt to—or resist—the challenges of sustainable governance.

177 - Towards an analysis framework of Positive Energy Districts' governance

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Keywords: Leadership, Stakeholder Collaboration, Governance, Positive Energy Districts

Abstract Initiatives for the Clean Energy Transition (CET) that target re-thinking how energy systems are planned in urban districts such as Positive Energy Districts (PEDs), and that exploit more synergies between different sources of energy call for new forms and practices of collaboration and agreements between a diverse constellation of stakeholders. With this, we mean municipalities, private owners, citizens, real estate developers, energy solutions and technology providers, and housing associations, among others.
The objective of this study is to propose a framework of analysis of the governance of Positive Energy Districts. To do this, we carried out a preliminary exploratory work on leadership and stakeholders' relations in the cities involved in the EU project Plan-4CET: Parma, Helsingborg, and Pamplona. During a project meeting held in Helsingborg this year, we organized working groups with the partners of the project and we collected data on experiences of leadership and collaboration practices in initiatives for CET. The data, consisting of notes of the participants prompted to fill out a form with three questions and discuss in the groups and notes of the group leaders during the group discussion and during the plenum session, revealed some key aspects that should be further investigated to deepen the understanding of the dynamics of collaboration and to draft an analysis framework for comparing leadership and collaboration practices in PEDs.
The following topics emerged from the exploratory work. Collaboration experiences seemed characterized by unclear roles and contribution, non-existent formal and informal procedures, and seemed to suggest that new ways of working and new collaborative forms are needed and should be tested. This indicates the need to investigate further roles, responsibilities and practices in PEDs. Lastly, it emerged very clearly that the 'initiative spirit' or the previous experience and competencies of some individuals are very crucial for the start and progress of the initiatives.
With these preliminary results in mind, we plan to analyse leadership, planning processes and dynamics among stakeholders involved in planning Sustainable Neighbourhoods in selected case studies in Italian cities of medium to large size (Cesena, Parma, Turin). In two of these cases the processes for evaluating, planning, and implementing actions towards Positive Energy Districts are carried out within the framework of European research projects where research organizations or universities are involved. By collecting data in the three selected case studies (ongoing) we plan to verify the validity of our analysis framework, and we expect to establish it as a tool for the analysis of leadership and stakeholders' collaboration practices of PEDs.

232 - The Solidarity Renewable Energy Community: A Model for Addressing Energy Poverty at the Local Level?

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Keywords: Solidarity Renewable Energy Communities (CERS), Urban Energy Transition, Energy Poverty, Just Energy

Abstract In 2021, as the EU Renewable Energy Directive was being transposed into Italian law, the environmental association Legambiente and a local third-sector entity in Naples initiated a new form of energy community: the Solidarity Renewable Energy Community (Comunità Energetica Rinnovabile e Solidale – CERS). This model stands out for its development in vulnerable urban contexts, its foundation by civil society actors, and its aim to alleviate energy poverty by redistributing the locally generated value of renewable energy to the benefit of low-income households.
Since its first implementation in East Naples, the CERS model has expanded to several Italian cities. Yet, beyond that initial case, the model remains underexplored in the literature. This research addresses the following question: How is the CERS model designed to address energy poverty at the local level in urban contexts?
To answer this, the study identifies four core dimensions of analysis: (1) the territorial context in which the CERS is embedded, (2) the actors involved and their motivations, (3) the inclusiveness of the design and implementation process, and (4) the intended impact on energy poverty. Following a review of the Italian regulatory framework and of the literature on energy communities and energy poverty, five case studies—three in Milan and two in Rome—are analysed. These cases are based on semi-structured interviews with representatives of the involved communities.
The comparative analysis shows that, while the model adapts to different urban contexts, it is consistently rooted in pre-existing solidarity networks. The CERS can be initiated by local organizations—such as associations, cooperatives, or parishes—or by local public authorities, and often emerges through cooperation between the two. These actors mobilize physical spaces, social trust, and contextual knowledge to activate inclusive energy communities in underserved areas.
The success of these initiatives also relies on intermediary actors—such as national NGOs, foundations, and socially committed energy providers—who translate technical, financial, and regulatory complexity into accessible processes. They enable coordination among diverse stakeholders and help co-design viable governance models.
Equally important is the contribution of multi-level institutional support—from municipalities to EU programs—which provides essential financial resources, particularly for initial investments and the long-term sustainability of energy-sharing schemes.
The CERS model illustrates how energy communities co-developed by public and local actors, supported by intermediaries and anchored in multi-level governance, can advance a more just and inclusive Urban Energy Transition. Future research should assess its long-term impacts and replicability.

SPECIAL SESSION

PARTICIPATIVE PLANNING FOR A JUST URBAN TRANSITION

Chair: Ilaria Beretta (Università Cattolica del Sacro Cuore - Faculty of Political and Social Sciences)

Since the adoption of the Rio Declaration and Agenda 21, climate change has increasingly been recognized as a central challenge for sustainable urban development (IPCC, 2022), placing cities at the forefront of mitigation and adaptation efforts. At the same time, a global scientific consensus has emerged on the link between climate change impacts at the urban level and issues of environmental and climate justice. Evidence from urban and rural settlements have demonstrated unequivocally that climate impacts are experienced disproportionately in urban communities, with economically and socially marginalized groups being the most affected (IPCC, 2022).

This consensus led to calls for justice-oriented strategies and local policies aimed at addressing the underlying political, social, and economic structures driving climate vulnerabilities and risks (Bulkeley et al., 2014).

In order to integrate issues of inequality and justice, most international agreements on sustainable urban development and urban climate action—such as UN Habitat III, Agenda 21, and the UN 2030 Agenda—advocated the integration of participatory processes in the design of local policies. While participation was recognized as a fundamental component of policy-making, particularly at the local level, the way participatory processes were designed made a significant difference in the distribution of environmental risks and benefits. Beyond participation, environmental and climate justice require consideration of

distributive and, above all, recognitional dimensions (Schlosberg, 2007; Fraser, 2009).

Through this special session, the organizers investigated how a deeper understanding of environmental and climate justice—also through the recognition of pre-existing inequalities and vulnerabilities—could support the design of more inclusive and equitable participatory processes for urban climate action. The session welcomed presentations addressing a wide range of topics related to participation in urban climate action, both theoretical and grounded in exemplary practices.

ORAL PRESENTATIONS

050 - Governing Climate Change: a foucaultian reading of the DESENACT project

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Keywords: Climate Adaptation, Biopolitics, Governmentality, Subjectivation, Participatory Education

Abstract This contribution explores the DESENACT project – Desenzano for Community Transition towards Climate Adaptation – using key ideas from Michel Foucault. Launched by the Alta Scuola per l'Ambiente (Università Cattolica del Sacro Cuore, Brescia) and the Municipality of Desenzano del Garda, the project supports local climate adaptation through action-research, environmental education, and citizen participation.
DESENACT starts from the idea that climate adaptation is not only a technical or legal issue, but also a cultural and social challenge. It requires communities to recognize their vulnerability, share knowledge, and build local responses. The project promotes a bottom-up approach that values local knowledge and supports intergenerational dialogue. This approach challenges the dominance of expert-based knowledge, opening space for subjective and everyday experiences.
A survey of 500 residents shows that people's knowledge about climate is often fragmented and influenced by symbolic or non-scientific views. DESENACT does not treat these views as wrong but uses them as a starting point for contextual and inclusive education (Malavasi, 2017; Birbes, 2017). This choice reflects Foucault's idea that knowledge is always linked to power and can support transformation.
In this context, the concept of biopolitics (Foucault, 2005) helps us understand how climate adaptation becomes a way of governing life – managing health, safety, and the environment. However, this form of governance can also risk producing passive behavior or blaming individuals instead of addressing systemic problems.
DESENACT tries to avoid this by promoting real participation. Citizens are seen as active agents who can contribute to decisions and promote change. This connects with Foucault's idea of governmentality (Foucault, 2015): a form of power that works not by force, but by guiding people's behavior through norms, education, and self-regulation.
In this way, adaptation becomes an example of ecological governmentality. People are invited to act responsibly, but this also requires critical thinking. It is important to distinguish between real empowerment and subtle control.
DESENACT proposes an educational path that supports ecological subjectivation (Cappa, 2013). Inspired by the ancient idea of epimeleia heautou (care of the self), the project encourages people to reflect, take care of others, and protect their environment. Through "meeting places" created by the project, different kinds of knowledge meet and citizens co-create shared narratives.
Finally, DESENACT can be seen as a practice of situated epistemology, where knowledge is built in relation to people, places, and experiences. Here, discourse (Foucault, 2004) is not only a way of communicating, but also a powerful tool for change – shaping new subjectivities, practices, and collective visions of the future.

061 - Environmental justice in the urban climate neutrality transition: The case of participation in the Italian Mission Cities

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Keywords: Urban Climate Neutrality, Environmental Justice, Participation, Sociotechnical Imaginaries

Abstract Cities and municipalities have become central actors for the transition to a greener and more just society, as e.g. SGD11 promotes more inclusive, safe, resilient and sustainable human settlements. While cities are the most vulnerable to and directly impacted from the effects of climate change (Bulkeley et al. 2015), they are also among the main polluters, as the estimates talk about 70% of greenhouse gases (GHGs) globally being produced in urban areas (IPCC 2022). Policymakers worldwide are thus implementing new strategies to tackle climate

change in the urban context. The goal of the present research is to investigate how cities are implementing climate change mitigation strategies, understood as the efforts to drastically reduce the concentration of GHGs in the atmosphere, by deeply decarbonizing the main energy and emission sources (Seto et al. 2021). While these efforts are often presented as a mainly technological and economic challenge, numerous studies show that smartness and technology for climate neutrality do not automatically produce social equity, but on the contrary can exacerbate already existing inequalities (e.g. March, 2022). The research thus focuses on questions of environmental and climate justice (Schlosberg, 2007) in the transition to urban climate neutrality at the European level, in the framework of the Horizon Europe Mission "Climate-neutral and smart cities". Through a qualitative analysis of the discourse in the main policy documents developed by European cities selected for the Mission (i.e. Climate City Contracts - CCC), an attempt is made to understand what kind of socio-technical imaginary (Jasanoff & Kim, 2015) for the climate-neutral city is envisioned by policymakers and what role, if any, issues of environmental and climate justice play in the urban transition to net-zero at the European level. This is done in particular through the analysis of the Italian case, with an in-depth analysis of the CCCs developed by the Italian cities part of the Mission, by investigating what challenges and solutions are identified by policymakers in the transition to net-zero emissions, and whether participation plays a role for the definition of more equitable policies, or as Hakuta and colleagues (2018) suggest, is rather a device for engaging citizens' responsibility for the transition.

098 - How and why to build participatory digital twins of nature-based solutions?

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Keywords: Legitimacy, Recognition Justice, Digital Twin, Nature-Based Solutions

Abstract Recent efforts to develop digital twins (DTs) for nature-based solutions (NbS) have primarily focused on capturing technical complexity, often overlooking the social and participatory dimensions essential to their real-world legitimacy and adoption. In the context of just urban transitions, this oversight risks reinforcing top-down decision-making and limiting the responsiveness of digital tools to diverse community needs.
This study explores how DTs of NbS can better reflect stakeholder perspectives by focusing on input legitimacy – the degree to which the knowledge embedded in DTs is co-produced through participatory processes. Drawing on four co-design case studies across Europe, we test four participatory methods from psychology and service design – namely, role construct repertory tests, the 20 statements test, impact journey mapping, and motivations canvassing, with 112 participants engaged in NbS implementation.
Our findings show that these methods produce stakeholder insights that can be directly translated into performance indicators and design principles for DTs. Psychology-based approaches elicit mental constructs and framing preferences, while service design tools reveal experiential values and potential use-cases. Together, these approaches allow DTs to be shaped not only about NbS performance, but also for the people they are meant to serve.
The main contribution of the study is demonstrating how knowledge brokerage can enhance the democratic legitimacy of DTs of NbS, offering practical methods for NbS project managers to ensure that their interventions reflect and respond to the needs of the wider public.

148 - Toward just and inclusive circular economy plans

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Keywords: Environmental justice, Circular economy, Vulnerable social groups, Inequality, Urban transition

Abstract As cities and regions increasingly adopt Circular Economy (CE) strategies to enhance resource-use efficiency and reduce environmental impact , they seek frameworks that are not only sustainable but also transformative (Hadfield et al., 2025). However, a critical dimension often remains underexplored: the unequal accessibility of circular practices and their associated social impacts (e.g., Monciardini et al., 2024). While CE is frequently framed as a pathway to foster urban and regional

transitions toward greater resource efficiency, this paper argues that such a perspective risks overlooking—and potentially reproducing—existing socio-economic inequalities (Liu, 2024; Wang & Lo, 2021).
This study focuses on the interaction between vulnerable social groups and CE practices, exploring their social impacts—particularly how such practices may reproduce or challenge structural inequalities. Drawing on empirical research conducted within the DUT ECLECTIC project, the study contributes by situating the CE approach within a justice-oriented framework that centers on the lived experiences and capacities of marginalized communities and social groups. We present and critically reflect on a mixed-methods research design developed to investigate the interaction between CE practices and vulnerable populations. Specifically, the methodology seeks to examine how structural inequalities influence access to CE practices—such as reuse, repair, upcycling, and food waste reduction—and to assess whether these practices serve as mechanisms of empowerment or, conversely, as avenues through which existing inequalities are maintained or exacerbated. The empirical research combines quantitative household-level surveys with in-depth interviews involving NGOs, social enterprises, and cooperatives across four regions: South Tyrol (IT), Coimbra (PT), Gothenburg (SE), and Jonava (LT). This mixed-methods approach enables a comprehensive understanding of how CE practices are adopted across different socio-economic groups and how they impact both vulnerable and non-vulnerable populations. It also helps identify the main societal effects of CE practices, particularly for vulnerable groups—whether positive (e.g., social inclusion, job creation, community empowerment) or negative (e.g., the reinforcement of systemic privileges, such as those based on class). While we will present selected preliminary findings from the ECLECTIC project, the primary aim of this presentation is to critically reflect on the methodology itself—its strengths, limitations, and potential for replication. We argue that such an approach is essential for developing inclusive, context-sensitive CE action plans that incorporate participatory planning and address the diverse needs of local communities, aligning CE strategies with broader goals of environmental and social justice in urban and regional transitions.

187 - Towards Landscape Justification: Participative Planning for Preserving Landscape Identity in Surcin, Serbia

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Keywords: Landscape Character, Landscape Quality Objectives, Just City, Co-Design, Geodesign, Scenario

Abstract Since the adoption of the European Landscape Convention (ELC, 2000) and growing calls for climate justice, landscape has emerged as a crucial dimension in discussions on spatial justice. However, it remains underrepresented in formal planning processes. As an expression of spatial justice, the ELC encourages assessing landscape quality objectives through both scientific and traditional knowledge, involving all stakeholders - officials, experts, and local communities. The Municipality of Surčin, within Belgrade administrative area, is experiencing intense spatial transformation driven by national large-scale infrastructure projects (e.g. EXPO 2027, the National Football Stadium) and investor-driven demand for residential and commercial development. These developments risk undermining the sensitive landscape character which embraces traditional values, social structures, and ecological functions, particularly the floodplain and steppe-like rural mosaics that have historically defined its identity. Current planning practices overlook the diversity, sensitivity, or climate-adaptive potential of such landscapes, while also failing to meaningfully involve/engage local communities in shaping transformation processes and an essential element of procedural justice (Rocco, 2023). This paper advocates for an integrated approach to landscape justification as recognitional and procedural justice in landscape and spatial planning. It aims to develop a framework, based on geodesign methodology (Steinitz, 2012), for preserving and enhancing landscape identity through integrated, collaborative, participative landscape planning. The research is part of the ongoing project "Preservation and Enhancement of Landscape Diversity and Character in the Municipality of Surčin," coordinated by the University of Belgrade Faculty of Forestry. The focus is on building inclusive participation processes and highlighting the need for just planning processes sensitive to landscape capacity and recognised through local knowledge. The research approach is based on landscape character assessment, complemented by stakeholder interviews and active community participation through co-design and scenario planning workshops. Preliminary results suggest that recognition of landscape values and their quality objectives through participation fosters broader public awareness and more

democratic decision-making. Local communities, often excluded from formal planning, express strong attachments to landscape features that contribute to place identity and climate resilience, such as forest remnants, agricultural fields, and water bodies. This research contributes to debates on spatial and climate justice by demonstrating how landscape identity, when meaningfully recognised through participative planning processes, can serve as both a functional and cultural basis for equitable urban transitions.

SPECIAL SESSION

INTERSECTING THE MULTIPLE SCALES OF CLIMATE JUSTICE: MAPPING INCLUSIVE ADAPTATION AND JUST FOSSIL FUEL TRANSITIONS

Chair: Francesca Peroni (University of Padua - Department of Civil, Environmental and Architectural Engineering)

Climate justice foregrounds the political and social dimensions of the climate crisis. It addresses questions of responsibility, impact, and decision-making, asking who is responsible, who is most affected, and who decides where and how to mitigate and adapt to climate change. Across interconnected geographical and policy scales—from the political geography of fossil fuels to the localized impacts of heatwaves on individual neighbourhoods—the spatial distribution of responsibility for greenhouse gas emissions, climate vulnerability, and proposed solutions called for an intersectional climate justice framework capable of ensuring more equitable and distributive mitigation and adaptation policies.

Historically, fossil fuel exploitation, particularly in the Global South, developed within different "zones of sacrifice," severely affecting the territories of local communities—such as Indigenous and mestizo populations and farmers—as well as fragile ecosystems in highly sensitive biodiversity areas. Implementing just transition pathways therefore required the adoption of restorative and reparative justice approaches, including infrastructure replacement, compensation mechanisms, community-centred renewable energy systems, community-based and ecosystem-based adaptation strategies, and the creation of alternative and sustainable economic opportunities, thereby enabling equitable and sustainable fossil fuel phase-out processes.

At the same time, the increasing frequency and intensity of extreme events—such as droughts, heatwaves, and intense precipitation—amplified existing socio-economic and cultural inequalities worldwide. These climate extremes had particularly strong impacts in urbanized areas, which host more than 50% of the global population. Despite this, urban adaptation policies often overlook the unequal spatial distribution of climate impacts and adaptation measures. This oversight contributed to exacerbating the vulnerabilities of disadvantaged and low-income populations—including migrants, older adults, children, and women—reinforcing existing inequalities through unjust and unfair interventions. Moreover, many urban adaptation plans risk triggering gentrification and displacement.

Inter- and multidisciplinary approaches from geography and GIScience provide a holistic framework for analysing both the socio-environmental impacts of climate change and climate policies. By integrating qualitative and quantitative methodologies, these approaches enable territorial analyses and simulations of inclusive adaptation and mitigation scenarios, support decision-making processes, and facilitate conflict negotiation among diverse territorial actors.

This special session brought together case studies, perspectives, challenges, and critical reflections on "just transitions" and "just adaptation," aiming to stimulate debate and promote the recognition and integration of climate justice into climate policies across different governance scales. Particular attention was given to case studies that analysed these phenomena through the critical lens of geography, employing geospatial technologies and cartography (GIS, WebGIS, GeoApp), participatory approaches, and empowerment processes.

ORAL PRESENTATIONS

127 - Citizen Science Ferrara: community-based environmental monitoring for co-design mitigation actions and improve climate justice

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Keywords: Citizen Science, Policy Co-Design, Open Data, Climate Justice, Data Justice

Abstract Traditionally, the development of policies has taken placed behind closed doors, under more traditional managerial approaches. It is against this background that co-design is seen as an alternative to provide a more open approach to the policy design process. This more open approach has proven that it can support synergies, learning and commitments to address complex problems and foster innovation.
The Citizen Science Ferrara (CSF) initiative represents an innovative approach to community-based environmental monitoring, promoted within the USAGE project (www.usage-project.eu) in collaboration with Fiumana APS association. This initiative addresses climate and data justice by empowering the local community in Ferrara (Italy) to actively participate in data collection and environmental policy-making processes.
CSF focuses on three critical environmental challenges affecting Ferrara's fragile urban ecosystem: extreme flooding events, urban biodiversity loss, and urban heat islands. These issues disproportionately impact vulnerable populations, making community involvement essential for developing equitable and effective adaptation strategies.
CSF prioritizes people-centered approaches, engaging over 100 students from three high schools and more than 200 citizens through training sessions (both in-person and online), informational materials, field data collection campaigns, and participation in environmental events (NoiSiamoAmbiente, City Nature Challenge, International Environment Day, Water Day, Biodiversity Day). Participants receive technical support from university experts (Padova and Ferrara Universities) and public institutions (ARPAE, Ferrara Municipality).
The initiative provides accessible data collection solutions including free mobile apps (iNaturalist, QField, GoogleForms) and low-cost sensors (MeteoTracker). A comprehensive "Citizen Scientist Manual" offers step-by-step guidance for using software and tools, with all training materials available at www.citizenscienceferrara.org.
This bottom-up approach to environmental governance demonstrates the potential for citizen science to bridge the gap between community knowledge and institutional decision-making in addressing urban climate challenges, by leveraging on standard-based sharing of citizen science sourced data through the city open data portal (https://dati.comune.fe.it) and via standard OGC protocols and formats.

131 - Towards an Arctic Atlas of Unburnable Carbon: Mapping Oil and Gas Extraction, Biodiversity and Indigenous Lands through a climate justice lens

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Keywords: Climate crisis, Unburnable carbon, Arctic; Biodiversity, Indigenous Lands, Fossil fuels

Abstract Leaving the majority of fossil fuel resources underground and phasing out fossil fuel production are essential steps to keep planetary boundaries within climate-stable limits. In this context, the Arctic has emerged as a critical frontier in the global discourse on fossil fuel phase-out and biosphere protection. This study presents the first spatially explicit atlas of oil and gas extraction across the Arctic, using openly accessible geospatial data and a GIS-based methodology to analyze interactions with biodiversity conservation areas and Indigenous Peoples' Lands (IPLs). By adopting the Arctic region's CAFF boundary, the analysis covers both terrestrial and marine zones across five Arctic countries, allowing for consistent spatial comparisons and transnational insights.
Our findings reveal significant spatial overlaps and proximities between extractive activities and sensitive biocultural territories. Approximately 543,000 km² of the Arctic—comparable to the size of France—are already under extraction licensing, and nearly one million km² are open for bidding. Russia alone accounts for over 65% of Arctic concessions, often within IPLs. Results show that 73% of Arctic oil and gas concessions overlap IPLs, and 7% intersect Protected Areas. Infrastructure such as wells, pipelines, and seismic lines frequently impact ecologically vital zones, including protected areas and key Arctic species ranges. In Alaska, the proximity of fossil fuel projects to Indigenous communities highlights structural gaps in procedural justice, particularly the lack of meaningful consultation and free, prior, and informed consent.
The research also highlights the phenomenon of "non-overlapping conflicts," where socio-environmental risks exist even in the absence of formal spatial overlaps, due to buffer-zone impacts. Through proximity analysis and overlay mapping, the study identifies potential conflict hotspots where oil and gas infrastructures are located near IPLs and conservation areas. These spatial insights challenge purely legalistic approaches to land use and emphasize the need for buffer zones, cumulative impact assess-

ments, and stronger Indigenous participation in governance.
We argue that supply-side climate policies must integrate spatial justice considerations to address both ecological fragility and Indigenous land rights. Considering the Arctic's growing geopolitical instability and its role in global fossil fuel supply, this study calls for the creation of an Arctic Fossil Fuel Non-Proliferation Zone grounded in climate justice and Indigenous leadership, inspired by recent global initiatives like the Fossil Fuel Non-Proliferation Treaty. By making spatial conflicts visible, this work contributes to the mapping of inclusive and just transition pathways across one of the planet's most threatened and symbolic regions.

133 - Climate justice in warming cities: mapping ten years of climate extremes and their potential impacts in Padua (Italy)

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Keywords: Urban Heat Islands, Urban Climate Justice, ERA 5; Heatwaves, Just Adaptation

Abstract In a +1.5 °C global warming world, record-breaking daily maximum temperatures will become even more frequent, intense and long-lasting, jeopardizing both urban infrastructure and public health. Thus, heat-related health risk represents an increasingly crucial issue, especially for cities world-wide, particularly Euro-Mediterranean region, widely recognized as a significant hotspot for the impacts of extreme meteorological events, such as heatwaves. Such events may exacerbate the phenomenon of urban heat islands (UHI), which dramatically increase climate risks, particularly in high-density urban areas. These impacts will disproportionately affect already marginalized people, including the poor, ethnic minorities, and women. As a result, mapping climate justice in the city requires understanding the overlapping patterns between the heat island phenomenon and the spatial distribution of vulnerable and disempowered groups - the ones who are taking the brunt of climate change impact. Moreover, the UHI phenomenon affects particularly elderly and children, which are the most affected by heat-related risk. This study aims to identify, quantify, and map UHI-related risk in the city of Padua (Northeast Italy), with a focus on climate extremes related to heatwaves, such as tropical nights and hot days. The study relies on high-resolution air temperature data (100 m) from the ERA5 climate model for the period 2008–2017 to map and quantify tropical nights and hot days. Such data are then combined with socio-demographic data from the municipality of Padua and used to compute the Urban Heat-Related Risk Index (UHRI).
Our findings highlight the presence of disproportionate risk among different neighborhoods. Specifically, marginalized areas of the city - such as the main train station, Stanga ad Arcella neighborhoods - are entrenched in multiple sources of risk being at the same time among the most affected by the intensity of UHI, high demographic density areas and hotspots for vulnerable populations and marginalized groups, such as foreigner immigrants.
In conclusion, the study confirms that an integrated approach should be considered to include the issue of justice and equity into climate risk assessment and adaptation planning.

153 - Equitable urban climate action through microclimatic simulations: a case study from Padua (Italy)

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Keywords: Equitable Climate Planning, Urban Heat Island, Microclimatic Simulations, Thermal Comfort

Abstract Urban heatwaves represent one of the most pressing local manifestations of climate change, exposing and amplifying existing socio-spatial inequalities in cities and raising critical questions for climate justice. In this context, the Urban Heat Island (UHI) phenomenon has become increasingly relevant for assessing differential risks and planning inclusive adaptation and mitigation strategies.
This study explores the potential of microclimatic simulations to support equitable urban climate planning, focusing on the city of Padua (Italy). The objective is to identify critical heat-exposed areas

and assess the effectiveness of local mitigation and adaptation measures, based on extreme temperature events recorded during the 2024 heatwaves. The analysis combines ENVI-met with open-source, GIS-based tools to simulate current and post-intervention scenarios at neighbourhood scale.
Results show how targeted interventions, such as urban greening, permeability enhancement, and the application of high-albedo surfaces, can improve outdoor thermal comfort in areas with high exposure and limited adaptive capacity. Specifically, urban greening is shown to reduce mean radiant temperature by up to -24 °C, UTCI by -6.3 °C, and PET by -10.7 °C during peak heat conditions.
The spatial overlap between heat hotspots and socially vulnerable neighbourhoods underscores the importance of integrating justice considerations into climate policy design. The findings demonstrate the added value of spatialised microclimate modelling in identifying priority areas for intervention and informing more inclusive, needs-based local climate action.
Future developments will aim to apply this methodology to other vulnerable urban contexts, further refining the approach through the inclusion of additional social and physical indicators, customising thermal comfort parameters for specific population groups, and experimenting with alternative open-source microclimate tools to enhance replicability and accessibility.

156 - Democratizing Science for Urban Climate Justice: the SCIFT experience in Bologna

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Keywords: SCIFT, Climate Justice, Future Cities

Abstract Cities are the most densely populated areas in the world, containing over half of the global population. These urban settlements are undergoing continuous expansion , driven by the construction of new infrastructure and the promotion of gentrification processes. Such dynamics contribute to increasing soil sealing and the fragmentation of green and blue spaces. Cities are progressively becoming more uninhabitable because of the worsening climate crisis. This is, in turn, fuelled by political inaction and inadequate adaptation and mitigation strategies to prevent the impacts of increasingly frequent and intense extreme weather events. . From the perspective of urban climate justice, these facts are disproportionately affecting vulnerable populations and marginalized social groups. In response, a reimaging of urban configuration and governance is urgently required. The experience of SCIFT (Science, Climate Activism, Imagination, Fostering Knowledge and Technology) emerges in this context. SCIFT is a laboratory based in Bologna (Italy),, where science and activism converge to propose a new form of urban climate actions. This critical space organizes various activities (workshop, seminar, roundtables), but it is mainly focused on the independent monitoring of the city through a methodology grounded in the principles of extreme citizen science . This approach actively engages all kinds of citizens, together with local organizations, in collecting and interpreting data, while also raising awareness about urban and climate-related issues. The generation of free, open and inclusive scientific data and knowledge, produced in collaboration with the plurality of stakeholders within the urban ecosystem, has the core objective of rethinking the configuration of Bologna through an equity and justice oriented lens. Using GIScience tools (satellite data, meteorological mobile sensors and stations) SCIFT aims to assess the impact of extreme events, particularly heatwaves and the urban heat islands. In parallel, the lab supports preventive monitoring of land-use change processes, especially those linked to soil sealing initiatives. Ultimately, this contributes to the bottom-up transformation of the city by advancing the democratization of science. This vision calls for urban strategies and planning processes able to respond to the current climate crisis, prioritizing the citizen well-being and the protection of natural ecosystems for a just and equitable future city.

218 - Spatial Disaggregation of Urban GHG Emissions: Empirical analysis based on an expanded Kaya Identity

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Keywords: Urban Emissions, Kaya Identity, GHG Emissions, Climate Change, Spatial Disaggregation

Abstract Cities are increasingly recognized as critical nodes in the global carbon footprint. Accordingly, there is an increasing interest in the measurement of urban emissions. Traditional greenhouse gases (GHG) inventories often provide a macroscopic view of emissions, obscuring the heterogeneity of cities. Recognizing this gap, this study proposes an expanded Kaya identity to spatially disaggregate the carbon emissions inventory and depicts future urban GHG emissions scenarios. Including additional variables to expand the traditional Kaya identity allows to retrieve a spatialized approximation of the emissions inventory that considers the heterogeneity of the city 's socioeconomic structure within the model. To contextualize this framework, Bogota, Colombia, was chosen as case study. Following the spatial extent of the planning units of the city as disaggregation extent of the GHG emissions, this article offers a view beyond the limitations of the traditionally aggregated data. Such disaggregation underscores the nature of urban emissions, influenced by the distribution of the population, income levels, and socioeconomic strata. This approach allowed to retrieve a spatialization of the GHG emissions scenarios provided by the local administration with a higher level of granularity and an explicitly spatial methodology. The results facilitate targeted policy interventions for effective urban climate action and the cities' sustainability transition.

224 - Data from the Margins: Intersectional Climate Justice and the Role of Personal Narratives

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Keywords: Climate Data, Intersectionality, Knowledge, Narratives, Litigation, Methodological Pluralism

Abstract Scientific evidence is crucial in addressing climate issues, particularly in planning resilience actions and transition paths. However, its use raises pressing epistemological questions: Who determines what constitutes valid evidence, and whose voices are heard or excluded? This study investigates the role of personal narratives—first-hand accounts of lived climate experiences—as potential game-changers in the production of climate justice data.
As climate change impacts intensify, climate litigation is gaining prominence. The Sabin Center's Climate Change Litigation Database has recorded over 2,600 cases to date. In a general context of inadequate governmental climate action, civil society members are increasingly turning to courts to contest decisions deemed climatically harmful and advocate for more ambitious policies. Whilst most cases rely on institutional scientific evidence, recent litigation has seen an emerging use of personal narratives from individual parties. The phenomenon characterizes litigation globally, with a prominent reliance on forms of personal narratives in cases recorded in the Global South.
These narratives, as forms of 'observational' evidence, complement dominant scientific data but raise fundamental methodological questions: Whose knowledge counts? What qualifies as admissible data? Who decides what forms of data are considered legitimate in climate litigation?
Drawing on Science and Technology Studies (STS) insights, this presentation examines how scientific authority is shaped by power relations, gatekeeping practices, and cultural norms that often exclude alternative epistemologies. Through the lens of epistemic justice and intersectionality of climate impacts, we argue that incorporating diverse knowledge systems—via citizen science, storytelling, and participatory approaches—is vital for planning a just transition.
We propose that methodological pluralism, combining qualitative and quantitative data, offers a pathway towards more inclusive and legitimate climate action. By centring data from the margins, climate litigation becomes not only a forum for legal redress but a contested space where knowledge, authority, and justice are actively renegotiated.
This study contributes to the growing discourse on climate justice, offering insights into the potential of personal narratives to reshape our understanding and approach to climate litigation, and to broader policy-making and interventions on climate matters.

233 - Circumnavigating Efficiency: Harnessing GIScience to unveil the Hidden Emissions from the Deliberate Drifting of LNG Carriers

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Keywords: LNG, Maritime Trade, GIScience, Methane Emissions

Abstract Maritime trade is a significant contributor to greenhouse gas (GHG) emissions. For this reason, recent amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) have focused on curbing not just pollution but also the GHG emissions that arise from shipping. These developments have introduced the mandatory measurement of energy efficiency for ships beyond a certain tonnage, in accordance with an annual operational Carbon Intensity Indicator (CII) devised by the International Maritime Organisation (IMO), effective since 2023. The IMO uses the CII indicator as a criteria for imposing corrective actions on ships achieving low ratings. Plainly defined as the ratio between a vessel's carbon emissions and its total mileage over a year, the CII has, as this research will seek to demonstrate, resulted in vessels with otherwise low ratings deliberately travelling longer distances for the sole purpose of increasing their ratings to a favourable value. Instead of navigating for the purpose of making progress towards a destination, these vessels intentionally sail in circles – in effect causing greater emissions than would otherwise have occurred. In one particular instance a vessel has been observed sailing aimlessly for nearly a month (lengthening its journey by a factor of 3.3), rendering the CII an inadequate instrument for its purpose. This phenomenon is prevalent among modern liquefied natural gas carriers (LNGCs). Due to the unstable nature of their super-chilled cargo, these vessels are by design unable to come to a stop as long as they are laden. This is due to the fact that their engines are built to run on the "boil-off" gas (BOG) that evaporates from the holds as the LNG inevitably heats up along a journey. Idling LNGCs could manage BOG by means of flaring or by re-liquefying it onboard, but are instead compelled to sail in circles to ensure that even as their emissions increase, so too does their mileage, keeping the vessel's overall CII ratio stable. Flaring or re-liquefaction could potentially be less emissions-intensive than aimless sailing, but the latter strategy is preferred so as not to incur penalties. At the same time several shipowners are reaping benefits, thanks to their seemingly virtuous ratings, which allow them to apply for sustainability-linked financial facilities. This research employs advanced GIS techniques able to accurately distinguish purposeful navigation from aimless drifting. This is done in order to understand the scale of this phenomenon and quantify the nautical miles travelled and the associated greenhouse gases emitted as an unintended consequence of the introduction of the CII indicator. The ultimate goal is to create a replicable methodology that can empower decision-makers to formulate more equitable and effective climate mitigation policies for the maritime industry.

TRACK 5

Economics and Valuation of the Urban Energy Transition

TRACK 5
Economics and Valuation of the Urban Energy Transition

As cities are increasingly taking a leading role in the energy transition, there is a growing need to assess how investments in renewable energy and decentralized systems created economic, environmental, and social value at the local scale. This track explored the valuation, financing, and policy dimensions of urban energy systems, focusing on how market mechanisms, financial models, and spatial–economic tools could support evidence-based decision-making and foster sustainable local development.

Key topics included the economic appraisal of urban energy projects—such as CAPEX/OPEX analysis, cost–benefit analysis (CBA), and risk assessment—the role of Renewable Energy Communities (RECs) in value generation and place-based innovation, and the integration of decision-support systems (DSS) and agent-based models to evaluate policy scenarios and market design. By examining the financial and macroeconomic benefits of urban energy projects, the track aimed to provide insights into how local economies could support the transition toward sustainable energy systems.

Particular attention was also given to real estate market dynamics, property value impacts, and the role of sector coupling and smart grids in enhancing the territorial capital and resilience of urban systems.

REGULAR SESSION

ECONOMICS AND VALUATION OF THE URBAN ENERGY TRANSITION

Chairs: Eugenio Muccio, **Giovanni Libardoni** (Eurac Research - Institute for Renewable Energy)

As cities lead the energy transition, understanding how investments in renewable and decentralized energy systems generate local economic, environmental, and social value becomes crucial. This session examined the valuation, financing, and policy dimensions of urban energy systems, exploring how market mechanisms, financial models, and spatial–economic tools could inform evidence-based decision-making.

Key topics included economic appraisal methods such as cost–benefit analysis, the role of Renewable Energy Communities in fostering innovation, and the use of decision-support systems to evaluate policy scenarios. The session also addressed real estate market dynamics, property value impacts, and how sector coupling and smart grids enhanced territorial resilience, providing insights into how local economies could effectively support and benefit from the energy transition.

ORAL PRESENTATIONS

035 - The CoolST Project - Adapting to Climate Change Impact: Crafting South Tyrol's Cooling Future for Energy Resilience

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Keywords: Cooling, South Tyrol, Energy Market, 2040

Abstract CoolST aims to shed light into the cooling market of South Tyrol (ST), providing evidence on the amount of cooling units installed, per type, per sector (residential, tertiary, industry, and transportation) - quantifying actual energy consumptions, being able to generate projections for upcoming years (2040), so to clarify future energy needs and set ground on how to face them best. CoolST will provide a Knowledge Hub, an online open-source repository of assembled and quality-controlled data and information about ST's cooling market, and a Tool transforming this data/information into knowledge easily understandable (i.e. graphs). Since households will play a more and more crucial role in this context, CoolST will focus on the residential sector. The focus will be on generating missing primary data by a number of bottom-up approaches. A detailed market analysis will identify the supply chain structure, assessing market shares of manufacturers, sellers, and resellers at the provincial level for direct data retrieval. Moreover, parametric simulations will be carried out, based on local climatic datasets, social clusters, and archetypes etc. Outcomes will be compared, evaluated by experts, and counterposed to the few available results of reliable/scientific sources. CoolST will adopt an interdisciplinary approach, intersecting the areas of engineering, architecture, economics, user-behaviour, ecology, health, and policies. We will gather data/information about the cooling market in ST, providing a comprehensive investigation on the status quo and future developments.

076 - Do Energy Conservation Workshops Help Households Save Energy? Experimental Evidence from Urban Apartment Communities

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Keywords: Demand-Side Management, Behavioral Intervention, Smart Meters, Electricity Tariffs, Urban Households

Abstract We evaluate household responses to a series of community-based, classroom-style energy conservation workshops aimed at reducing residential electricity consumption. These workshops, held in the common areas of apartment complexes in urban Taiwan, were designed as a low-cost behavioral intervention and demand-side management (DSM) strategy. Participants were provided with tools to better understand household electricity usage, interpret electricity bills, and adopt practical energy-saving behaviors—for example, recognizing the energy use of various appliances, using affordable timers to manage consumption, and understanding Taiwan's progressive electricity tariff scheme. The workshops also introduced the concept of smart meters and examined how the lack of real-time usage feedback may affect users' cost perception and responsiveness to price signals.
Using a difference-in-differences model with household and time fixed effects, supplemented by two synthetic control methods for robustness, we find that the overall reduction in electricity use is modest—ranging from 3% to 10% in the baseline model, though not statistically significant in the synthetic control specifications. Heterogeneous effects, however, are consistent: households with higher initial energy knowledge, more conservative goal-setting, no automatic bill payment, sole decision-making authority, and longer air conditioner usage are more likely to reduce electricity consumption after the intervention. Our findings demonstrate the multifaceted value of such workshops, including educational and behavioral benefits, enhanced cost awareness, and energy-saving potential. By improving public understanding of energy consumption, tariff structures, and conservation tools, these workshops empower households to shift their usage patterns—particularly by avoiding peak pricing brackets and reducing peak load pressure on the grid. Compared to large-scale infrastructure upgrades, community workshops are a cost-effective way to promote energy democracy, support DSM strategies, and accelerate behavior-based energy transitions. The results

further offer empirical insights to guide government policies on scaling up smart meter adoption and advancing smart grid integration in urban and aging residential contexts.

089 - Hourly Energy Model of Residential Health Care Facilities for their Assessment in Renewable Energy Communities

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Keywords: Renewable Energy Community, Energy Modelling, Residential Health Care Facility, Self-Consumption

Abstract Achieving energy transition in urban areas requires innovative approaches that match renewable energy production with local consumption patterns while addressing social and economic sustainability. Renewable Energy Communities (REC) represent a strategic model for energy transition, enabling citizens, businesses, and public bodies to produce, consume, and share renewable energy. This promotes sustainable behaviours and greater responsibility towards efficient energy use, while creating new opportunities for innovation and decentralization.
This work focuses on the role of residential health care facilities (RSA, using the Italian acronym) within RECs. Even though RSAs are energy-intensive consumers and, therefore, can have a significant impact in local energy sharing, there is a gap in the literature as regards their energy modelling, while the adoption of generalized consumption profiles fails to properly capture their actual characteristics. This paper presents a data-driven model implemented to create normalised hourly electricity consumption profiles for RSAs. The dataset used for this analysis includes real energy data from five facilities located in Northern Italy, with different size, number of beds and installed photovoltaic (PV) equipment. The methodology includes data preprocessing to remove inconsistencies, PV self-consumption assessment, and a custom interpolation algorithm for missing data. Representative normalized hourly load profiles are derived for each month, distinguishing between weekdays and holidays, and model validation shows maximum deviations below 25% compared to real data.
The resulting profiles have been integrated into the testing environment of RECON, an online simulation tool developed by ENEA aimed to assess the energy and economic performance of RECs according to the current Italian legislative and support schemes. Results demonstrate that a REC with RSA can achieve high levels of diffuse self-consumption and self-sufficiency when coupled with appropriately sized PV systems, alongside economic benefits that can be used to activate community services, thereby enhancing local welfare.
Therefore, this study aims at contributing to plan strategies for energy transition in cities and territories and shows how social welfare structures integrated into RECs can foster economic and social value, inclusivity, and long-term resilience and sustainability.

151 - Digital Twins for Positive Energy Districts (PEDs): a decision-support model for energy planning in urban areas

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Keywords: Positive Energy District, Digital Twin, Cost-Benefit, CBA, MCDA

Abstract As cities lead the transition toward climate neutrality, the development of Positive Energy Districts (PEDs) presents a multidimensional challenge that spans technical, economic, and social dimensions. This study investigates the application of Digital Twin (DT) technology as an integrated decision-support system to guide urban energy planning and policy. We propose a novel methodological framework that combines Cost-Benefit Analysis (CBA) with Multi-Criteria Decision Analysis (MCDA) to evaluate and rank alternative PED implementation scenarios, capturing both monetary and non-monetary impacts on local development.
Building on established practices in environmental and infrastructure decision-making, our approach is tailored to the urban energy context through the dynamic capabilities of a DT. Leveraging the ExPEDite Horizon Europe project, the proposed approach is applied to a district in Riga, the capital city of Latvia, where the DT integrates real-time data on energy consumption, building performance, and user behavior. This integration enables the simulation of alternative retrofit and renewable energy strategies under various financial, environmental, climate and behavioral assumptions.

CBA is employed to evaluate project feasibility and economic returns while MCDA accounts for critical qualitative dimensions such as energy resilience, carbon reduction, and citizen engagement. The two streams are integrated into a hybrid scoring and ranking model, offering an economic decision-support tool for urban stakeholders and policymakers. The research contributes to emerging debates on the economic valuation of urban energy projects, demonstrating how advanced modeling tools can support evidence-based planning, risk-informed investment decisions, and policy co-design. By facilitating structured trade-offs between financial, environmental, and social objectives, the proposed approach promotes more transparent and participatory energy transition pathways. Additionally, the study addresses the potential for DT-based tools to enhance local governance capacities, inform place-based innovation strategies, and strengthen the territorial capital and resilience of urban systems.

SPECIAL SESSION

INNOVATIONS IN DECISION-SUPPORT AND AI-DRIVEN VALUATION FOR URBAN ENERGY TRANSITION

Chairs: Marta Bottero (Politecnico di Torino), **Eugenio Muccio**, **Adriano Bisello** (Eurac Research - Institute for Renewable Energy), **Alessandra Oppio** (Politecnico di Milano)

Achieving a just energy transition in cities requires evidence-based and optimized decision-making processes capable of addressing environmental, economic, and social dimensions. This special session invited contributions exploring how decision-support tools, including AI-driven applications, could enhance the multidimensional evaluation of urban and territorial transformations. Artificial intelligence played an increasingly pivotal role by enabling the identification of spatial patterns, predictive modelling, and the comparison of alternative scenarios, thereby helping to navigate complexity and assess multiple benefits and impacts across different scales.

The session focused on evaluation methodologies supporting energy transition strategies at urban and regional levels, including their impacts on property values, mass appraisal techniques, machine learning applications, spatial data analysis, and participatory decision-making frameworks. Particular emphasis was placed on data-driven approaches integrating geographic information systems (GIS), multi-criteria decision analysis (MCDA), and advanced spatial analytics to model urban dynamics, assess intervention scenarios, and align decisions with sustainability and equity objectives.

The session welcomed contributions presenting methodological innovations, case studies, and critical reflections on these evaluation practices. It aimed to advance decision-support tools and evaluation frameworks that bridged technical potential with societal needs, empowering decision-makers to design and prioritize interventions that fostered energy-efficient, resilient, and inclusive cities.

ORAL PRESENTATIONS

141 - Digital Tools for Urban Change: Empowering Local Governance through the new software IBTool

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Keywords: DSS, MCDA, IBTool Software, GLOSSA Project, Sustainable Urban Transition

Abstract Urban areas play a pivotal role in driving multi-dimensional transitions, yet local administrations often lack the appropriate knowledge and tools to assess the impacts of projects and plans, including those related to energy investments or associated sectors.
The impact of digital decision-support tools on urban transitions can be understood as the process leading to the reorganisation of Public Administration (PAs) work at tactical and operational levels through the use of technology. Digital assessment tools, such as Decision Support Systems (DSS) or Group Support Systems (GSS), enable local administrations to manage socio-technical transitions in urban settings due to their capabilities in real-time data visualisation and processing, scenario simulation, and performance-based decision-making.
Addressing this knowledge gap, among various objectives, the GLOSSA research project (GLOcal Knowledge-System for the Sustainable Assessment of Urban Projects), funded as a Project of Relevant National Interest (PRIN), has developed the Indicators-Based Tool (IBTool), an innovative DSS designed to assist public PAs in the impact evaluation and monitoring of urban regeneration projects. This is

aligned with the 2030 Agenda guidelines, with a particular focus on SDG 11 targets and indicators.
IBTool functions as an open-source, modular software platform that integrates qualitative and quantitative methods to generate composite indices of territorial performance and project impacts. By combining multi-group and multi-criteria decision analysis (MCDA) techniques with locally adapted indicators, the tool enables context-sensitive project appraisal, long-term monitoring, and the integration of sustainability, equity, and resilience goals into planning and decision-making processes.
As part of the GLOSSA project, training activities have been designed to test the tool's functionality, explore its potential and limitations, and engage users from diverse backgrounds and levels of expertise. These activities serve a dual purpose: improving the tool's usability and fostering dialogue on the role of indicators as key instruments for advancing urban transition processes aligned with SDG 11.
Preliminary findings from beta tests conducted in multi-stakeholder settings reveal the tool's effectiveness in aligning policy design with shared priorities, enhancing transparency in project evaluation, and supporting sustainability principles linked to equity, democracy, and participation. This contribution presents the theoretical foundations, methodological framework, and initial results from GLOSSA's training programme, offering insights into the indicator selection process and its relevance for financing, governance, and evaluation strategies in the context of resilient and low-carbon urban systems.

166 - An evaluation framework of public-private compensation mechanisms in energy efficiency interventions in residential building stocks

Debora Anelli (1) - Pierluigi Morano (2) - Francesco Tajani (1)

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Keywords: Green Value Recapture, Energy Transition, Compensative Model, Energy Performance Of Buildings

Abstract The revision of the European Directive on the energy performance of buildings (EPBD) stipulates that, by 2030, the sale and rental of residential properties in an energy class lower than E will be prohibited. In Italy, where over 60% of the building stock is classified in class F or G, these regulatory provisions may have repercussions on the real estate market, thereby rendering energy efficiency interventions mandatory. In such a scenario, there is a necessity to equip oneself with evaluation tools capable not only of estimating the financial profitability of interventions, but also of exploring innovative ways of managing and capturing the surplus value created. Among these, the principle of Green Value Recapture (GVR) is of particular importance, understood as a hypothesis of recovery, by the community, of a share of real estate surplus value induced by energy transformations supported – directly or indirectly – by public policies.
The present work puts forward a proposal for an integrated assessment framework, with the aim of achieving the following objectives:
i) the identification of the minimum interventions necessary for the adjustment to class E, and the subsequent assessment of their financial profitability, is of paramount importance;
ii) the assessment of the real estate surplus value associated with the energy class improvement;
iii) outlining potential GVR mechanisms for the redistribution of benefit generated according to sustainable urban taxation logic.
The proposed framework is conceived as a potentially generalisable evaluation tool, capable of accompanying the energy transition of the existing building stock by integrating four different analytical dimensions – energy, economic, regulatory and fiscal. These dimensions are considered useful for increasingly implementing cost-effectiveness evaluation mechanisms. The logical structure of the framework enables a systemic reading of energy requalification processes, thereby enhancing the connection between regulatory obligations, investment choices and redistributive impacts.
The contribution sets out to promote an integrated and replicable evaluation approach, which is intended to combine private convenience and public interest in the context of managing the urban energy transition.

179 - Learning from the past: AI-Driven insights from SNAI 2014–2020 to guide territorial strategies definition processes

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Keywords: Inner Areas, SNAI Strategy, AI-Empowered Text Mining, Agri-Food, Economic Enhancement, Rural Development

Abstract Inner areas in Italy face persistent socio-economic challenges—including demographic decline, weak service provision, and limited economic dynamism—which traditional development policies often fail to address effectively. A key limitation is the absence of structured, data-driven evaluation mechanisms to guide strategic planning. This research aims to develop and apply a data-driven and Artificial Intelligence (AI) based methodological approach to support decision-making processes that address territorial inequalities and enable multidimensional evaluation of local development strategies.
Conducted by the Politecnico di Torino within the Branding4Resilience (B4R) research project, this research proposes a five-step AI-based methodological approach combining data-driven analyses and participatory listening processes with stakeholder engagement. It integrates open datasets (notably the "OpenCoesione" database), text and data mining, topic modeling (LDA), and clustering techniques to identify spatial and thematic investment patterns, strategic gaps, and funding imbalances in past territorial development interventions.
The proposed methodological approach was applied and tested in the context of Valsesia, a new Italian Inner Area nominated by the second programming cycle 2021-2027 of the "National Strategy for Inner Areas" (SNAI), with a specific focus on the agri-food sector.
The analysis revealed a national underinvestment in "Research & Innovation" and "Competitiveness of companies" within agri-food strategies, particularly in the Piedmont region. In Valsesia, SMEs in the agri-food sector emerged as potential drivers of local development, with strong potential to support youth employment, sustainable resource use, and innovation. Mapping past interventions allowed the identification of recurring strategic actions at the national level, in the field of technological innovation and digitalization of the agri-food sector and of circular economy and food waste reduction.
Results showed how open data analyses and AI-empowered text mining can effectively support territorial strategies definition processes and the related allocation of resources. The test conducted in the Valsesia area led to the identification of a set of Key Strategic Actions (KSAs) in the agri-food sector, as integral components of a broader Territorial Roadmap, offering a replicable planning support tool for local authorities. The framework bridges technical potential with local needs, empowering public decision-makers to design and prioritize strategic and place-based interventions.

180 - Supporting Public Decision-Making in Energy-Efficient Heritage Preservation within the Framework of Renewable Energy Communities

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Keywords: Life Cycle Costing (LCC), Heritage Energy Empowerment, Renewable Energy Communities, Public projects

Abstract Effective financial and economic analyses are crucial for guiding public-sector strategies in the energy transition, particularly in contexts involving architectural and landscape heritage and different stakeholders.
This research proposes a methodological approach developed to support Public Administrations in decision-making processes to identify and evaluate energy empowerment strategies within the framework of Renewable Energy Communities (RECs). The approach is applied to the case of the future public spaces of the Former Ammunition Depot in Sangano (Piedmont, Italy), a historical abandoned site now targeted for redevelopment within the local REC improvement.
The economic evaluation of heritage energy empowerment is based on Life Cycle Costing (LCC) as a decision-support tool to compare alternative intervention scenarios in a life cycle perspective, accounting for long-term operational, maintenance, and end-of-life implications of energy retrofitting solutions. The decision-making process is based on a structured involvement of Public Administrations, actively engaged in all evaluation phases to ensure institutional feasibility and shared outcomes.
LCC emerges not only as a cost assessment tool but as a core component of the decision-making workflow, enabling the identification of economically sustainable strategies aligned with energy transition objectives, budgetary constraints, and heritage conservation priorities. The results demonstrate the value of a replicable and adaptable evaluation framework to support small and mid-sized municipalities in planning resilient, inclusive, and financially grounded transition pathways.

229 - Spatial Decision Support in Transitional Cities: Integrating Machine Learning and GIS-MCDA to Assess Housing Price Dynamics

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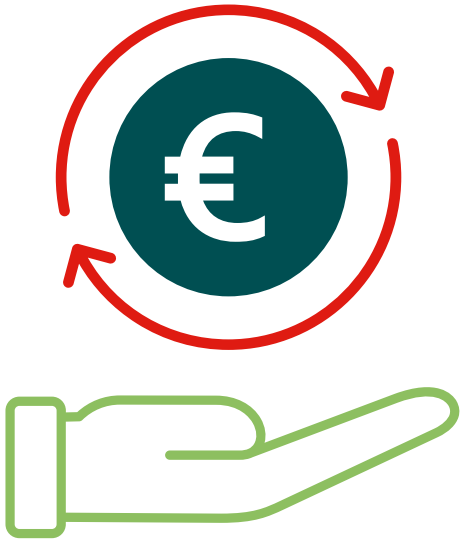
Keywords: Spatial Decision Support System, Real Estate, Spatial Econometrics, LASSO Regression, GIS-MCDA

Abstract Property valuation is a crucial lens for interpreting urban transformation, offering insights that support both policy-making and market forecasting. Understanding the dynamics of real estate markets in transitional cities requires advanced approaches that go beyond traditional models, which often fall short in capturing spatial-temporal complexity. This study proposes a hybrid methodological framework that combines machine learning (ML) and spatial econometrics within a Geographic Information System (GIS) environment to reveal spatial patterns in property values and support evidence-based urban decision-making.
The methodology combines statistical modelling, spatial analysis, and an indicator-based approach to develop a Spatial Decision Support System (SDSS), aimed at supporting policy-makers through structured, multi-dimensional, and spatial-temporal assessments of housing market dynamics. It leverages advanced techniques such as the Least Absolute Shrinkage and Selection Operator (LASSO) for variable selection and forecasting, and GIS-based Multi-Criteria Decision Analysis (GIS-MCDA) method to prioritise valuation criteria.
The case study of Rotterdam, The Netherlands, tests the methodology and investigates how short- and long-term housing markets interact across space and time. LASSO regression, applied in R, identifies key predictors of property prices, which are then aggregated using the TOPSIS method in a GIS environment to generate a composite index capturing multi-dimensional dynamics such as spatial value shifts, income distribution, and market intensity.
Spatial outputs generated in GIS provide visualisations of housing value trends, highlighting the city's main axes of residential development and areas affected by tourism-induced urban pressures.
The resulting SDSS offers an adaptable interface for urban planning under uncertainty, particularly in addressing gentrification, displacement, and equitable housing access.
This research contributes a replicable methodology for analysing property market dynamics in transitional cities. By bridging data-driven analysis with spatial decision support, it delivers practical insights for decision-makers involved in climate-neutral and socially inclusive urban development.



TRACK 6

Closing the Loop: Circular Economy strategies for Urban and Regional Systems

TRACK 6
Closing the Loop: Circular Economy Strategies for Urban and Regional Systems

As cities and regions continue to grow, the challenges associated with resource use, pollution and waste generation, climate change, health, and biodiversity loss also increase. The transition from a linear to a circular economy offers unique opportunities to address these socio-ecological challenges by rethinking urban and regional systems in ways that can minimize waste, circulate products and materials, regenerate nature, and contribute to the well-being of citizens.

The transition toward a more circular economy requires innovative approaches in the design and planning of urban and regional systems, the development of circular business models and governance structures, cross-sectoral collaboration across value chains, and robust methods, metrics, and tools to assess and monitor potential environmental, economic, and social impacts.

This track aimed to bring together interdisciplinary research and practical applications of the circular economy in urban and regional contexts. The goal was to discuss state-of-the-art approaches, best practices, strategies, case studies, methods, and tools that could support and inform policymakers, urban planners, businesses, and civil society in accelerating the transition toward resource-efficient, regenerative, and circular cities and regions.

REGULAR SESSION

CLOSING THE LOOP: CIRCULAR ECONOMY STRATEGIES FOR URBAN AND REGIONAL SYSTEMS

Chairs: Federico Voltolini, **Chiara Pellegrini** (Eurac Research - Institute for Renewable Energy)

As cities and regions grow, they face mounting challenges related to resource use, pollution, waste generation, climate change, and biodiversity loss. The transition from a linear to a circular economy offers opportunities to address these issues by redesigning urban and regional systems to minimize waste, circulate materials, regenerate nature, and enhance citizen well-being. This session gathered interdisciplinary research and practical applications of circular economy principles in urban contexts, exploring innovative approaches in design and planning, circular business models, cross-sectoral collaboration, and assessment methods. By discussing state-of-the-art strategies, best practices, and tools, the session aimed to support policymakers, urban planners, businesses, and civil society in accelerating the transition toward resource-efficient, regenerative, and circular cities and regions.

ORAL PRESENTATIONS

023 - The PROSUST Project - Planning Tool for Sustainable Construction in South Tyrol

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Keywords: Life Cycle Assessment, Life Cycle Costing, Construction, South Tyrol

Abstract The PROSUST project proposes the development of an integrated approach to address sustainability challenges in the construction sector in South Tyrol, aimed at improving the competitiveness of local companies and reducing the overall carbon footprint. The initial phase will be dedicated to research and technological development activities focused on analyzing the local construction sector and assessing environmental and economic impacts through Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) approaches. Subsequently, an intuitive and accessible tool will be developed for all stakeholders in the sector, integrating GIS (Geographic Information System) information for the geolocation of material recycling sites. The primary objective of the tool is to optimize the use and reuse cycle of materials within the South Tyrolean construction sector, with particular attention to reducing the environmental and economic impact associated with the disposal of processing waste. The development of the tool will be guided by an initial phase of co-design workshops with stakeholders, followed by training sessions and the technical development of the tool. Finally, communication and awareness activities will inform stakeholders about the benefits of using the tool. Primarily, the tool will enable construction companies to plan sustainable solutions ex-ante, promoting circular economy practices already in the design phase of buildings, considering the entire life cycle of materials from installation to dismantling (from cradle-to-cradle approach). The collateral aim is to support the province in identifying and implementing sustainability strategies in the field of sustainable construction, promoting more efficient resource management and reducing the CO2 footprint in South Tyrol.

042 - From Data to Value: The Interlinkages of Digital Product Passports and Circular Business Models in Construction

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Keywords: Digital Product Passport, Circular Business Model, Bio-based material, Circular Economy

Abstract The Digital Product Passport (DPP), as promoted by the Ecodesign for Sustainable Product Regulation (ESPR, 2024), serves as a comprehensive digital repository providing accessible information about a product's composition, origin, performance, and environmental footprint. This data availability offers a transformative opportunity to rethink how construction materials and components are managed, from initial sourcing to their end-of-life. This paper explores the critical interlinkages between DPPs and new Circular Business Models (CBMs) in redefining how lifecycle data can create added value among stakeholders and support the adoption of new CBMs based on a closed-loop approach. By embedding enhanced traceability and transparency, DPPs optimize existing processes and establish entirely new benchmarks for increasing asset value and fostering circular practices. This paper presents key findings from an EU-funded research project that specifically investigated the practical implementation and impacts of a DPP for bio-based construction materials. Outcomes will focus on:

1. Supply Chain Facilitation: by digitizing and centralizing key information, it allowed for the effortless sharing of data regarding the quality, sustainability certifications, and environmental impact of raw materials. This streamlined information flow significantly reduced administrative burdens, paperwork, and time loss.
2. Local Regeneration & Community Engagement: by providing verifiable data on the sustainable attributes of bio-based materials and their carbon sequestration potential, the DPP enabled the transparent quantification and potential sale of carbon credits. It can play a key role in improving local communities' understanding and involvement in urban regeneration initiatives.
3. Innovative Post-Sale Services: by collecting and analysing lifecycle data, stakeholders can be guided in circular practices. Specifically, this aims on extending product lifespans and facilitating material recovery strategies once a product reaches the end of its initial use or changes function. By taking responsibility for their products beyond the point of sale, manufacturers are driven to design for durability, recyclability, and reusability.

This research unequivocally demonstrates that DPPs are far more than a regulatory or compliance tool; they are a powerful, indispensable catalyst

for systemic change, driving the emergence of new business paradigms that prioritize resource longevity, radical transparency, and collaborative value creation across the entire construction industry.

186 - Challenges of governance to support circular economy implementation in the building sector

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Keywords: Circularity Indicators, Design For Disassembly, Recycled Materials, Guidelines, Drivers, Barriers

Abstract The construction sector is responsible for a significant amount of resource depletion. It has been estimated that buildings account for more than 30% of raw materials globally, and up to 40% of the total waste sent to landfill. A significant number of international agendas have recently placed emphasis on the integration of energy efficiency with the increasing necessity to mitigate the embodied impact of all construction-related processes, in order to comprehensively address the transition towards the concept of a climate-neutral city. The Circular Economy (CE) transition is recognised as one of the pivotal strategies in this regard.
Nevertheless, the systematic implementation of CE practices continues to encounter numerous barriers, encompassing technical, procedural, and operational aspects. These barriers pertain to the limited skillset of operators and the pervasive absence of knowledge. In this context, policymakers have the capacity to initiate change by promoting pragmatic measures and binding assessments to facilitate CE uptake in construction.
The Italian-funded project PRIN Better Policies addressed the issues with the aim of identifying obstacles and opportunities for a systemic transition in the construction sector. In this context, the CE issue was considered as one of the key interrelated issues to tackle along with decarbonization, digitalization and life-cycle assessment.
To achieve this objective, a dual analysis is performed to detect barriers and drivers to CE implementation in the construction sector, with particular attention paid to the national policy framework.
On the one hand, a literature review is conducted to detect gaps and open challenges, as well as good practices from the international context. On the other hand, Green Building Rating Systems are screened with a view on circularity indicators to understand how national regulatory tools (e.g. Criteri Ambientali Minimi – CAM) can be improved to achieve higher CE levels.
Guidelines have been formulated to enhance national CE-related measures at many levels. It is evident that the siloed approach currently being implemented on a national basis risks hindering the systematic and effective implementation of CE practices in buildings. In contrast, digitalization is regarded as a potent means to facilitate multi-scalar and multi-level considerations and operations. The higher requirements for the pre-use stages (e.g. use of recycled materials) are supported, while greater emphasis on the post-use stages (e.g. design for disassembly, adaptability, and durability) is called for to exploit the full CE potential in constructions. The results offer policymakers actionable insights to implement dedicated measures from national to local levels.

196 - Are the Twin Transitions Sustainable? A discourse analysis of digital technology development and the data industry in the news

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Keywords: Twin Transitions, Green Transition, Digital Transition, Sustainable Development, Discourse Analysis

Abstract The transition toward a sustainable future will inevitably involve sustainable digital media ecosystems. Digitalized societies view value creation within digital media ecosystems based upon the most available information sources in the burgeoning digital technology and data industries: policymakers and the industries themselves. The “twin transitions”, green and digital, are depicted as being in complementary alignment and even promoted as such in policy actions. This work explores the research problem of their potential misalignment as a question of relativism based on institutional logics. In a comparative discourse analysis, I examine industry and government leaders’ stated positions as depicted in journalistic texts in three highly digitalized countries (Germany, Norway, and the United States). This serves the aim of illustrating leadership in the twin transitions and the processes and practices behind it.
Problem representation and environmental discourse analysis methods are used here to understand value, institutional logics, and depictions of the alignment of the twin transitions. As the sustain-

ability of data and digital technologies comes into question in developed countries, journalistic depictions of institutional and operational leadership roles in the twin transitions are key to driving public understanding and attitudes as well as practices both driving and resulting from policy.
On one hand, this work seeks examples of representations of digitalization as positive or negative for the environmental impact of digital technologies. On the other hand, I seek to find representations of capital to represent value in a digital media ecosystem. The way in which institutions frame capital and the alignment of the twin transitions reflect institutional values (not value). Statements and positions of elite actors (within industries supplying digital goods and services) as well as those of government elites are evaluated in the context of their institutional logics.
Preliminary results show American leaders address the twin transitions with technological solutionism, market logic, weak sustainability, and weak ecological modernization. Ultimately, those in the U.S. are growth-oriented, primarily concerned with digital capital and market capital, viewing sustainability as a means to an end. Norwegian results show a socio-technical approach to leadership, one using sustainable development logic skewed toward strong sustainability and strong ecological modernization. Here, natural capital is much more of a focus of the discourse. The German corpus is intermediate. Not only do these results reflect differences in institutional culture, but in the liberal an democratic corporatist media systems present. A scaling up of Norwegian leadership viewpoints in international regulatory bodies is worth investigation to address the research problem.

255 - The carbon footprint of structures: the case study of prefabricated dwellings

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Keywords: Prefabricated Building Elements, Life-Cycle Analysis, Carbon Footprint, Circular Economy, Environment

Abstract Prefabrication is a construction technique applied in many constructions in the last years. Unlike conventional construction methods, where buildings and infrastructures are constructed entirely on-site, prefabricated building components are produced in factories under controlled conditions and then transported to the construction site for assembly. Prefabrication offers significant advantages, such as reduced construction time, improved quality and accuracy, and waste reduction.
The carbon footprint as well as the pollutants emitted from the construction of a prefabricated house was investigated in this research study. The environmental and human impacts of the construction process of prefabricated building elements were also investigated. The OpenLCA software was used to analyze the life cycle of the prefabricated building elements, from the raw materials extraction to the construction of a prefabricated house.

POSTER PRESENTATIONS

036 - Integrating circular economy practices to enhance sustainability in the textile industry

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Keywords: Circular Economy, Textile Industry, Eco-design, Circular business, Life Cycle Assessment

Abstract The textile and apparel industry is a central pillar of the global economy, employing over 60 million people worldwide. It is also among the most environmentally intensive sectors, responsible for approximately 8–10% of global greenhouse gas emissions. This impact is largely driven by a linear "take–make–dispose" model, marked by short production cycles, high resource consumption, and accelerated garment disposal. Circular economy (CE) strategies are gaining traction, yet recent research highlights eco-design as the most effective approach to reduce the sector's environmental footprint. Eco-design involves integrating durability, repairability, disassembly, recyclability, and low-impact materials at the design stage. Life-cycle assessments (LCA) indicate that doubling a garment's lifespan can cut its climate impact by up to 44%, and reusing one kilogram of clothing may prevent roughly 25 kilograms of CO_2-equivalent emissions. Policy is beginning to reflect this evidence. The European Union's proposed Ecodesign for Sustainable Products Regulation would require durability and recyclability for all textiles placed on the single market, signalling a shift toward design-led circularity. However, despite increasing interest, comprehensive analyses of eco-design implementation remain limited. Much of the literature focuses on individual materials or product types, rarely addressing systemic barriers, enabling conditions, or broader sustainability

outcomes. To address this gap, this study conducts a systematic review of literature published between 2021 and 2025. The review draws from peer-reviewed journal articles indexed in Scopus and Web of Science, and institutional reports from UNEP, ILO, the European Environment Agency, and the Ellen MacArthur Foundation. The SPAR-4-SLR framework ensures a rigorous, transparent, and replicable methodology for study identification, selection, and analysis. Initial searches yielded articles in Scopus and in Web of Science. After removing duplicates, remaining studies were screened using established exclusion criteria. The review is guided by six research questions: (1) What CE practices, especially eco-design and recycling, are adopted in textiles? (2) How are closed-loop supply chains and circular business models applied? (3) What barriers and enablers affect CE integration? (4) What environmental, economic, and social benefits result? (5) What research is needed to scale CE adoption? (6) How is LCA used to assess CE outcomes? This review synthesises current evidence to offer practical insights for policymakers, industry, and researchers. It identifies high-impact eco-design strategies, systemic mechanisms to promote adoption, and the role of integrated assessment tools in supporting the transition to a low-carbon, resource-efficient textile industry.

231 - Designing Predictive Building Stock Models for Circular Urban Economies: Methodological Blueprint from the Beam Me Up Project

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Keywords: Building Stock Model, Circular Economy, Material Flows, Urban Mining, Data Integration

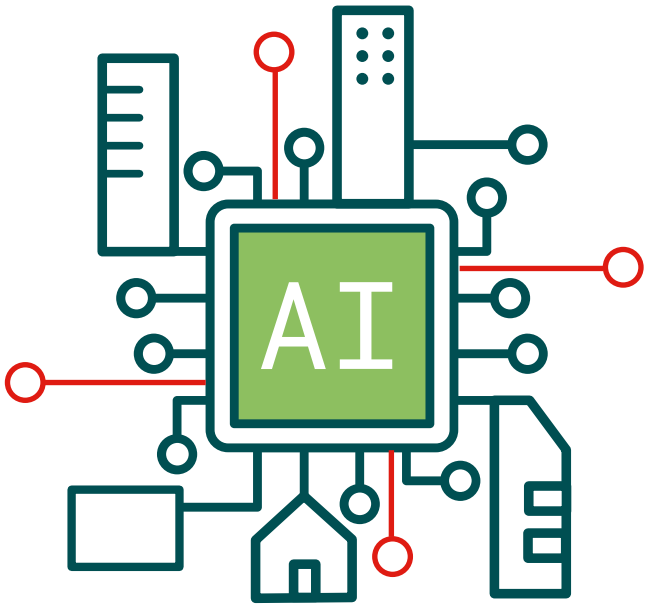
Abstract A successful transition to circular urban development depends on the ability of cities to anticipate material flows and plan for the reuse of construction components at scale. However, most existing building stock models are limited by coarse spatial resolution, lack of disaggregated material data, and poor alignment with practical reuse scenarios. The Beam Me Up project, launching in early 2026, addresses these challenges by developing predictive, geo-referenced building stock models that estimate construction material streams for reuse, repurposing, and recycling. This paper outlines the conceptual and methodological foundations of the modelling framework as a contribution to the evolving discourse on data-driven circular economy strategies in urban contexts.

Our approach is based on integrating top-down national and municipal datasets—such as cadastres, building registries, and demolition permits—with bottom-up data from pre-demolition audits and building-specific attributes. The resulting hybrid model is designed to support regional planning, material cadastres, and urban mining projections. Key challenges include data harmonization across cities, managing gaps in historical records, and aligning building typologies with material estimation logic. A structured data schema and standardized metadata framework are being developed to ensure interoperability and scalability.

The model will be piloted and validated through multi-city case studies in Trondheim, Gothenburg, Copenhagen, and Chambery. These cases will allow the project to benchmark predictions against real demolition and reuse data, helping refine the modelling process iteratively. Special attention is paid to creating feedback loops between stakeholders—urban planners, public authorities, and reuse actors—so that model outputs are actionable and policy-relevant.

While the project is in its preparatory phase, this contribution shares early design decisions, methodological trade-offs, and cross-city coordination experiences. By articulating a common framework before implementation, we aim to initiate dialogue around modelling standards, practical data integration strategies, and the role of predictive tools in enabling circular construction flows at the urban scale.

Digital Poster Gallery: https://sspcr.eurac.edu/en/programme/digital-poster-gallery-2025


AI

TRACK 7

Data and AI-Powered Territories: City Intelligence for Urban Planning and Management

TRACK 7
Data and AI-Powered Territories: City Intelligence for Urban Planning and Management

Generative AI is transforming the way work, creativity, and complex problem-solving are approached. In urban planning and management, this transformation opens new possibilities for enhancing decision-making, optimizing resource allocation, and fostering more sustainable, resilient, and inclusive cities. AI-driven models enable urban planners, architects, and decision-makers to address critical challenges, ranging from optimizing land use and infrastructure design to enhancing participatory governance and climate resilience strategies.

This track explored how generative AI has been shaping the future of cities. Contributions proposed innovative applications of generative AI in urban analysis, synthetic data generation, scenario modelling, and governance processes. In addition, the track encouraged discussions on the ethical implications, biases, and challenges associated with the deployment of generative AI in urban contexts.

SPECIAL SESSION

DIGITALLY ENHANCED, PEOPLE-CENTRIC PLANNING FOR CLIMATE-NEUTRAL CITIES

Chairs: Jhon Ricardo Escorcia Hernandez (Politecnico di Torino), **Sara Torabi Moghadam** (Politecnico di Torino - Interuniversity Department of Regional and Urban Studies and Planning)

As cities and regions are required to address the challenges of climate change and growing social inequalities, the need for inclusive, people-centred, participatory, and just urban transformations have become increasingly urgent. Digital technologies—ranging from participatory platforms and immersive environments to AI-powered decision-support systems—offer new opportunities to reshape governance and planning processes, empower marginalized communities, and foster equitable climate adaptation strategies.

This special session aimed to explore the intersection of digitalization, climate neutrality, and social inclusion in urban planning. Contributions investigated how digital tools and participatory approaches could support people-centred planning, co-creation, and the co-implementation of climate-responsive solutions. Particular interest was given to case studies, conceptual frameworks, and methodological innovations demonstrating how digital technologies could amplify underrepresented voices, bridge knowledge gaps, and foster long-term, inclusive engagement in planning and governance processes.

Interdisciplinary perspectives combining urban studies, digital innovation, environmental justice, and stakeholder engagement were strongly encouraged, alongside critical reflections on the limitations and ethical implications of digital approaches.

ORAL PRESENTATIONS

031 - Identifying Optimal Location for New Biogas Plants by Livestock Waste Biomass to Support Evidence-based Energy Policy: A Case Study in the Alps

Samuele Zilio (1)

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Keywords: Circular Energy System, Biomass, Biogas Plants, Spatial Modelling, Territorial Sustainability

Abstract Bioenergy production, particularly from livestock waste, plays a crucial role in realistic deep decarbonization pathways toward a circular energy system. The Alpine region offers significant potential in this context due to the widespread availability of biomass resources, both animal and vegetal.
This study identifies optimal locations for new biogas plants utilizing livestock waste biomass in South Tyrol (Italy), through a comprehensive spatially explicit assessment. The proposed framework considers both enabling and constraining land-use-related factors, including proximity to urban areas, transport and energy infrastructure, legal and ecological restrictions (e.g., water bodies, protected natural areas, slope gradients), and the distribution of biomass feedstock. To embed these critical components into the decision-making process, the methodology combines a multi-criteria analysis with an optimization algorithm to identify and rank potential suitable locations based on supply chain efficiency and logistical feasibility, particularly minimizing transportation distances/costs.
The resulting scenarios facilitates a comprehensive evaluation of competing priorities to support evidence-based energy policy and unveils the importance of spatial modelling in the decarbonization process, addressing economic, environmental and social challenges to reconcile energy goals with territorial sustainability.

067 - USAGE project: how to link urban Data Space and Local Green Deals with data

Piergiorgio Cipriano (1) - Luca Giovannini (1) - Fabio Remondino (2) - Daniela Poli (3)

(1) Deda Next, Bologna, Italy - (2) Fondazione Bruno Kessler, Trento, Italy - (3) Avt Airborne Sensing, Trento, Italy

Keywords: Data Space, Interoperability, Standards, Geomatic, AI, Citizen Science

Abstract Through the Green Deal, the European Commission has set the ambitious target of making Europe the first climate-neutral continent by 2050 and the key to this commitment is represented by cities implementing Local Green Deals.
This is exactly the process that the Horizon Europe project "USAGE" (www.usage-project.eu) has been supporting for the past years in 4 pilot cities (Ferrara, Graz, Leuven, Zaragoza), working to overcome legal and technical barriers to share and exploit urban data among public bodies, private organisations and civil society, with the aim of developing actionable data-driven tools to directly support decision makers and environmental local policies.
Main outcomes are:

- involvement of civil society in citizen science initiatives for collecting and analysing data about urban heat islands, flash floods, biodiversity and other topics
- creation of data governance frameworks for cities (local data spaces)
- deployment of software solutions for data-sharing and their exploitation
- improvement of availability, quality and interoperability of data for Local Green Deals

On top of spatial data (LiDAR point clouds, hyperspectral and thermal data from airborne sensors, multispectral data captured from satellite, citizen-sourced data from apps and mobile sensors, ...), USAGE developed algorithms and data services that transform input data into value-added products (Decision Ready Information), leveraging on ML and DL algorithms.
Some of the most relevant results are:

- hyperspectral image analysis to automatically derive tree canopies and species estimation;
- classification of roof material type, road pavement type, level of soil imperviousness, all based on hyperspectral images;
- implementation of an indicator measuring which buildings satisfy the "3-30-300 rule, to identify the areas that are most lacking also in relation to Urban Heat Islands hot-spots;
- solar potential estimation in public areas and buildings roofs, to identify available spaces to develop community solar projects.

USAGE was deeply based on the FAIR principles: both input (raw) and derived datasets (DRI) are discoverable via public catalogues (usage.geocat.live/catalogue and local ones) and accessible through OGC interoperable standard protocols and formats; likewise,

algorithms and tools are described and published on the project GitHub (github.com/USAGEHub).
The talk presents workflows and resulting DRI for decision makers, technicians and citizens. Indeed, some of data-elaboration pipelines have been developed using AI techniques and their result is specifically oriented to provide actionable decision-making tools for city administrators.
Lastly, the talk describes how the issues of data governance, management and use were handled within the project, together with practical lessons learnt on data constraints and involvement of civil society (e.g. www.citizenscienceferrara.org).

183 - Who is afraid of the smart transition? Artificial intelligence and spatial asymmetries in marginal contexts

Pierfrancesco Celani (1) - Massimo Zupi (1) - Antonella Pelaggi (1)

(1) University Of Calabria, Environmental Engineering, Rende, Italy

Keywords: Artificial intelligence, Territorial asymmetries, Marginality, Digital planning

Abstract AI offers enormous potential for urban planning, but it requires special attention to ethical, inclusiveness and justice aspects in order to properly manage interactions between humans and AI and the impacts on complex practices. Data-driven technologies and predictive models based on advanced algorithms require an information, digital and organisational infrastructure that fragile contexts (think of the myriad of small municipalities that characterise the Italian territory, but also European ones) do not possess. The digital transition, presented as inevitable and universal, is proving to be selective: inclusive for territories that are already digitally mature, excluding those on the margins.
This contribution proposes a critical reflection on the unequal distribution of the benefits (and costs) of algorithmic transformation applied to planning, highlighting how smart strategies often ignore the geography of marginality. In the absence of structured data, analytical capabilities and technical capital, the adoption of AI in these contexts is limited to sporadic solutions, often imposed 'from above', without local adaptation processes or real decision-making empowerment.
The analysis of significant case studies and comparison with international literature highlight the need for an AI approach to planning not so much as a technological package to be imported, but as a local-based process, built from local knowledge, the actual availability of resources and the participation of local actors. In this perspective, AI can become a tool for rebalancing, provided that the systemic asymmetries that hinder fair access and effectiveness are recognised and addressed.
The purpose of this reflection is to contribute to the debate on the future of smart planning, calling for a pluralist and contextual vision of technological innovation, capable of also including territories currently excluded from the mainstream smart city narrative.

201 - Bridging the Divide: Empowering Croatian Communities through Bottom-up Sustainable Development

Federica Maino (1) - Alice Borsari (2) - Irene Bertolami (2) - Giovanni Dalle Nogare (2) - Adriano Bisello (2) - The National Foundation I3.0 Team The National Foundation I3.0 Team (3)

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Keywords: Bottom-Up Development, Local Empowerment, Territorial Justice, Sustainable Communities, Croatia

Abstract In the face of escalating and interconnected social and ecological crises, there is an urgent need to reimagine development strategies toward more just, inclusive, and regenerative human–ecosystem relationships. This paper presents the case study of the "Community Potentials" Program, a novel initiative launched in 2023 by the National Foundation for Civil Society Development in Croatia. The program seeks to empower Croatian local communities through sustainable, community-led development, with a strong focus on building human capacities and fostering local innovation.
Croatia currently faces territorial imbalance: coastal regions are increasingly shaped by resource-intensive tourism and infrastructure development, resulting in environmental and socio-cultural impacts (e.g., biodiversity loss, GHG emissions, gentrification, overtourism). In contrast, many rural inland areas suffer from depopulation, economic stagnation, and a lack of public services. Both types of regions experience marginalization in top-down governance structures, limiting community agency and creating socio-economic disparities.
To address this divide, the "Community Potentials" Program introduces a bottom-up development model under the i3.0 Strategic Partnerships for Com-

munity Innovation framework. Its core objective is to transform passive communities into proactive agents of change by identifying and activating their unique local resources. The program promotes human capacity-building for sustainability, supports locally driven initiatives, and aims to create inclusive socio-economic environments.
In its first phase, the program is being led in eight Croatian cities. This contribution outlines the design and methodology of the research, and the preliminary results of its first phase which combines online questionnaires and on-site visits to gather baseline data on sustainability conditions in participating cities. Conducted in partnership with Eurac Research and Relatomics, this exploratory phase provides a snapshot of territorial challenges and potentials, offering a foundation for tailored community action and laying the groundwork for the co-creation of a targeted educational program to support long-term local development.
Preliminary findings highlight the importance of participatory approaches, education, local knowledge integration, and context-sensitive development pathways. The authors discuss emerging strengths and limitations of the research and offer insights into fostering resilient and equitable communities in Croatia and across the Mediterranean region.
The study contributes to the broader discussion on territorial justice, community empowerment, and sustainable local development.

258 - AI as a Participatory Tool for Urban Reimagination

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Keywords: AI, Urban Planning, Participatory Design, Community Engagement, Public Space

Abstract Contemporary urban landscapes often reflect a blend of structured road networks and concrete architecture. Yet, the prospect of integrating natural elements and community-driven development is gaining traction. In this context, Researchers in South Tyrol have crafted four innovative visions for the future of South Tyrol as part of the 'Let's shape the future, Together' project. These visions were further reimagined through the lens of AI, focusing on their foundational principles. Additionally, we introduced two scenarios: one addressing tangible challenges in the Don Bosco-Bolzano area and another portraying a potential dystopian outcome due to inaction and lack of progressive ideas. Building on these ideas, a major community event was held to engage citizens in the transformation of their cityscape. In this event, participants were exposed to all six scenarios, including the newly developed ones, and their input was sought for transforming five distinct public spaces in Bolzano. This initiative opened a direct line of communication among the community, researchers, and stakeholders, aligning the redevelopment projects with the community's desires and necessities. In our study, we highlight the active participation of the community in these decisions, our study emphasizes the critical role of public involvement in urban development and demonstrates the effectiveness of AI in supporting such collaborative processes.

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