Empa
Materials Science and Technology

# BOOK OF ABSTRACTS

## Urban Futures Symposium: Innovations, Trends, and Challenges

September 1-2, 2025
Dübendorf, Switzerland

## Impressum

Book of Abstracts

Urban Futures Symposium: Innovation, Trends and Challenges

**Publisher**

Urban Energy Systems Laboratory,

Empa - Swiss Federal Laboratories for Materials Science and Technology

Überlandstrasse 129,, 8600 Dübendorf, Switzerland

**Editors**

Ana Bendiek Laranjo

Mathias Niffeler

Mashael Yazdanie

Binod Koirala

Georgios Mavromatidis

**Date of publication**

September 1, 2025

**Citation**

Mavromatidis, G., Koirala, B., Yazdanie, M., Laranjo B. A., Niffeler, M. (2025) Book of Abstracts – Urban Futures Symposium: Innovations, Trends and Challenges, Urban Energy Systems Lab, Empa, Switzerland, http://doi.org/10.55368/empa:42510

**Acknowledgement**

This book of abstracts is published as part of the Urban Futures Symposium 2025 at Empa organized on the occasion of the 10th anniversary of the Urban Energy Systems Laboratory. We acknowledge generous support of Swiss National Science Foundation (SNSF), Baudirektion Canton of Zürich, the City of Dübendorf, and the St. Galler Stadtwerke.

# Urban Futures Symposium 2025 – Opening Address

I am delighted to welcome you to the Urban Futures Symposium 2025, hosted by the Urban Energy Systems Laboratory (UESL) at Empa, Switzerland. This gathering marks a special milestone as we celebrate the 10-year anniversary of UESL, reflecting on a decade of research and looking ahead to the challenges that define our urban future.

Cities today face unprecedented challenges. Home to over half of the world's population and responsible for more than 70 percent of global carbon emissions, urban areas represent both our greatest sustainability challenge and our most promising opportunity for transformative change. The decisions we make about urban energy systems, infrastructure, and governance in the coming years will determine whether cities become catalysts for environmental regeneration or continue to drive ecological decline.

The Urban Futures Symposium brings together researchers, policymakers, and practitioners from around the world to explore these pressing urban challenges. By connecting people across disciplinary and sectoral boundaries, we foster dialogue between established leaders, emerging scholars, and innovators who will shape the next generation of urban systems. It is this spirit of inter- and transdisciplinary collaboration that allows us to move beyond isolated solutions and towards approaches that are both scientifically rigorous and practically applicable.

Our program features distinguished keynote presentations, interactive workshops, and research presentations that span technological innovation, policy frameworks, and community-driven initiatives. Together, these contributions reflect the breadth of perspectives needed to create cities that are sustainable, resilient, and inclusive.

I extend my sincere thanks to everyone who has made this symposium possible. My gratitude goes to all presenters for sharing their insights, to the organizing committee and volunteers for their tireless work, and to our advisory committee for their valuable guidance. I am equally grateful to our sponsors for their generous support, which has enabled us to bring together such a diverse group of participants from around the world.

Finally, I thank you, the participants, for joining us in this important endeavor and for your shared commitment to advancing sustainable urban futures. During these two days, I look forward to the exchanges and partnerships that will emerge from our time together and to the inspiration that will carry forward well beyond this symposium.

With best wishes for an inspiring symposium,

Dr. Georgios Mavromatidis

Head of the Urban Energy Systems Laboratory, Empa

# Table of contents

**About the Lab** ..... **10**

**Program Day 01, September 1, 2025** ..... **12**

Program Overview ..... 13

Keynote Speakers ..... 14

Parallel Sessions 10:45-12:00 CEST ..... 17

Citizen engagement and participatory approaches for just urban planning ..... 19

Open-source approaches for urban environmental insight and resilience ..... 19

Neighbourhood-based energy cooperations (QUBE) – Doing the energy transition together ..... 20

Reclaiming public spaces: Community-driven placemaking as urban transformation in post-apartheid South Africa township. ..... 21

The future of high-density cities: Integrating emotional feedback for sustainability ..... 22

Participation Beyond Consultation: Lessons from Collective Energy Initiatives ..... 23

Urban energy systems ..... 24

Modeling long-term sectoral integration and interconnectivity in urban energy and sustainability transitions ..... 24

Systemic innovation for the defossilisation of cities and regions: Experiences from the Innosuisse Flagship DeCIRRA and recommendation for future work ..... 25

Economy and sustainability analysis of sector coupled district energy systems using white-box models in distributed co-simulation ..... 26

Urban building energy modelling and multi-objective optimization for PED transition in an existing neighbourhood in Sweden, decentralized renewable energy system integration in communities ..... 27

Ensuring a solar future: Integrating the local actor perspective in urban energy systems planning ..... 28

Nature-based solutions, green-blue infrastructure & ecology ..... 29

From vision to action: Sustainable integrated districts as climate change solutions ..... 29

Cultural diversity in urban park use and perception ..... 30

The ‘fifth façade’ as the new urban ground: A Citizen Science Approach to Blue-Green Roofs ..... 31

Decentralised Water Reuse for Urban Water Security: The case of Bangalore, India ..... 32

Parallel Sessions 13:45-15:00 CEST ..... 33

Sufficiency: pathways to living well within planetary boundaries ..... 35

A systems perspective of housing and mobility interrelations, and implications on wellbeing, sufficiency, shared spaces, energy, de-sprawl, governance, justice, public policy ..... 35

Achieving more by demanding less: The potential of sufficiency ..... 36

Space sufficiency: How institutional real estate and single family home owners approach this challenge ..... 37

Sufficiency: From concept to collective movement with the World Sufficiency Lab ..... 38

The future of mobility ..... 39

It's not you, it's me - Global urban visual perception varies across demographics and personalities ..... 39

Quantifying accessibility and its implications for sustainable urban mobility systems ..... 40

Potential Willingness to use Autonomous Ride-pooling: Insights from a Case Study in Hamburg ..... 41
Integrated urban mobility policies in metropolitan areas: A system dynamics model ..... 42
Regenerating underused urban spaces to support electric vehicle charging ..... 43
Building performance and retrofitting ..... 44
Prior conditions of heat pump adoption in the United States ..... 44
Determining the energy performance classes of buildings using machine learning algorithms: The case of Istanbul ..... 45
To zero or not to zero: Overcoming barriers to smart building retrofit in the European commercial real estate sector ..... 46
Comparative LCA study of an office building renovated according to innovative "KEGEL Klimasystem" vs. the standard approach ..... 47
NEST-Bot: Integrating knowledge graphs and language models for scalable access to building energy data ..... 48
Poster Sessions ..... 50
Poster session 1 ..... 52
Decentralising Heat: Socio-Technical Lessons from Denmark's Community-Based District Heating for EU Energy Transitions ..... 52
Optimizing Urban Fuel Poverty Governance: Spatial Heterogeneity, Dynamic Forecasting, and Contagion-Sensitive Intervention ..... 53
Opacity, imagination, and futures: Exploring climate change discourses and social imaginaries in Santiago de Chile ..... 54
Hybrid Building Energy Modeling of Building Energy Systems ..... 55
Poster session 2 ..... 56
Enhancing transparency and openness in energy system modeling with a focus on addressing the availability and quality of energy data at the regional level ..... 56
Charting the path to Net-zero: A case study of the Bündner Rheintal ..... 57
Under Lake Infrastructure for thermal capture and Storage of Solar Energy (ULISSE) for district heating and cooling services ..... 58
Panels and Workshops ..... 59
PowerHood: Playtesting a serious game for energy transition in neighborhoods ..... 61
From Forma Urbis to Forma Horta: Blue–Green Urban Futures in Dense, Heritage-Rich Cities ..... 62
Sufficiency: Radical rapid societal transformation for ecosystem and human wellbeing ..... 63
From Insight to Impact: Transforming the Evidence-to-Policy Pipeline ..... 64
Gridly: Interactive engagement tool for Local Energy Community, market, and users' interconnectivity ..... 65
Futuring cities: Participatory visioning for resilient futures ..... 66

**Program Day 02, September 02, 2025 ..... 67**
Program Overview (Day 2) ..... 68
Keynote Speakers ..... 69
Parallel Sessions 10:45-12:00 ..... 71
Participative, multidisciplinary and cross-border learnings ..... 73
Building a cross-border territorial vision 2050: A multidisciplinary, multi-stakeholders consensus approach for Greater Geneva based on regenerative planning principles ..... 73
Enabling city transfer-learning by innovating evidence synthesis of climate solutions from 20,000 urban case studies ..... 74
Low-carbon housing supply chains and inclusive urban transformation models for Africa's emerging mega- and gigacities ..... 75
Universities in action: Leading sustainable construction across Latin America ..... 76
Hot & cold: from cooling to district heating ..... 77
The effect of urban microclimates on the cooling demand of Padova ..... 77
Smart control of district heating networks: A case from Switzerland ..... 78
Assessment of uncertainties in the district heating decarbonization: Discussions around the Vienna case study ..... 79
ULISSE "Under lake infrastructure for capture and storage of solar energy" for district heating and cooling services ..... 80
Data-driven personalized thermal comfort model for Office workers in Switzerland ..... 81
Digital approaches for urban planning and design ..... 82
Shaping urban futures: 3D simulations of urban planning regulations ..... 82
Modelling and simulation towards resilient urban systems: Enabling sectoral interoperability through semantic web technologies ..... 83
UrbanTwin: Accelerating the transition to net-zero cities through integrated urban systems ..... 84
Towards an Integrated Platform for Urban Energy Planning: Connecting Data and Digital Services with Semantic Technologies in Digicities ..... 85
Integrating digital needs to cities: A holistic approach of sustainable computing ..... 86
Circularity, materials and embodied emissions ..... 87
Mapping operational and embodied emissions in relation to household and ownership profiles: The case of Vaud, Switzerland ..... 87
Circular sanitation toolbox: Practical guides for resource-oriented sanitation ..... 88
Soil and construction spoil metabolism in New York City ..... 89
User-adapted design and optimization of a multi-purpose solar cooking stove for sustainable urban energy futures: A numerical and experimental study ..... 90
Analysis of technical pathways and certification for carbon-based energy carriers ..... 91
Parallel Sessions 13:45-15:00 ..... 92
Reimagining cities: the role of communities, education, and co-benefits ..... 94
Co-benefits of climate-change mitigation in cities ..... 94
Reimagining urban futures: The role of religion in eco-sustainability and public health ..... 95
Reimagining Alexandria’s streets through landscape pedagogy and cultural memory (virtual) ..... 96
Work-from-home and residential energy demand: A machine learning analysis for Swiss households ..... 97
Regenerative African Urban Futures through Alternative Design ..... 98

Grids, networks, flexibility and resilience ... 99
Flexibility-aware planning of electricity distribution network reinforcements ... 99
Integrating sustainability and resilience aspects into the assessment of power systems in urban futures ... 100
GridPLAN & BOMES: Geometric planning and Bayesian optimization of multi-energy grids ... 101
Flexibility opportunities and regulations for distributed resources in the EU countries ... 102
The potential of cost-optimal demand-side flexibility in pharmaceutical industry clusters ... 103
Justice, equity and urban governance ... 104
Data-driven circularity: Visualizing urban heat inequity for just green transitions ... 104
Integrative infrastructure planning in Al Muhaisnah 2: A multiscalar approach to urban resilience and social equity ... 105
Resilient cities, inclusive futures: Rethinking affordable housing in African cities ... 106
The effect of global environmental justice on preferences for the location of climate policy implementation ... 107
When Systems Decide: Infrastructure, Justice, and Agency ... 108
Modeling tools and technology for urban innovation ... 109
From Prototype to Practice: Key Enablers in Operationalising the Urban Climate Model PALM-4U ... 109
On future envelope construction: Robots and people ... 110
ReSIM: A simulation platform for urban energy systems ... 111
FlexECO: A multi-energy optimal dispatch and planning software tool ... 112
Digitalized design-build-deploy-operate based on platform based design and emerging ASHRAE Standards 231P and 223P ... 113
Poster Sessions ... 114
Poster session 3 ... 116
Why Are We Still Not Retrofitting? A Systemic Review of Barriers and Enablers for Urban-Scale Energy Retrofits ... 116
Kypseli superblock: A multi-scale vision for climate adaptation, social inclusion & urban livability in Athens ... 117
A transnational NbS network of cities and followers – the GreenScapeCE experience ... 118
Activation of Social Potential Through Environmentally Sound Strategies: A Case Study of Courtyards in the Kypseli Neighborhood, Athens ... 119
Poster session 4 ... 120
Waste heat utilisation from edge data centres integrated in tertiary buildings ... 120
Integrating the design and operation of energy systems ... 122
Panels and Workshops ... 123
Enhancing Urban Resilience through Nature-based Solutions (NbS): Strategies for Reducing Disaster Risks ... 125
How to establish heavy-duty supply chains for low-carbon housing in Africa's emerging Mega- and Gigacities ... 126
"My Neighbourhood": Building energy transition, one neighbourhood at a time ... 127
Shaping the future of urban digital twins in Switzerland ... 128
Playing with the Business Model Assembler for clean energy urban hubs ... 129

Bridging the gap: Fostering collaborations between social scientists and engineers for urban systems research ..... 130
**Committees** ..... **131**
**Sponsors & Partners** ..... **132**

# Practical Information

### Reaching Campus

Getting around Switzerland by train, tram and bus is the easiest, most convenient and sustainable way to travel!

You can use SBB's website and app to search for connections and buy tickets: https://www.sbb.ch/en

The nearest stops to the Empa Campus are:

- 🚌 Bus: Dübendorf, EMPA – 2min walk to Empa NEST
- 🚆 Train: Dübendorf – 11min walk to Empa NEST
- 🚋 Tram: Dübendorf, Am Ring – 7 min walk to Empa NEST

### Map of Campus

A map of the Empa campus can be found on the last page of this book of abstracts.

### Food

Lunch will be served in the entrance hall (Foyer) of the Akademie building.

Morning and afternoon coffee breaks will also take place at the Akademie Foyer.

Alternatively, the campus café (Flair) next to the NEST building is open to all guests. Unfortunately, items consumed in the bar are not included in the event fee.

### Wifi

Network name: Urban Futures Symposium

Password: UFS@empa2025

### White lanyard

Members of the Urban Energy Systems Laboratory will be wearing white lanyards during the Symposium. Please feel free to approach any of them for information or any questions you might have about the Symposium or the Empa campus.

*For more information on the symposium venue, accommodation, travel, and the city of Zurich, please consult the "Practical Information" section on the Urban Futures Symposium website: https://urban-futures.empa.ch/*

# About the Lab

The Urban Energy Systems Laboratory (UESL) at Empa was established in 2015 as part of the Department of Engineering Sciences with the ambition to pioneer sustainable, resilient, and equitable solutions for urban energy systems. Over the past ten years, the Lab has grown into a vibrant community of scientists, postdoctoral researchers, doctoral candidates, engineers, and support staff. More than fifteen PhD students have successfully defended their theses here, with more currently pursuing their doctoral work. Alumni of UESL today contribute across academia, industry, and public institutions, helping to shape the energy transition in Switzerland and abroad.

Leadership of the Lab has evolved over time. The founding head, Viktor Dorer, guided UESL from 2015 to 2018, laying the groundwork for the Lab's strengths in energy system modeling and long-term storage technologies. His successor, Dr. Kristina Orehounig, led the Lab from 2018 to 2023, expanding its scope towards national and international collaborations and pioneering work in multi-energy systems, control, and urban informatics. She has since taken up a professorship at TU Vienna. Since October 2023, her successor, Dr. Georgios Mavromatidis, has been heading UESL, steering it into its second decade with a renewed focus on integrated strategies that bridge technology, policy, and society.

From its earliest days, UESL has combined advanced modeling and data-driven methods with real-world demonstrators. A milestone was Empa's NEST building, inaugurated in 2016, where UESL has played a key role in establishing the ehub platform. Together, they provide a unique testbed for validating ideas in practice, from the first energy hub models to advanced control strategies and digital twins of urban systems. This commitment to experimentation has become a hallmark of the Lab's identity: research that is rigorous but always connected to application.

Over the years, UESL's research focus has expanded while maintaining continuity. Early work on decentralized energy supply systems and energy hubs grew into today's efforts on multi-energy systems, building flexibility, and urban informatics. Today, UESL explores the entire spectrum of energy system development: from the design of sustainable buildings and district energy systems to strategies for decarbonizing large infrastructures and national networks; from advanced control of decentralized systems to harnessing digital twins and artificial intelligence for planning and operation. Increasingly, this work is framed by broader societal perspectives, ensuring that technological solutions are aligned with policy frameworks, economic realities, and societal needs.

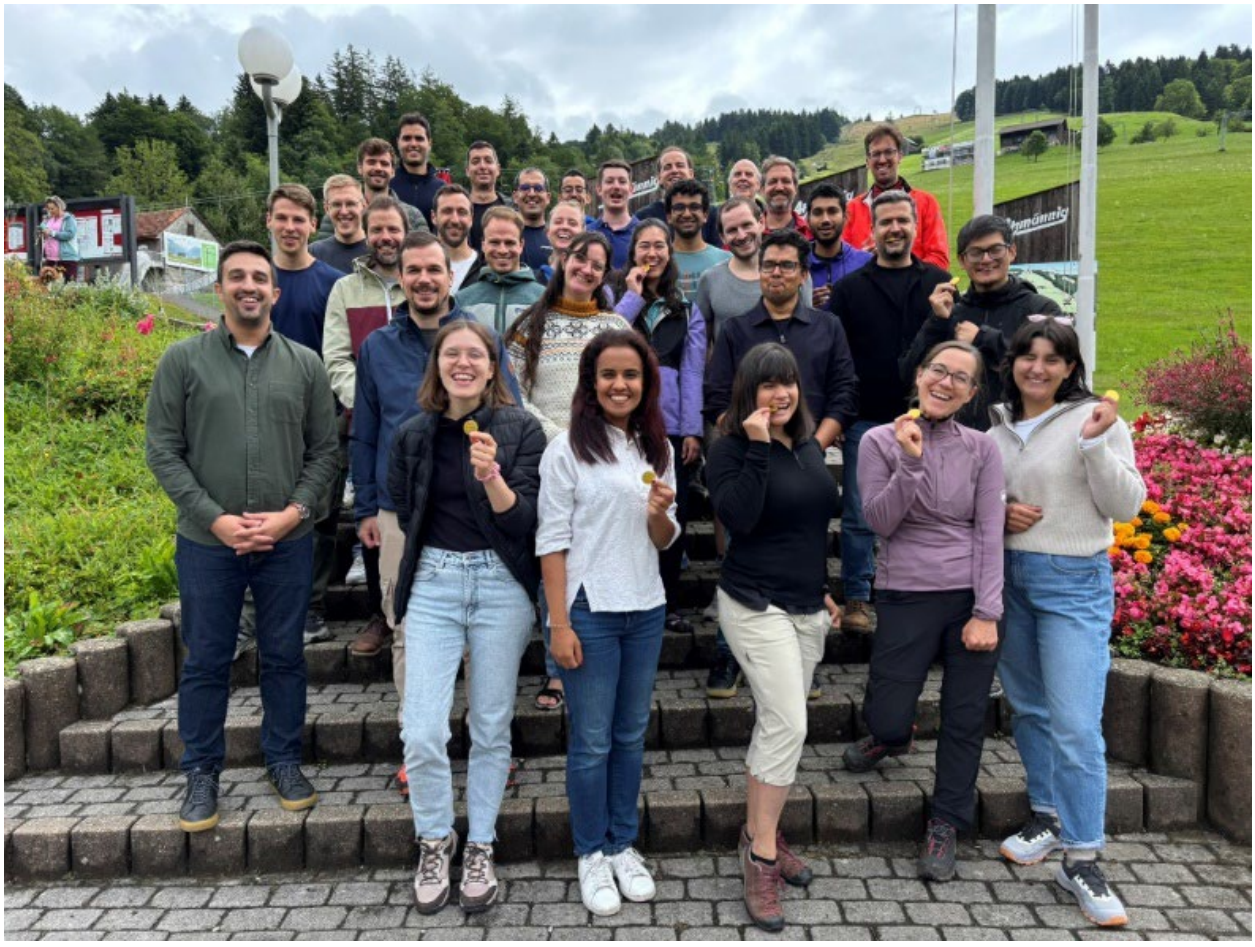
National and international projects have been the vehicles through which this vision has been realized. UESL played an important role in the SCCER FEEB&D (Future Energy Efficient Buildings & Districts), which anchored building and district energy research in Switzerland. More recently, UESL has been active in the Swiss Federal Office of Energy (SFOE)'s SWiss Energy research for the Energy Transition (SWEET) program, coordinating and contributing to projects such as PATHFNDR, CoSi, DecarbCH, ReFuel.ch, and LANTERN. These projects address topics ranging from decarbonization of heating and cooling and sector coupling to social dimensions of energy transitions and data harmonization across research domains. Beyond national frameworks, UESL participates in European H2020, Horizon Europe, ERA-NET, and Driving Urban Transitions (DUT) projects and collaborates closely with industry, utilities, and municipalities. Beyond Europe, the UESL has collaborated with West African institutes on urban climate resilience in Ghana (the MEASURES project), and with the International Renewable Energy Agency (IRENA) on local sustainable energy planning in China. Municipal projects like DUT Pol4PED, Colouring Dübendorf, and Net-Zero Frauenfeld, as well as regional projects, such as Net-Zero Rheintal and Sisslerfeld, demonstrate how the Lab engages with local authorities to co-design solutions in real urban

districts, turning cities into living labs for innovation, contributing to net-zero transformation of Switzerland and beyond.

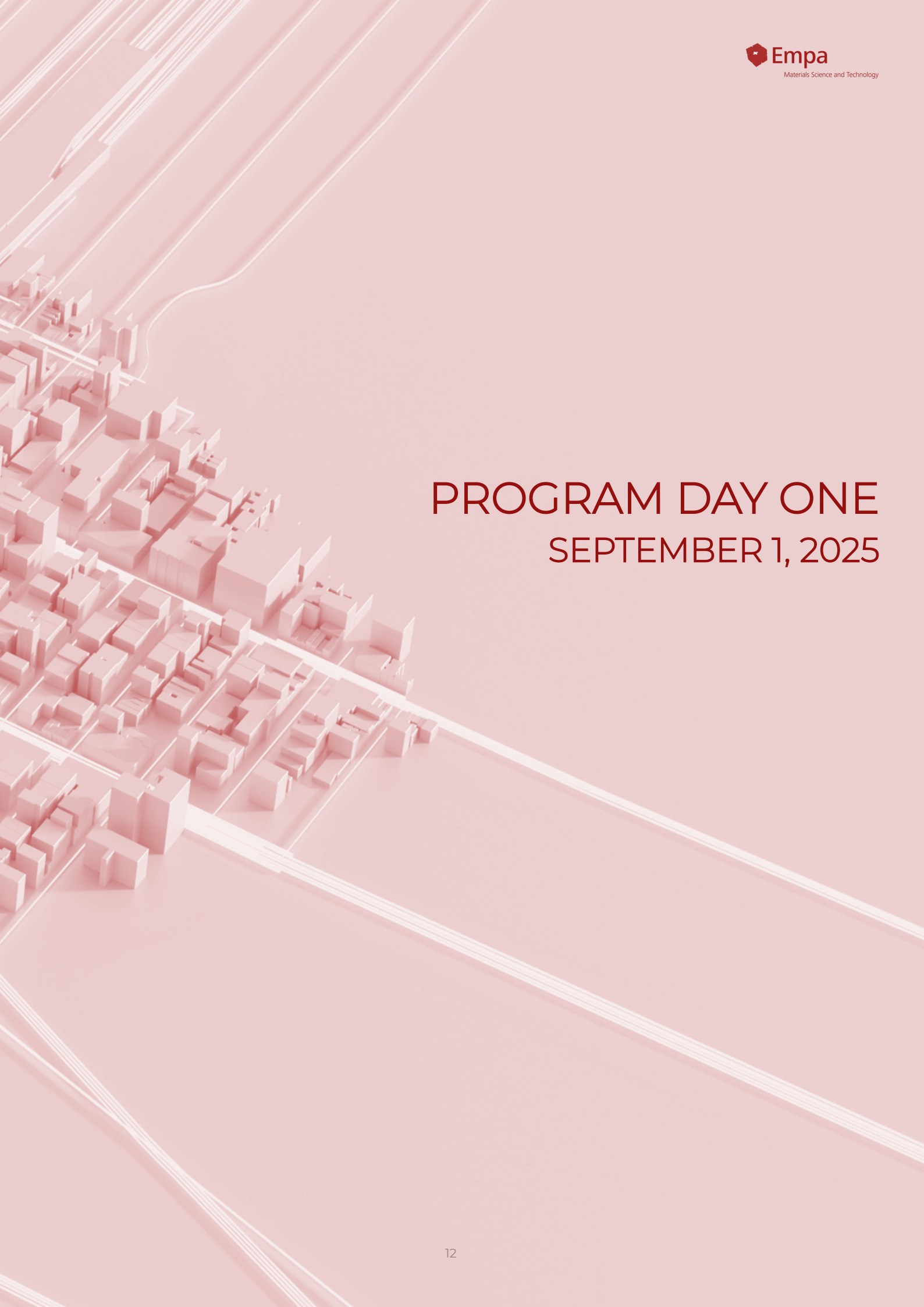
Collaboration has always been central to UESL's identity. At the national level, the Lab works closely with ETH Zurich, EPFL, and Swiss Universities of Applied Sciences. Internationally, UESL partners with institutions such as Lawrence Berkeley National Laboratory and MIT (USA), Imperial College London (UK), Aalborg University (Denmark), KU Leuven (Belgium), Kwame Nkrumah University of Science and Technology (KNUST), IRENA, and DTU and RISE (Scandinavia). These networks allow UESL not only to contribute Swiss expertise to global debates but also to bring global perspectives into Swiss urban energy research.

As UESL celebrates its 10th anniversary, it does so with gratitude to all its members, past and present, and to the many partners who have contributed to its journey. What began as a small group working on energy hubs and storage has grown into a globally connected center of excellence in urban energy research. The coming decade will see UESL expand its scope further, exploring system integration across energy, materials, and mobility; embedding circular economy and social equity into energy strategies; and advancing digital tools that turn complexity into actionable knowledge.

UESL remains committed to the same vision that inspired its founding: to pioneer research that is scientifically rigorous, practically relevant, and socially meaningful. By bridging science, technology, and society, the Lab will continue to support the transformation of cities into sustainable, resilient, and equitable places to live.



*The Urban Energy Systems Laboratory team during our Annual Retreat in 2025*



# PROGRAM DAY ONE
## SEPTEMBER 1, 2025

## Program Overview

| Time | Location | September 1, 2025 | | | |
|---|---|---|---|---|---|
| **8:00-9:00** | Akademie Foyer | Registration | | | |
| **9:00-9:30** | Akademie | Welcome address by the Empa directorate (Prof. Matthias Sulzer) & "Urban Futures and 10 years of the UESL" (Dr. Georgios Mavromatidis) | | | |
| **9:30-10:15** | Akademie | **Keynote**: Urban Planning in Research - Prof. Adrienne Grêt-Regamey (ETH Zurich) | | | |
| **10:15-10:45** | Akademie Foyer | Poster session & coffee break | | | |
| | | Parallel sessions | | | Workshop |
| **10:45-12:00** | (See session) | *Urban energy systems (Akademie)* | *Citizen engagement and participatory approaches for just urban planning (LB)* | *Nature-based solutions, green-blue infrastructure & ecology (VE 102)* | *From Insight to Impact: Transforming the Evidence-to-Policy Pipeline (ETH Zurich) (NEST-MF)* |
| **12:00-13:00** | Akademie Foyer | Lunch | | | |
| **13:00-13:45** | Akademie | **Keynote**: "Neighbourhoods First: Spatial Design as a Lever for Urban Energy Transitions" - Dr. Vincent Kitio & Yassine Moustanjidi (UN-Habitat) | | | |
| | | Parallel sessions | | | Panel |
| **13:45-15:00** | (See session) | *Sufficiency: pathways to living well within planetary boundaries (LB)* | *The future of mobility (VE 102)* | *Building performance and retrofitting (VE 202)* | *From Forma Urbis to Forma Horta: Blue–Green Urban Futures in Dense, Heritage-Rich Cities (University of Patras, University of Geneva & others) (Akademie)* |
| **15:00-15:30** | Akademie Foyer | NEST tour, poster session & coffee break | | | |
| | | Panel & Workshops | | | |
| **15:30-17:00** | (See session) | *Panel - Sufficiency: Radical rapid societal transformation to ecosystem and human well-being (EPFL, Empa, Sciences Po/IPCC, ZHAW) (Akademie)* | *PowerHood: Playtesting a serious game for energy transition in neighborhoods (Empa) (NEST-MF)* | *Gridly: Interactive engagement tool for Local Energy Community, market, and users' interconnectivity (Lucerne University of Applied Sciences and Arts) (NEST-M2C)* | *Futuring cities: Participatory visioning for resilient futures (United Nations University) (LB)* |
| **17:00-17:30** | Akademie | Closing address | | | |
| **17:30 +** | Multifunktion Recreational | UESL 10th anniversary dinner & networking celebration! | | | |

## Keynote Speakers

MONDAY, SEPTEMBER 1, 2025, 9:30 – 10:45 AM CEST

### “Bridging design and science for unlocking urban resilient pathways”

Engineering has long influenced how cities are planned and designed, often favoring optimal, highly efficient solutions for transportation, communication, and energy systems. Policy frameworks such as those shaping the New Urban Agenda often interpret urban sustainability narrowly, as increased resource efficiency alone. While efficiency can be valuable, an exclusive focus on it can unintentionally erode resilience by eliminating redundant backup systems and ignoring social demands. Sustainability goals and resilience goals, if not examined carefully, can therefore be at odds with one another, where maximizing efficiency at the same time reduces resilience. This keynote will introduce a design-science loop approach, fostering an intensive inter- and transdisciplinary dialogue to chart resilient and sustainable urban development pathways. Leveraging emerging digital technologies in a collaborative process, this approach supports the creation of culturally grounded, locally specific solutions that address complex environmental challenges. It calls for weaving vernacular intelligence into urban planning and design, ensuring that cities are not only sustainable in theory but also resilient in practice.

Prof. Dr. Adrienne Grêt-Regamey

Professor and Chair of Planning, Landscape and Urban Systems (PLUS), ETH Zurich

*Adrienne Grêt-Regamey is an environmental scientist and landscape planner. She has been Professor at the Chair of Planning Landscape and Urban Systems at the Institute for Spatial and Landscape Development, ETH Zürich (Switzerland) since 2008. Currently, her research focuses on understanding how the interactions and/or actions of humans shape landscapes at various temporal and spatial scales, using different land-use decision models in forecasting and backcasting modes. For fostering participatory landscape planning, she investigates how people perceive the landscape in her lab, where state-of-the-art 3D visualizations and auralizations of landscape changes are generated and decision support tools developed. She also explores how an iterative process between design and science can allow co-creating place specific responses satisfying human needs and demands for well-being in a sustainable manner.*

MONDAY, SEPTEMBER 1, 2025, 13:00 – 13:45 PM CEST

## “Neighbourhoods First: Spatial Design as a Lever for Urban Energy Transitions”

Urban energy transitions begin at the scale closest to people’s lives—the neighbourhood. This keynote draws on UN-Habitat Urban Lab’s global experience in neighbourhood planning and the “My Neighbourhood” methodology to highlight how spatial design decisions—from layout and density to land use mix and mobility networks—directly impact energy demand, efficiency, and resilience. Through case studies from diverse urban contexts, the talk will demonstrate how integrated planning at the neighbourhood scale can reduce infrastructure needs, support passive energy strategies, and foster sustainable lifestyles. It argues that to achieve equitable, low-carbon cities, we must prioritise design approaches that embed energy efficiency into the very fabric of urban form.

Dr. Vincent Kitio and Yassine Moustanjidi

Urban Planning and Design Lab (Urban Lab), UN-Habitat

*Dr. Vincent Kitio is an architect with a master degree from the Institute of Architecture of Venice and a PhD in Appropriate Energy Technologies from the University of Rome "La Sapienza," Italy. He leads the Urban Energy Solutions Team at UN-Habitat, focusing on energy access for the urban poor, energy efficiency in the built environment, and renewable energy technologies deployment in urban areas.*
*Vincent develops and implement innovative and transformative clean energy and resource efficient built environment programs in Africa, such as mainstreaming energy efficiency strategies in building practices, building codes and building standards. He designs projects that promote decentralized clean energy generation from solar, wind, hydro, and municipal waste to energy. He promotes: carbon-neutral building materials and sustainable, adequate, and affordable social housing.*
*Currently, Vincent oversees the development of two major city projects: the GEF 8 - Nairobi Sustainable City Integrated Project and the development of a 200MW renewable energy projects in west Cameroon. He is also creating an online platform to promote Net Zero Carbon Architecture for Africa.*

*Yassine Moustanjidi is an Urban Planning Expert at UN-Habitat, specialising in integrative urban design and resilience. His work bridges research and practice, with experience across the MENA region, China, wider Asia, and Europe. He has contributed to a wide range of projects addressing urban planning, housing, green infrastructure, metropolitan urbanization, urban–rural linkages, and the preservation of urban heritage.*
*Before joining UN-Habitat, Yassine was a lecturer in the Department of International Urbanism at the University of Stuttgart, Germany, and served as coordinator for the international project Future Megacities: Energy and Climate Efficient Structures in Urban Growth Centres, funded by the German Federal Ministry of Education and Research (BMBF).*
*Yassine holds a Diploma in Architecture from the École Nationale d’Architecture in Rabat, as well as a dual Master's degree in urban design from the Tongji University in Shanghai and the Technical University of Berlin. He is currently a PhD candidate researching cross-border urban governance in the Singapore–Johor–Riau extended urban region.*

Empa
Materials Science and Technology

# ORAL PRESENTATIONS

Monday, September 1st, 2025

**Parallel Sessions 10:45-12:00 CEST**

• Citizen engagement and participatory approaches for just urban planning
LB

• Urban Energy Systems
AKADEMIE

• Nature-based solutions, green-blue infrastructure & ecology
VE 102

| September 1, 2025<br>10:45-12:00 | | |
|---|---|---|
| Time | Presentation title | Presenter |
| Citizen engagement and participatory approaches for just urban planning (LB) | | |
| 10:45-11:00 | Open-source approaches for urban environmental insight and resilience | *Sachit Mahajan, ETH Zurich* |
| 11:00-11:15 | Neighbourhood-based energy cooperations (QUBE) – Doing the energy transition together | *Corinne Schwaller, Ulrike Sturm, Lucerne University of Applied Sciences (HSLU)* |
| 11:15-11:30 | Reclaiming public spaces: Community-driven placemaking as urban transformation in post-apartheid South Africa township. | *Thendo Mafame, Sol Plaatje University* |
| 11:30-11:45 | The future of high-density cities: Integrating emotional feedback for sustainability | *Hari Priya Peddigari* |
| 11:45-12:00 | Participation beyond consultation: Lessons from collective energy initiatives | *Vanja Djinlev, Empa* |
| Urban energy systems (Akademie) | | |
| 10:45-11:00 | Modeling long-term sectoral integration and interconnectivity in urban energy and sustainability transitions | *Erik Ahlgren, Chalmers University of Technology* |
| 11:00-11:15 | Systemic innovation for the defossilisation of cities and regions: Experiences from the Innosuisse Flagship DeCIRRA and recommendation for future work | *Serge Biollaz, Paul Scherrer Institut (PSI)* |
| 11:15-11:30 | Economy and sustainability analysis of sector coupled district energy systems using white-box models in distributed co-simulation | *Haozhen Cheng, Karlsruhe Institute of Technology* |
| 11:30-11:45 | Urban building energy modelling and multi-objective optimization for PED transition in an existing neighbourhood in Sweden, decentralized renewable energy system integration in communities | *Elena Malakhatka, Chalmers University of Technology* |
| 11:45-12:00 | Ensuring a solar future: Integrating the local actor perspective in urban energy systems planning | *Natasa Vulic, School of Applied Sciences and Arts Northwestern Switzerland* |
| Nature-based solutions, green-blue infrastructure & ecology (VE 102) | | |
| 10:45-11:00 | From vision to action: Sustainable integrated districts as climate change solutions | *Maryam Hajizarghani, Double Height Construction Ltd., Brandt Developments Ltd.* |
| 11:00-11:15 | Cultural diversity in urban park use and perception | *Tural Aliyev, Eawag* |
| 11:15-11:30 | The ‘fifth façade’ as the new urban ground: A Citizen Science Approach to Blue-Green Roofs | *Alcestis Rodi (University of Patras), Poly Hudson (Alan Turing Institute), Robert Hecht (IOER), Alexandre Hedjazi (University of Geneva)* |
| 11:30-11:45 | Decentralised water reuse for urban water security: The case of Bangalore, India | *Abishek Narayan, Eawag* |

**CITIZEN ENGAGEMENT AND PARTICIPATORY APPROACHES FOR JUST URBAN PLANNING**

10:45-11:00

LB

*SACHIT MAHAJAN, ETH ZURICH, SWITZERLAND*

## Open-source approaches for urban environmental insight and resilience

Open-source tools and frameworks are playing an increasingly critical role in shaping how cities are understood, experienced, and sustained. This talk highlights a series of open, adaptable innovations designed to deepen environmental insight and foster urban resilience. At the intersection of data, design, and participation, the work brings together modular tools for assessing urban greenness, participatory approaches to environmental monitoring, and open-source frameworks for multi-criteria spatial decision-making. Each example illustrates how transparent, accessible technologies—rooted in local context and aligned with community values—can empower decision-making at multiple levels. The presentation considers how open-source ecosystems can contribute to more inclusive and adaptive urban practices, highlighting their potential to support emerging approaches to urban research and planning.

CITIZEN ENGAGEMENT AND PARTICIPATORY APPROACHES FOR JUST URBAN PLANNING

11:00-11:15

LB

*CORINNE SCHWALLER, ULRIKE STURM, INSTITUTE FOR SOCIOCULTURAL COMMUNITY DEVELOPMENT, LUCERNE UNIVERSITY OF APPLIED SCIENCES AND ARTS (HSLU) - SCHOOL FOR SOCIAL WORK, SWITZERLAND*

## Neighbourhood-based energy cooperations (QUBE) – Doing the energy transition together

Decarbonisation of existing residential or mixed-use neighbourhoods with heterogeneous building and ownership structures is particularly challenging. As part of the SWEET Lantern research project, we address this issue by applying and testing socio-cultural participation methods to encourage cooperative energy transition in neighbourhoods. While participatory, multi-stakeholder processes are well established in areas such as urban planning and neighbourhood development, they are rarely used in the energy sector. We see considerable potential for this bottom-up approach in the field of energy transition, as it facilitates the collective sensitisation, activation, and engagement of different stakeholders in developing and realising cooperative energy solutions tailored to the specific structural conditions of the neighbourhoods and the needs, interests, and possibilities of the people involved.

In this presentation, we will share our experiences and (preliminary) findings from two neighbourhood projects in the Lucerne (sub)urban area. During a first project from 2021 to 2023 (QUBE I), the project team developed a socio-technical transformation process for cooperative energy transition in neighbourhoods. As part of the SWEET Lantern project, this process was aligned with a Living Lab approach and tested in a second neighbourhood project in 2024/25 (QUBE II). Our goal is to develop a transferable process model with the corresponding guidelines, materials, and tools, which can be adopted by various actors in the field for promoting the energy transition within existing neighbourhoods, such as municipal authorities or community associations.

Experience on the ground shows that cooperative renewable energy projects face a variety of challenges, including changing legal regulations, a lack of support structures, technical and market-related uncertainties, and issues of coordination and commitment. Also, such processes tend to reach and engage only a limited range and type of people. Yet, if the municipalities take an active role and provide the necessary support structures, and if homeowners and neighbourhood residents are involved from the outset and accompanied throughout, such processes have demonstrated to have the potential to yield viable and feasible renewable energy solutions. In addition, such bottom-up approaches often have intangible effects on neighbourhoods beyond energy solutions, ranging from increased individual knowledge and empowerment to community building and greater neighbourhood cooperation.

By reflecting on the outcomes of the projects and on the experiences of the various stakeholders involved, we will discuss opportunities and challenges of this approach, as well as its potential for dissemination and for accelerating the adoption of sustainable energy solutions with a high level of social acceptance.

**CITIZEN ENGAGEMENT AND PARTICIPATORY APPROACHES FOR JUST URBAN PLANNING**

11:15-11:30

LB

*THENDO MAFAME, SOL PLAATJE UNIVERSITY, SOUTH AFRICA*

## Reclaiming public spaces: Community-driven placemaking as urban transformation in post-apartheid South Africa township.

CITIZEN ENGAGEMENT AND PARTICIPATORY APPROACHES FOR JUST URBAN PLANNING

11:30-11:45

LB

*HARI PRIYA PEDDIGARI, INDEPENDENT RESEARCHER | MS ARCHITECTURE (NJIT, USA), UNITED STATES*

## The future of high-density cities: Integrating emotional feedback for sustainability

Cities with high population density like New York, London, Delhi, Tokyo and Shanghai are under immense environmental pressure with systems for energy, water, waste and public space under constant stress. While digital infrastructure provides access to real time environmental data, this data rarely connects with residents daily lives. The resulting disconnect prevents individual engagement with sustainability efforts and creates a barrier to inclusive urban transformation.

This presentation explores the potential of emotionally responsive feedback systems to act as intermediaries between urban populations and the ecological conditions of their cities. Drawing from interdisciplinary frameworks of architecture, behavioral design, and human-computer interaction, I will present speculative interface designs that make environmental data like energy consumption, air quality metrics, or biodiversity trends visible and emotionally resonant for everyday citizens. These systems can manifest as interactive installations in the urban landscape, public facing dashboards or mobile platforms that reflect individuals' local environmental impact in real time.

Inspired by the metaphor of a shared digital companion, like the responsibility one has for a Tamagotchi, this concept encourages a shift from passive awareness to emotional investment. The goal is to create feelings of empathy, responsibility, and pride towards one's immediate environment, to trigger behavioral change at the local level. Instead of presenting abstract metrics, these systems can translate sustainability goals into personally relevant and culturally contextual cues.

This work directly addresses SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) by proposing human centered tools for inclusive participation, behavioral insight and local action. It also reflects the principles of integrated urban systems thinking and the broader mission of equitable and resilient urban development.

The real goal is not to present data visually; it's to create a real emotional connection with the urban environment. By incorporating emotional feedback into city life, individuals can become more aware and engaged. This way, citizens can play an active and informed role in shaping the evolution of densely populated urban spaces.

**CITIZEN ENGAGEMENT AND PARTICIPATORY APPROACHES FOR JUST URBAN PLANNING**

11:45-12:00

LB

*VANJA DJINLEV (1), MICHAEL BRENNER-FLIESSER (2), BINBIN PEARCE (3), (1) EMPA, SWITZERLAND, (2) JOANNEUM RESEARCH, AUSTRIA, (3) TU DELFT, NETHERLANDS, SWITZERLAND*

## Participation Beyond Consultation: Lessons from Collective Energy Initiatives

Infrastructure planning claims to be participatory, yet participation often stops at consultation, providing citizen visibility without sustained agency. This presentation draws on findings from over 60 Collective Energy Initiatives (CEIs) across Europe to examine how citizen engagement is enacted, and how it is subsequently enabled, constrained, or transformed by systemic conditions. Using the Energy Cultures Framework and the SES-ICES Framework, the analysis explores the interactions between material infrastructures, norms, and governance systems that shape citizen participation.

The study distinguishes between three main types of CEIs: Energy Communities (ECs), Collective Targeted Actions (CTAs), and Political/Social Movements (PMs). Each reflects a distinct form of participation. ECs are typically motivated by climate goals, cost savings, and community cohesion, but face barriers of legal complexity and bureaucratic inertia. CTAs focus on pragmatic, project-based solutions, yet struggle with resource limitations and continuity. PMs mobilize around systemic justice and equity but face resistance, burnout, and limited institutional receptiveness.

Across these forms, three participation profiles emerge: lifestyle changers, technically engaged, and full-spectrum shifters. These profiles reveal that participation is not equal, as it depends on both citizen initiative and the systemic environments that sustain or constrain it. The findings suggest that just, citizen-centered infrastructure planning requires recognizing and supporting the diversity of citizen engagement types. Participation must be cultivated as a structural condition, not performed as a superficial consultation.

**URBAN ENERGY SYSTEMS**

10:45-11:00

AKADEMIE

*ERIK AHLGREN, CHALMERS UNIVERSITY OF TECHNOLOGY, SWEDEN*

## Modeling long-term sectoral integration and interconnectivity in urban energy and sustainability transitions

The world is urbanising, and cities are playing an increasingly important role in the economy and for the environment. Cities are large contributors to greenhouse gas emissions, but also drivers of change. Transitions to mitigate emissions and adapt to a changing climate require collaboration of city departments and stakeholders with different mandates and interests. It also requires integration and interconnectivity across sectors such as electricity, heating/cooling, and transport in order to utilise constrained resources in smart ways. Such integration and interconnectivity in climate transitions can lead to important synergies and resource efficiency if correctly designed. Addressing sectoral interlinkages is essential to capture synergies and solve potential goal conflicts. There is thus a need for integrated synergistic planning to reduce emissions and the overall climate impact, but planning is often done in silos. Transitions should also be just, both to be implementable and to leave no-one behind. This complexity of urban transitions leads to demand for tools enabling sustainability assessments across temporal and spatial scales and across a multitude of stakeholders, and covering both the mitigation and adaptation climate dimensions.

To deal with these complexities and provide policy and decision support to city planning and transitioning processes, we have developed technology-rich cost-optimization models based on the TIMES modelling framework. Integration have been central in the development of the models, which cover intra-sectoral and inter-sectoral interactions and include spatial dimensions. The developed models have been applied to different city energy systems in Denmark and Sweden and used in close stakeholder interaction.

The modelling have aimed to drive city climate transitions by addressing, and providing solutions to, different types of integration and interconnectivity (and potential conflicts): between city and urban planners, between supply and demand sides of the energy system, between large-scale and decentralised technologies, between the city and its rural surroundings, between short- and long-term targets, between different city areas, and through alignment between city and national climate strategies and policy. Costs of the addressed interconnectivity and integration have also been addressed. The modelling study results show that it is necessary to address and include interconnectivity and integration in studying city energy transitions to find smart, cost- and resource-efficient solutions, and also show how such solutions can be designed. Further, it is shown how the modelling as a process can contribute to stakeholder interconnectivity and shared understanding of complex issues. The presentation builds upon six recently completed and published studies within the research group and will cover a combination of case specific results and methodological advances.

**URBAN ENERGY SYSTEMS**

11:00-11:15

AKADEMIE

*SERGE BIOLLAZ, PAUL SCHERRER INSTITUT (PSI), SWITZERLAND*

## Systemic innovation for the defossilisation of cities and regions: Experiences from the Innosuisse Flagship DeCIRRA and recommendation for future work

Decarbonisation resp. defossilisation of cities and regions is one challenge which needs to be addressed to achieve the Swiss Net Zero Target by 2050. In an interdisciplinary and transdisciplinary setting, the Innosuisse Flagship DeCIRRA addresses the following questions: How might we decarbonise cities and regions? How might we make best use of local resources and existing infrastructure? What role can energy distributors and renewable gases play in the transition towards an energy system without net-emissions of CO2?

DeCIRRA is a platform bringing together practitioners from many sectors and is focusing on critical aspects of sector coupling and relevant options of the production of renewables gases, including Power-to-Gas. Different Carbon Capture and Storage (CCS) and Negative emission Technologies (NET) are compared as they are necessary for achieving the Net-Zero Target.

The resources available in Switzerland are and remain limited (renewable energies, land, building land, etc.). They must be utilised as efficiently and effectively as possible in order to improve domestic value creation and increase self-sufficiency. Local energies (e.g. heat and wet biomass, which cannot be transported over long distances) should therefore always be utilised locally first. Conversely, non-local and easily transportable energy sources (e.g. wood, biomethane, H2, methanol, etc.) are available for energy services that cannot be provided in any other way, such as high-temperature heat for industry. Accordingly, false incentives in national and cantonal laws and regulations must be eliminated, for example with regard to support instruments for biomass plants that favour electricity generation over other types of use.

In order to reach Net Zero, two measures are critical. Expand the production of renewable electricity on a municipal level (PV, Wind, hydro) and integrate the electricity, heat and electric mobility sector on grid level seven. The other critical measure is Carbon Capture and Storage (CCS) form point sources. The role of energy gases (Hydrogen and Methane) considerably depends on the existing gas distribution system and the future demand from industry. For peak supply of heat and electricity in urban energy systems, energy gases will most likely still play a relevant role.

**URBAN ENERGY SYSTEMS**

11:15-11:30

AKADEMIE

*HAOZHEN CHENG, KARLSRUHE INSTITUTE OF TECHNOLOGY, GERMANY*

## Economy and sustainability analysis of sector coupled district energy systems using white-box models in distributed co-simulation

This work presents a comprehensive methodology for the techno-economic and sustainability assessment of District Energy Systems (DES) using white-box models within a distributed co-simulation environment. In response to the growing need for energy-efficient and low-carbon urban developments, we introduce an integrated modeling framework that couples high-fidelity representations of buildings, heat, and electricity grids together with sector-coupling elements, enabling holistic system-level analysis across multiple domains and indicators.

One of the key contributions is a novel white-box building model developed in Modelica, designed with a high degree of modularity and flexibility. The model allows for diverse configurations, including varying levels of thermal insulation, heating systems (e.g., heat pumps, gas boilers), occupancy patterns, and climate conditions. Through 36 scenario simulations, the thermodynamic validity of the model is demonstrated, and results highlight that heat pump-based systems in well-insulated buildings yield both significant carbon savings and economic benefits, while gas boilers remain cost-efficient for poorly insulated structures.

Complementing the building simulations, we present a new methodology for district heating variant analysis. This involves a modular, co-simulated representation of heating centers, pipeline grid, and building interface units. After the verification of these models mentioned above, we examine various energy carriers and heating technologies. Results indicate that using biomethane can reduce carbon equivalent emissions by nearly 70%, while hydrogen-powered systems with heat pumps achieve up to 77% reductions. Ground-source heat pumps are shown to offer high economic viability when economic benefits are considered.

To manage the complexity and computational load of large-scale white-box simulations, model order reduction techniques are applied, significantly enhancing the efficiency of distributed co-simulation workflows. The framework supports long-distance, multi-stakeholder collaboration and facilitates early-stage planning for new urban districts through systematic variant modeling and scenario-based decision support.

These studies demonstrate the potential of modular white-box models and distributed co-simulation to inform strategic planning, enabling optimized design choices for future-ready, low-carbon neighborhoods.

**URBAN ENERGY SYSTEMS**

11:30-11:45

AKADEMIE

*ELENA MALAKHATKA, CHALMERS UNIVERSITY OF TECHNOLOGY, SWEDEN*

## Urban building energy modelling and multi-objective optimization for PED transition in an existing neighbourhood in Sweden, decentralized renewable energy system integration in communities

Transitioning existing urban neighborhoods to Positive Energy Districts (PEDs) requires integrated planning to address complex energy, cost, and lifecycle carbon emission challenges. This paper introduces and applies an integrated Urban Building Energy Modelling (UBEM) and bi-objective Mixed-Integer Linear Programming (MILP) framework. The framework co-optimizes building retrofits and heating systems, Photovoltaic (PV) systems, and Battery Energy Storage System (BESS) capacities over a 10-year horizon with hourly resolution, targeting minimal life-cycle costs and total carbon emissions (operational and embodied). Applied to a 1950s neighborhood in Gothenburg, Sweden, the analysis demonstrated that achieving full PED status (net-zero energy import, net-zero carbon, and energy surplus) with the evaluated interventions is highly challenging. While optimized scenarios significantly reduced grid dependency (to ~ 63% with PV and BESS under volatile prices) and overall carbon emissions (by ~ 13% compared to baseline), complete net-zero energy import, full carbon neutrality, including embodied impacts, and an energy surplus were not realized. The study quantitatively identified critical trade-offs between investment costs, embodied carbon, operational performance, and resilience. Optimal solutions were highly sensitive to local factors, including Sweden's low-carbon district heating and electricity price volatility affecting BESS viability. The proposed framework provides a robust decision-support tool for strategic PED planning in existing urban areas, enabling exploration of complex techno-economic and environmental trade-offs.

**URBAN ENERGY SYSTEMS**

11:45-12:00

AKADEMIE

*NATASA VULIC, INSTITUTE FOR SUSTAINABILITY AND ENERGY IN BUILDINGS, SCHOOL OF APPLIED SCIENCES AND ARTS NORTHWESTERN SWITZERLAND, SWITZERLAND*

## Ensuring a solar future: Integrating the local actor perspective in urban energy systems planning

**NATURE-BASED SOLUTIONS, GREEN-BLUE INFRASTRUCTURE & ECOLOGY**

10:45-11:00

VE 102

*MARYAM HAJIZARGHANI, DOUBLE HEIGHT CONSTRUCTION LTD., BRANDT DEVELOPMENTS LTD., CANADA*

## From vision to action: Sustainable integrated districts as climate change solutions

Sustainable Integrated Districts (SIDs) are emerging as a model for high-density, high-livability, resilient, and sustainable future cities. SIDs function as integrated urban systems composed of a diverse range of green landscape typologies and interconnecting elements collectively known as Green Infrastructure (GI). These networks deliver multiple functions and ecosystem services (ESs), offering integrated environmental, socio-cultural, and economic benefits. Incorporating SIDs into urban contexts can help address various challenges faced by modern cities, such as climate change.

To create highly interconnected, efficient, and sustainable green systems, SIDs leverage the advantages of district-scale planning and their unique physical and spatial characteristics—including the typologies, forms, and spatial relationships of their constituent Green and Blue Infrastructures (GBIs). These features contribute to long-term synergistic impacts and enhance the provision of broader ecosystem services. As a result, SIDs play a key role in improving cities' environmental performance, resilience, sustainability, and livability at the district level.

Currently, there is a lack of robust methods for developing SIDs. In particular, the design of SIDs requires comprehensive models to guide and evaluate urban transformation, ensuring the effective delivery of ecosystem services. These models should define the optimal forms, typologies, and configurations of GI systems best suited to support ESs within SID networks, especially under changing climate conditions.

**NATURE-BASED SOLUTIONS, GREEN-BLUE INFRASTRUCTURE & ECOLOGY**

11:00-11:15

VE 102

*TURAL ALIYEV, EAWAG, SWITZERLAND*

## Cultural diversity in urban park use and perception

As cities become larger and culturally more diverse, urban green areas such as parks are an increasingly important measure to mitigate climate change. We investigate the preference and use of urban green spaces – urban parks and urban forests - between people with different cultural backgrounds.

Motivational, emotional, and ecological dimensions form a framework that elucidates how cultural backgrounds shape individuals' use and perception of parks. The analysis relies on 100 face-to-face interviews with park users in four parks in Zurich, Switzerland, and uses a combination of quantitative and qualitative approaches.

Results suggest that shared appreciation for health benefits, cultural differences in motivations and emotional responses, and varying preferences for structured versus simple environments shape park use.

The article contributes to the literature by combining the analysis individuals' use and perceptions of urban green areas with individuals' cultural backgrounds, by proposing three dimensions and explicitly incorporating ecological structure of urban green areas into the analysis, and by studying a case in a European context. In general, the study thus contributes to the interdisciplinary combination of ecological and social perspectives in urban studies.

**NATURE-BASED SOLUTIONS, GREEN-BLUE INFRASTRUCTURE & ECOLOGY**

11:15-11:30

VE 102

*ALCESTIS RODI (1) , POLY HUDSON (2), ROBERT HECHT (3), ALEXANDRE HEDJAZI (4)*

*(1) PROFESSOR OF URBAN DESIGN AND PLANNING, DEPARTMENT OF ARCHITECTURE, UNIVERSITY OF PATRAS,*

*(2) ALAN TURING INSTITUTE*

*(3) LEIBNIZ INSTITUTE OF ECOLOGICAL URBAN AND REGIONAL DEVELOPMENT (IOER)*

*(4) LECTURER AT THE UNIVERSITY OF GENEVA – INSTITUTE OF ENVIRONMENTAL SCIENCES AND ACADEMIC DEPUTY DIRECTOR OF THE "GLOBAL ENVIRONMENTAL POLICY PROGRAMME*

## The 'fifth façade' as the new urban ground: A Citizen Science Approach to Blue-Green Roofs

Rooftops, the buildings' "fifth façade", represent a critical yet underused surface in cities. Often constructed from high thermal mass materials, they significantly contribute to the urban heat island effect and account for 20–25% of urban land cover (US EPA, 2011; LBNL, 2007). Repurposed as blue-green infrastructure, rooftops can mitigate heat stress, manage stormwater, capture pollutants, support biodiversity, improve public health, and create much-needed green spaces in compact cities (NASA GISS, 2022; RESILIO, 2022; IGNITION Project). Recent innovations, such as MIT Roofscapes, allow for interventions even on complex roof structures.

However, successful rooftop transformation demands fine-grained data on structural capacity, inclination, material condition and weathering, sun and wind exposure, access, and ownership patterns. Moreover, since most rooftops are privately owned, transformation fundamentally relies on citizen awareness, willingness, and active participation. Citizen Science offers a scalable method for gathering such detailed information, especially in dense urban areas where sustained public engagement is feasible.

Our approach leverages academic expertise to map, visualize, and analyze building stock, while adopting a Citizen Science methodology to foster public involvement. This provides both data-driven insights and practical, science-based strategies for climate adaptation. The starting point is heat-threatened Athens, where 90% of buildings have flat roofs suitable for adaptation. Despite growing interest in blue-green infrastructure (e.g., Sponge City, BEGIN, Climate City Capital Hub, EU Biodiversity Strategy 2030), the feasibility of rooftop adaptation (particularly in Mediterranean cities like Athens) remains underexplored. Existing models, such as Amsterdam's Blue-Green Trays, are context-specific and require testing for regional transferability. Furthermore, existing knowledge often lacks critical information on rooftop suitability for blue-green solutions. To address this, we combine remote sensing and cadastral data (e.g., roof slope, material) with insights from citizen scientists (e.g., roof access, and uses such as storage or drying clothes), capturing hidden realities that would otherwise be overlooked.

This methodology to investigate the transformation of rooftops is already underway in the Kypseli neighborhood, where students from the University of Patras and the University of Geneva won the C40 Students Reinventing Cities competition.

Scalable and replicable, our research offers a climate-responsive model that can be adapted globally, especially in high-density urban areas. Its success can inform policy incentives, legislative reforms, and urban planning strategies, transforming underutilized urban surfaces into key assets for climate responsive urban design and urban resilience.

**NATURE-BASED SOLUTIONS, GREEN-BLUE INFRASTRUCTURE & ECOLOGY**

11:30-11:45

VE 102

*ABISHEK SANKARA NARAYAN [1*], FRANCINE VAN DEN BRANDELER [1,2*], CHESHTA RAJORA[3], REBECCA HUMBORG[1], SHASHANK PALUR[3], SHREYA NATH[3], SNEHA SINGH[3], CHRISTOPH LÜTHI [1]*

*[1] EAWAG: SWISS FEDERAL INSTITUTE OF AQUATIC SCIENCE AND TECHNOLOGY, DÜBENDORF 8600, SWITZERLAND*

*[2] THE EARTH COMMONS, GEORGETOWN UNIVERSITY, REGENTS HALL, 37TH AND O STREETS, N.W., WASHINGTON, D.C.*

*[3] WATER, ENVIRONMENT, LAND AND LIVELIHOODS (WELL) LABS, INSTITUTE FOR FINANCIAL MANAGEMENT AND RESEARCH, BENGALURU, KARNATAKA 560004, INDIA*

**EQUAL CONTRIBUTORS*

## Decentralised Water Reuse for Urban Water Security: The case of Bangalore, India

The world's escalating urban water crisis demands innovative solutions such as decentralised wastewater treatment and reuse. While there are examples globally, such as San Francisco, Hamburg, or Addis Ababa, the Indian megacity of Bengaluru has been a pioneer in implementing this at scale, making it a unique case globally. This study examines how the shifts towards decentralisation and circularity have transformed (waste)water policies and practices in Bengaluru, by combining a water reuse value chain conceptualisation with an analysis of the emerging DWTRS governance architecture. The analyses are based on a mixed-methods approach, including policy analysis, stakeholder interviews, quantitative estimation, and site visits. It is estimated that approximately 25% to 60% of the total wastewater generated in the megacity could potentially be reused for various non-potable purposes, both onsite and offsite. Realising the full potential of DWTRS requires reforms towards a comprehensive multi-level governance framework across the entire reuse value chain that supports a holistic approach to urban water management. In 2024, during a policy window created by a drought, citizen action and research findings were used to create the foundations for the first ever "wastewater market". The learnings from the city contribute to the design of an enabling governance framework for DWTRS for other rapidly urbanising regions with similar water-related challenges.

Monday, September 1st, 2025

**Parallel Sessions 13:45-15:00 CEST**

• Sufficiency: pathways to living well within planetary boundaries

LB

• The future of mobility

VE 102

• Building performance and retrofitting

VE 202

| September 1, 2025<br>13:45-15:00 | | |
|---|---|---|
| Time | Presentation title | Presenter |
| Sufficiency: pathways to living well within planetary boundaries (LB) | | |
| 13:45-14:00 | A systems perspective of housing and mobility interrelations, and implications on wellbeing, sufficiency, shared spaces, energy, de-sprawl, governance, justice, public policy | *Sascha Nick, EPFL* |
| 14:00-14:15 | Achieving more by demanding less: The potential of sufficiency | *Til Sommer, Fatih Topak, Kristina Orehounig, TU Wien* |
| 14:15-14:30 | Space sufficiency: How institutional real estate and single family home owners approach this challenge | *Christina Marchand, Zurich University of Applied Sciences (ZHAW)* |
| 14:30-15:00 | Sufficiency: From concept to collective movement with the World Sufficiency Lab | *Yamina Saheb (Sciences Po), Mashael Yazdanie (Empa)* |
| The future of mobility (VE 102) | | |
| 13:45-14:00 | It's not you, it's me - Global urban visual perception varies across demographics and personalities | *Matias Quintana, Singapore-ETH Centre* |
| 14:00-14:15 | Quantifying accessibility and its implications for sustainable urban mobility systems | *Marco Miotti, ETH Zürich* |
| 14:15-14:30 | Potential willingness to use autonomous ride-pooling: Insights from a case study in Hamburg | *Ann-Sophie Voss, Institute for Technology Karlsruhe (KIT)* |
| 14:30-14:45 | Integrated urban mobility policies in metropolitan areas: A system dynamics model | *Ani Melkonyan-Gottschalk, Technical University of Clausthal* |
| 14:45-15:00 | Regenerating underused urban spaces to support electric vehicle charging | *Liu Yang, School of Architecture, Southeast University, China* |
| Building performance and retrofitting (NEST-MF) | | |
| 13:45-14:00 | Prior conditions of heat pump adoption in the United States | *Christine Gschwendtner, Massachusetts Institute of Technology (MIT)* |
| 14:00-14:15 | Determining the energy performance classes of buildings using machine learning algorithms: The case of Istanbul | *Melis Karli & Fatih Terzi, Istanbul Technical University* |
| 14:15-14:30 | To zero or not to zero: Overcoming barriers to smart building retrofit in the European commercial real estate sector | *Krassimir Gurov, ABB & ETH Zurich* |
| 14:30-14:45 | Comparative LCA study of an office building renovated according to innovative "KEGEL Klimasystem" vs. the standard approach | *Jeremy Karim Voitchovsky, University of Geneva* |
| 14:45-15:00 | NEST-Bot: Integrating knowledge graphs and language models for scalable access to building energy data | *Michael Locher, Empa* |

**SUFFICIENCY: PATHWAYS TO LIVING WELL WITHIN PLANETARY BOUNDARIES**

13:45-14:00

LB

*SASCHA NICK, EPFL, SWITZERLAND*

## A systems perspective of housing and mobility interrelations, and implications on wellbeing, sufficiency, shared spaces, energy, de-sprawl, governance, justice, public policy

Switzerland's housing and mobility systems face interlinked crises: high energy demand, material overuse, biodiversity destruction, urban sprawl, and uneven wellbeing. Addressing these requires coordinated action at multiple scales, with a central importance for neighborhoods, where daily life and mobility choices are shaped. We present a framework that operationalizes the 15-minute city concept with accessibility mapping, renovation strategies, shared living, and targeted deconstruction, bridging national climate goals with local decision-making. Modeling shows potential for deep energy cuts, sprawl reversal, and faster, lower-cost transitions, as demonstrated in Geneva. This demand-side, needs-centered approach strengthens resilience, inclusion, and biodiversity, offering an evidence-based foundation for societal dialogue and transformative urban experimentation.

**SUFFICIENCY: PATHWAYS TO LIVING WELL WITHIN PLANETARY BOUNDARIES**

14:00-14:15

LB

*TIL SOMMER, FATIH TOPAK, KRISTINA OREHOUNIG, TU WIEN, RESEARCH UNIT OF BUILDING PHYSICS AND BUILDING ECOLOGY, AUSTRIA*

## Achieving more by demanding less: The potential of sufficiency

Switzerland's long-term climate strategy, as outlined in the Swiss Federal Office of Energy's Energy Perspectives 2050+, targets a fully decarbonized building stock by 2050. While public policies have mainly focused on increasing efficiency and integrating renewables in the building sector, sufficiency, which promotes reducing consumption through behavioral and lifestyle adaptations, remains an underexplored yet promising strategy. A systematic assessment of its potential is still lacking, particularly to support informed decisions at building, municipal, and cantonal levels. To address this gap, this work presents a bottom-up, human-centric approach to quantify the potential of sufficiency measures in Switzerland's residential building stock.

Our objectives are threefold: (i) to assess the potential of sufficiency on operational and embodied emissions by considering behavioral diversity across the population, (ii) to identify sufficiency pathways that align with well-being, policy, and climate targets, and (iii) to provide evidence-based recommendations for multi-level decision-making. A comprehensive literature review identified a catalogue of sufficiency measures across behavioral, spatial, and technical domains. Relevant data on municipalities, buildings, and households was collected from national databases and research sources. A multistage clustering approach—using K-Medoids and K-Modes algorithms—was applied to identify five representative municipalities, 270 representative buildings, and 17 representative household types. These household types were further enriched with lifestyle profiles derived from a national survey. Using the Jensen-Shannon divergence metric, three lifestyle types were assigned to each household type, enabling the development of a sufficiency acceptance matrix to reflect behavioral diversity and sufficiency acceptance likelihood across the population.

To evaluate the effect of sufficiency measures, building energy simulations were performed in EnergyPlus, combining representative buildings, meteorological data, and scenario-specific inputs. Simulated scenarios captured behavioral, technical, and spatial sufficiency strategies. The modeling framework enables the estimation of energy and emission reductions across Switzerland, aligning technical potential with social acceptance. Our results revealed that sufficiency can deliver substantial energy savings and emission reductions, particularly in behavioral and spatial domains, with lower costs and embodied emissions than conventional retrofitting. The findings support the integration of sufficiency into urban energy planning and climate policy in Switzerland and provide a scalable methodology to incorporate household diversity into national decarbonization strategies.

**SUFFICIENCY: PATHWAYS TO LIVING WELL WITHIN PLANETARY BOUNDARIES**

14:15-14:30

LB

*CHRISTINA MARCHAND, ZHAW, SWITZERLAND*

## Space sufficiency: How institutional real estate and single family home owners approach this challenge

Our work explores the willingness and strategies for space efficiency in Kanton Zürich. Almost 40 qualitative interviews with institutional property owners, tenants and owners of single-family homes were conducted over the last two years about chances and challenges associated with per capita living space reduction. Key questions include whether stakeholders acknowledge the issue of excessive living space, their plans to address it, and the factors that could facilitate or hinder change. The interviews dive into the role of regulations, awareness campaigns, and potential obstacles that hinder progress. By analyzing these perspectives, the research aims to identify practical solutions and policy recommendations that can promote space efficiency and reduce living space in urban settings. The findings show that most actors see the benefits of space reduction per capita, but also see a lot of obstacles on the way. Especially tenants with too much space often would be willing to reduce if it also means financial benefits like a reduced rent. This is not possible on the free market right now, but would need support by big real estate, where switching could be made possible and attractive. In spite of this, our interviews show that here the topic is mainly present when new houses are built or rebuilt, but not for the current tenants. Also, homeowners are partly willing to reduce, but often face hindering regulations for remodeling and a lack of financial incentives. The only actors that have the possibility and already act are living cooperations that have partly already established rules for occupancy rates and try to build highly space efficient new houses. All actors ask for more governmental support and also a broader recognition and discussion of the topic. With our research, we hope to contribute to the broader discourse on sustainable urban development and provide insights for policymakers, practitioners, and researchers working towards creating resilient and inclusive cities.

**SUFFICIENCY: PATHWAYS TO LIVING WELL WITHIN PLANETARY BOUNDARIES**

14:30-15:00

LB

*YAMINA SAHEB (1), MASHAEL YAZDANIE (2), (1) SCIENCES PO, (2) EMPA, FRANCE*

## Sufficiency: From concept to collective movement with the World Sufficiency Lab

The World Sufficiency Lab (WSL) and the Swiss Sufficiency Lab (SSL) were created around a simple but powerful idea: sustainability is not only about doing things more efficiently, but also about rethinking what is enough. Sufficiency invites us to reshape how we live, work, and use resources so that thriving communities can exist within planetary limits. As a think-to-do tank, the WSL offers a global platform to connect people and ideas, linking researchers, policymakers, practitioners, and beyond. The SSL, as the Swiss national node of the WSL, anchors this effort domestically by uniting fragmented actors and initiatives to co-create sufficiency-based innovations. Together, the WSL and its network of national labs provide a space where science meets practice and philosophy; it's where new choices and pathways for well-being, resilience, equity, and justice are co-created and made visible. This talk will introduce these initiatives and invite participants to take part in shaping this growing movement.

**THE FUTURE OF MOBILITY**

13:45-14:00

VE 102

*MATIAS QUINTANA, SINGAPORE-ETH CENTRE, SINGAPORE*

## It's not you, it's me - Global urban visual perception varies across demographics and personalities

**THE FUTURE OF MOBILITY**

14:00-14:15

VE 102

*MARCO MIOTTI, ETH ZÜRICH, SWITZERLAND*

## Quantifying accessibility and its implications for sustainable urban mobility systems

The concept of “accessibility” encompasses three key drivers of urban mobility patterns and therefore mobility energy use: people (who is traveling?), places (where do people want to go to?), and the mobility infrastructure (how can they get there?). As such, accessibility measures play an important role in many urban and transportation planning applications, including in efforts to design and develop urban areas for more sustainable mobility without sacrificing the quality of service that those mobility systems provide. Such accessibility measures range from simple counts (such as the number of supermarkets within a 500m radius) to far more complex options based on gravity decay functions and generalized travel costs (utility). While there are inherent trade-offs between how powerful, intuitive, and context-specific different accessibility measures are, systematic comparisons have been rare. In this work, we evaluate how well simple accessibility metrics perform compared to complex ones that require more data and that are more difficult to interpret. Based on these observations, we then investigate what these metrics can tell us about how to design more sustainable urban systems that maintain or even improve the levels of accessibility that we are used to. We evaluate accessibility measures of different complexities and based on travel distance, travel time, and generalized travel cost (utility) by how well they correlate with different sustainable mobility indicators. We do so for different types of trips: work, education, groceries, other errands, and leisure. We find that easily interpretable accessibility metrics perform 80-90% as well as more complex ones, but that correct hyperparameter choices are important and that they depend on the trip purpose and type of travel costs (distance, time, or utility) used. We also highlight that accessibility operates at different scales: the local scale (< 500 m) is important to accurately capturing active mobility (walking and cycling) trips, while the general urban scale is important to capture the impact of sprawl on typical trip distances for motorized travel. Based on these observations, we highlight specific urban planning levers that may lead to changes in mobility behavior and promote more sustainable mobility.

**THE FUTURE OF MOBILITY**

14:15-14:30

VE 102

*ANN-SOPHIE VOSS, INSTITUTE FOR TRANSPORT PLANNING AT THE INSTITUTE FOR TECHNOLOGY IN KARLSRUHE (KIT), GERMANY*

## Potential Willingness to use Autonomous Ride-pooling: Insights from a Case Study in Hamburg

(Autonomous) Ridepooling appears to be a promising extension of urban transport systems. However, its potential role in ensuring accessible and fair mobility has not yet been widely studied. As part of the project ALIKE, an online survey was conducted in Hamburg in November and December 2024 to generate insights into current mobility behavior and attitudes towards (autonomous) ridepooling. Additionally, a Stated Choice Experiment was implemented to capture preferences for different forms of mobility in hypothetical scenarios, with a particular focus on autonomous ridepooling.

Current literature suggests that individuals with low incomes or those disadvantaged by the existing mobility system—such as families or single parents with children—face significant barriers when it comes to transportation. The goal of this contribution is to identify different (disadvantaged) user groups and analyze how their use of private and public mobility options differs, what kinds of access barriers they face, and what attitudes they hold toward autonomous ridepooling services. The central research question addresses social participation in (autonomous) ridepooling, particularly focusing on potentially isolated or marginalized groups.

An interesting aspect concerns household income, as the surveyed sample lies slightly above the national median in terms of net household income, allowing for a differentiated analysis of socioeconomic disparities.

Based on the empirical findings, recommendations for action can be derived—particularly focusing on how (autonomous) ridepooling can be designed to promote broader social participation. The aim is to contribute meaningfully to the ongoing debate on socially inclusive and well-designed mobility services.

**THE FUTURE OF MOBILITY**

14:30-14:45

VE 102

*ANI MELKONYAN-GOTTSCHALK, TECHNICAL UNIVERSITY OF CLAUSTHAL, GERMANY*

## Integrated urban mobility policies in metropolitan areas: A system dynamics model

We take a novel and holistic approach to analysing transformative pathways towards sustainable urban mobility, considering the complex dynamics in metropolitan regions. To achieve this, we develop a toolset to assess the impact of potential measures to be taken by decision makers. Our innovative approach is based on the introduction of a new system framework to link the interrelated sector parameters of mobility systems by considering the effects of innovative mixed methods (both qualitative and quantitative) on scenario development and evaluation on the basis of global trends at the macro scale and their specific influences on the mobility sector at the local scale. To this end, we used a participatory modelling approach to develop scenarios and evaluate them as integrated simulation runs via a comprehensive and holistic system dynamics (SD) model. Thus, we estimated dynamic interdependencies between all of the factors relating to the mobility sector and then assigned business decision-making criteria to the urban systems. Furthermore, we introduced a sustainable net present value framework to estimate the sustainability outcomes of government investment in urban mobility infrastructure. A case study relating to the Rhine-Rhine-Ruhr metropolitan region in Germany was applied in order to simulate four scenarios co-created with stakeholders involved in our study, namely, Smart City, Sustainable/Healthy City, Deurbanisation, and Business-as-Usual (BaU), which served as a solid basis from which to quantify path dependencies in terms of policy implementation. At the same time, recommendations were derived for sustainable mobility transformation within metropolitan regions.

**THE FUTURE OF MOBILITY**

14:45-15:00

VE 102

*LIU YANG, SCHOOL OF ARCHITECTURE, SOUTHEAST UNIVERSITY, CHINA*

## Regenerating underused urban spaces to support electric vehicle charging

An essential strategy to realize low-carbon objectives in the urban transportation system is the promotion of electric vehicles (EVs). This transition from conventional fuel-driven vehicles to electric counterparts will inevitably reshape urban landscapes, particularly in the context of charging infrastructure development. Consequently, investigating the selection of new charging station locations to meet charging demands while minimizing adverse effects on urban spaces is of importance. In the meantime, rapid urbanization has led to the emergence of underused spaces with poor conditions. Practitioners and researchers highlight diverse service provisions in these spaces, notably to offer electric vehicle charging facilities and associated parking infrastructure. This could also lead to more footfall from EV drivers in those areas. Thus, repurposing underused urban spaces for charging facilities facilitates cleaner built environment and may innovate urban regeneration policies.

Therefore, this study aims to achieve the following objectives: 1) Space Categorization: Systematically categorizing various types of underutilized urban spaces to identify prospective charging locations, leading to rational site ranking. 2) Spatial Evaluation: Assessing their potential to cater to the evolving demands of future urban charging requisites. 3) Traffic Prediction: Predicting the growth in charging requirements for electric vehicles in the upcoming years as a result of EV adoption and urbanization/densification, as well as the impact of charging stations as a trip destination, using an agent-based model. 4) Synthesis Assessment: By comparing charging supply against charging demand, deriving an ultimate site selection.

**BUILDING PERFORMANCE AND RETROFITTING**

13:45-14:00

VE 202

*CHRISTINE GSCHWENDTNER, MIT, UNITED STATES*

## Prior conditions of heat pump adoption in the United States

Heat pumps could reduce greenhouse gas emissions from residential heating, but adoption rates must accelerate to meet climate goals. Despite various policy incentives, adoption remains relatively low, suggesting a limited empirical understanding of the factors associated with adoption, particularly the importance of prior conditions and their changes over time. This study addresses that gap by identifying key features associated with household heat pump adoption in the U.S. We analyze both a national sample and a sample including 15 metropolitan statistical areas (MSAs) from the American Housing Survey (AHS), and account for non-linear relationships and interactions between features, using machine learning. Our findings indicate that prior equipment, particularly the use of electricity for space and water heating, might have the strongest association with adoption. While confirming that climate and fuel prices are among the most important features, a change in occupants appears particularly relevant for heat pump adoption, likely by enabling renovation opportunities. Additional features positively associated with adoption include the readiness of buildings for electrification (e.g., building age, duct systems), changing to electric water heating, and changes in unitsize. In contrast, increased discomfort from cold—-possibly indicating heating system failure-—appears to have a relatively low association with heat pump adoption. These findings highlight the importance of prior conditions and their changes, with implications for both policymakers and energy system modelers.

**BUILDING PERFORMANCE AND RETROFITTING**

14:00-14:15

VE 202

*MELIS KARLI & FATIH TERZI, ISTANBUL TECHNICAL UNIVERSITY, TURKIYE*

## Determining the energy performance classes of buildings using machine learning algorithms: The case of Istanbul

Cities are responsible for approximately 70% of global energy consumption. The increasing trend of urban population indicates that this share will continue to rise over time. For this reason, the disciplines of urban planning and architecture have focused on investigating the impact of urban form on energy consumption in order to design energy-efficient urban areas based on scientific data. Studies in this field have confirmed the significant relationship between urban form and energy consumption. A closer examination of these studies reveals that they have been conducted at various spatial scales using different scientific methods. However, there are only a limited number of studies that utilize big data across entire urban areas.

This research aims to predict the energy performance classes of buildings across the metropolitan area of Istanbul. The study uses energy performance ratings classified from A to G, from best to worst. Urban morphological variables are used as independent variables. After completing the pre-processing stage, which involved a detailed examination of the dataset, machine learning techniques such as Random Forest, LightGBM, XGBoost, and SVM were applied during the modeling phase. The model performances of these algorithms are evaluated using metrics such as Accuracy, F1 Score, Precision, and Recall. The contribution of each variable to the model is analyzed in detail using SHAP values. The model with the best performance is then used to predict the energy classes of buildings whose performance labels are unknown across Istanbul. Geographic Information Systems (GIS) are utilized to present a detailed spatial analysis of the results.

In this way, the study contributes to identifying which areas of the city should be prioritized for improvement and discusses the necessary interventions in urban morphology. This research is particularly significant as it enables the identification and assessment of the energy performance of buildings at the citywide scale.

**BUILDING PERFORMANCE AND RETROFITTING**

14:15-14:30

VE 202

*KRASSIMIR GUROV, ABB & ETH, SWITZERLAND*

## To zero or not to zero: Overcoming barriers to smart building retrofit in the European commercial real estate sector

As Europe's commercial building sector faces mounting regulatory pressure to decarbonize – driven by legislative instruments like the Energy Performance in Buildings Directive (EPBD) and the Corporate Sustainability Reporting Directive (CSRD) – building owners, operators, and technology providers confront a "to zero or not to zero" dilemma: how to scale IoT-based digital solutions for building automation and energy management (IoT-BA&EM) across a highly fragmented, aging building stock, amid rising economic and market volatility.

This research draws on a multi-level qualitative study combining new stakeholder interviews (from owners, facility managers, integrators, and consultants), industry webinar/podcast transcripts, and extensive market and customer research (including >2,000 survey responses and expert interviews by ABB). Focusing on small/mid-sized commercial buildings – where most floor area and energy use lie, but digital adoption lags – the study uncovers and maps the real-world barriers that slow smart retrofits and limit decarbonization at scale.

The core findings reveal a "rugged landscape" of interdependent obstacles: misaligned incentives (split incentives between owners and tenants), technical fragmentation (legacy systems, lack of standards, high integration cost), skills and capacity gaps, and unclear ROI amid regulatory flux. These are compounded by complex value chains, evolving customer expectations for ESG/IAQ, and a patchwork of digital readiness across regions.

To accelerate progress, the study surfaces proven and emerging approaches from both industry leaders and pragmatic "doers" – including modular, open-system architectures, bundled business models (e.g., "pay-per-use", servitization), portfolio-level data analytics, and new models for collaboration between owners, tenants, and technology partners. Implications are drawn for both corporate strategy and public policy, highlighting the need for ecosystem-wide shifts to unlock large-scale, sustainable retrofit.

The session will share actionable frameworks, market insights, and practical "what works" for practitioners, policymakers, and innovators committed to a climate-positive built environment. Attendees will gain a nuanced understanding of Europe's retrofit challenge and a toolkit for driving meaningful, scalable transformation.

**BUILDING PERFORMANCE AND RETROFITTING**

14:30-14:45

VE 202

*JEREMY KARIM VOITCHOVSKY, UNIVERSITY OF GENEVA, SWITZERLAND*

## Comparative LCA study of an office building renovated according to innovative "KEGEL Klimasystem" vs. the standard approach

**BUILDING PERFORMANCE AND RETROFITTING**

14:45-15:00

VE 202

*MICHAEL LOCHER, EMPA, SWITZERLAND*

## NEST-Bot: Integrating knowledge graphs and language models for scalable access to building energy data

Urban energy systems research relies on heterogeneous datasets: sensor measurements, BIM models, simulation results, and project documentation. At the NEST demonstrator building, these resources are rich but often difficult to discover, connect, and use efficiently. To address this challenge, we are developing NEST-Bot, an AI-powered assistant that combines a knowledge graph (structured relations among sensors, models, and building entities) with vector-based retrieval (semantic access to unstructured reports and metadata). By leveraging retrieval-augmented generation (RAG), users can query NEST-Bot in natural language and receive grounded responses that link directly to underlying datasets and metadata. This approach enhances data discoverability, ensures traceability of results, and lowers the barrier for researchers, engineers, and stakeholders to interact with NEST data.

We present the NEST-Bot architecture, first use cases in energy and building system analysis, and discuss how this framework can support more transparent, scalable, and collaborative research in urban energy systems.

Empa
Materials Science and Technology

# POSTER PRESENTATIONS

Monday, September 1st, 2025

## Poster Sessions

AKADEMIE FOYER

Poster session 1:
10:15 – 10:45 AM

Poster session 2:
15:00 – 15:30

| September 1, 2025 | | |
|---|---|---|
| Time | Presentation title | Presenter |
| | Session 1 | |
| 10:15 – 10:45 | Decentralising heat: Socio-technical lessons from Denmark's community-based district heating for EU energy transitions | *Eirini Sampson, Imperial College London* |
| | Optimizing urban fuel poverty governance: Spatial heterogeneity, dynamic forecasting, and contagion-sensitive interventions | *Yixing Li, Yunqian Yao, Jianming Wu, King's College London* |
| | Opacity, imagination, and futures: Exploring climate change discourses and social imaginaries in Santiago de Chile | *María Paz Cárdenas, 4Cities Erasmus Mundus Programme (ULB, University of Vienna, University of Copenhagen, UCM, UAM, VUB)* |
| | Hybrid building energy modeling of building energy systems | *Leandro Von Krannichfeldt, Empa* |
| | Session 2 | |
| 15:00 – 15:30 | Enhancing transparency and openness in energy system modeling with a focus on addressing the availability and quality of energy data at the regional level | *Wided Medjroubi, University of Groningen* |
| | Charting the path to net-zero: A case study of the Bündner Rheintal | *Arijit Alip Upadhyay, Robin Mutschler, Binod Koirala, Matthias Sulzer, Empa* |
| | Under lake infrastructure for thermal capture and storage of solar energy (ULISSE) for district heating and cooling services. | *W. van Sprolant, CvS énergies Sàrl* |

**POSTER SESSION 1**

10:15-10:45

*EIRINI SAMPSON, IMPERIAL COLLEGE LONDON, GREAT BRITAIN*

## Decentralising Heat: Socio-Technical Lessons from Denmark's Community-Based District Heating for EU Energy Transitions

*Overview*

To meet its Paris Agreement obligations, the EU launched the Green Deal (2019) and Fit-for-55, aiming to reduce GHG emissions by 2030. Phasing out natural gas is a key priority, especially in Heating and Cooling (H&C), which relies heavily on fossil fuels and accounts for 62% of EU energy use. District Heating (DH) is often dubbed a "Swiss army knife for decarbonisation" due to its ability to integrate local renewable electricity and excess industrial or urban heat. Decarbonising H&C through DH must align with the EU's justice-centric energy policy framework. In this context, decentralising DH by expanding Energy Communities (ECs) offers a strategic pathway to empower citizens and support the clean heat transition.

Though challenging, Denmark provides a successful model. Through coordinated infrastructure planning, the country built cost-effective DH networks—covering two-thirds of its heat demand, 90% of which is owned by municipalities or cooperatives. This poster presents findings from a Rapid Evidence Assessment (REA) of Denmark's socio-technical DH framework, examining environmental, governance, social, and economic dimensions. The goal is to extract policy insights for EU-wide application, stressing the importance of an interdisciplinary enabling framework for the heating transition.

*Methods*

This research uses a case-study approach to analyse Denmark's heating transition, with a focus on decentralised DH and the role of ECs. Studying decentralisation and nonprofit structures allows for a deeper understanding of energy law in practice and offers comparative insights (Yin, 2018). The case-study format permits flexible, ethical, and context-specific data collection (Priya, 2021).

To ensure objectivity, this research uses a Rapid Evidence Review – a structured and transparent search, collection, and assessment of evidence to inform policy and enhance accountability within evidence gathering (Stone, 2013). REAs offer a replicable and efficient way to analyse existing literature (Twigger-Ross et al., 2014), allowing for robust conclusions based on critical evidence appraisal (Collins et al., 2015).

*Results*

The review identifies a gap in EU practice and literature regarding EC-driven DH networks. Denmark's case shows the value of localised ownership and decentralised fuels, which are underutilised across the EU. The Danish experience highlights key transferable practices. As DHNs function as natural monopolies, challenges arise in price regulation and ownership. The Danish transition is guided by four principles: municipal heat planning and zoning for lowest socio-economic cost; true-cost principle; municipal and end-user inclusion.

Three key lessons emerge: incorporating municipal and cooperative ownership; implementing effective price regulation to ensure affordability and reinvestment in local projects; and building municipal capacity to engage in and operate DH.

**POSTER SESSION 1**

10:15-10:45

*YIJING LI, YIXING LI, YUNQIAN YAO, JIANMING WU, KING'S COLLEGE LONDON, GREAT BRITAIN*

## Optimizing Urban Fuel Poverty Governance: Spatial Heterogeneity, Dynamic Forecasting, and Contagion-Sensitive Intervention

We propose a three-tiered intervention framework that integrates spatial heterogeneity, trend forecasting, and network contagion modeling to address the structural complexity of urban fuel poverty. Grounded in Hills (2012)'s Low Income High Costs (LIHC) framework, we identify and bridge three key gaps in current methodologies:

1. underrepresentation of spatial heterogeneity,
2. limited predictive capability for emerging poverty hotspots, and
3. lack of network-based modeling for cross-regional poverty transmission.

We construct three nested intervention strategies:

1. Baseline Optimization utilizes Geographically Weighted Regression (GWR) to estimate local coefficients ($\beta\_EPC_i$) and builds a quantitative response model $\Delta P_i = \beta\_EPC_i \times \Delta EPC_i$. We apply Particle Swarm Optimization (PSO) to determine investment strategies that maximize aggregate poverty reduction under budget constraints.
2. Forward-Looking Intervention incorporates univariate time series models (Prophet/ARIMA) to forecast borough-level poverty trajectories. We define a composite risk score based on predicted poverty increase and current EPC vulnerability, enabling the PSO to prioritize boroughs with deteriorating trends.
3. Contagion-Sensitive Strategy constructs a weighted inter-borough transmission network based on GWR similarity, geographic adjacency, and socioeconomic proximity. A tri-state dynamic model (Low Risk → High Risk → High Poverty) simulates structural propagation. We introduce $contagion\_risk_i$, a score combining a borough's outward influence and inward vulnerability. A multi-objective PSO jointly minimizes $\sum \Delta P_i$ and $\sum contagion\_risk_i$, generating tiered interventions: deep retrofits for key spreaders, medium-scale upgrades for transmission corridors, and preventive actions for vulnerable peripheries.

All strategies generate borough-level investment plans and are evaluated within a unified framework using three metrics: total poverty reduction, structural risk mitigation, and investment efficiency. Visualizations include poverty maps, radar charts, and projected trajectories. The study is based on open UK datasets (e.g., EPC records, income, housing characteristics), ensuring empirical rigor and policy relevance.

This framework enables local governments to move beyond static indicators and adopt structure-aware, forward-looking governance tools. By linking spatial inequality, predictive analytics, and contagion dynamics, it provides a dashboard-ready approach for equitable, adaptive, and systems-informed urban poverty mitigation. This model is scalable and transferable, offering a replicable template for resilient and equitable energy governance in global urban contexts.

**POSTER SESSION 1**

10:15-10:45

*MARÍA PAZ CÁRDENAS, 4CITIES ERASMUS MUNDUS PROGRAMME (ULB, UNIVERSITY OF VIENNA, UNIVERSITY OF COPENHAGEN, UCM, UAM, VUB), BELGIUM*

## Opacity, imagination, and futures: Exploring climate change discourses and social imaginaries in Santiago de Chile

Climate change represents more than objective environmental realities—it has become a rich political and cultural imaginary combining complex narratives, symbols, and competing visions of the future. This research investigates how urban actors in Santiago de Chile construct and interpret future imaginaries concerning climate change, examining the multiplicity of visions that emerge from interactions between scientific knowledge and deep-rooted social imaginaries.

Methodology: Employing a qualitative approach grounded in constructivist epistemology, this study utilized semi-structured interviews, snowball sampling, and discourse analysis to explore climate imaginaries among diverse urban stakeholders. Fieldwork revealed the inadequacy of desk-based research methods, necessitating immersive, context-sensitive approaches that moved beyond formal climate terminology and institutional frameworks.

Key Findings: Analysis identified three primary actor groups constructing climate futures: (1) social organizations engaged in climate and urban action, operating within formal institutional frameworks; (2) youth movements articulating alternative futures through diverse conceptual frameworks, including veganism and animal rights groups whose climate-relevant imaginaries emerged without explicit environmental terminology; and (3) artists employing creative expression to envision emotionally resonant representations of potential climate futures.

Five distinct typologies of climate imaginaries emerged: Status Quo/Business-Oriented (preserving existing systems with minor adjustments), Technological Solution (emphasizing clean energy and market innovations), Catastrophic (envisioning collapse and doom scenarios), Transformative (advocating fundamental systemic changes), and Reformist (proposing modifications within existing structures).

Urban-Climate Intersectionality: Interviews revealed complex tensions between urban development priorities and climate concerns, with many viewing climate initiatives as conceived at artificial scales that fail to address lived urban realities. Participants consistently highlighted governance, infrastructure, and health as central to their future imaginaries, reflecting broader questions about decision-making power in shaping urban futures.

Implications: This research demonstrates that climate futures in Santiago are being imagined through diverse vocabularies and frameworks that may not align with dominant scientific and policy discourse. Understanding the full spectrum of climate imaginaries requires attentiveness to alternative framings and varied entry points into environmental futures discussions. These findings have significant implications for developing context-sensitive climate communication strategies and urban adaptation policies that resonate with local communities' diverse ways of envisioning climate futures.

**POSTER SESSION 1**

10:15-10:45

*LEANDRO VON KRANNICHFELDT, EMPA, SWITZERLAND*

## Hybrid Building Energy Modeling of Building Energy Systems

Building energy modeling plays a vital role in optimizing the operation of building energy systems by providing accurate predictions of the building's real-world conditions. In this context, various techniques have been explored, ranging from traditional physics-based models to data-driven models. An emerging trend is to combine physics-based and data-driven models into hybrid approaches with the aim of leveraging the advantage of each. This talk will provide an overview of such hybrid approaches, explore their mechanisms, and showcase their application on a real-world building model. Specific aspects of evaluation include predictive performance, data dependency, and interpretability.

**POSTER SESSION 2**

15:00- 15:30

*WIDED MEDJROUBI, UNIVERSITY OF GRONINGEN, NETHERLANDS*

## Enhancing transparency and openness in energy system modeling with a focus on addressing the availability and quality of energy data at the regional level

Energy system modeling plays a critical role in navigating today's complex energy landscape and in guiding the transition toward sustainable, carbon-neutral, and affordable energy systems. While a substantial body of research has been devoted to national-scale modeling—reflected in the proliferation of specialized tools and frameworks—there remains a significant gap in the maturity and applicability of models at regional and urban scales. These localized contexts present unique challenges that current modeling approaches are often ill-equipped to address.

At the urban level, energy systems are increasingly characterized by interdependent infrastructures, spatial constraints, and dynamic socio-economic patterns. To effectively support planning and policy development in these contexts, modeling approaches must evolve to be more transparent, participatory, and capable of integrating high-resolution, context-specific data. A critical barrier in this evolution is the limited availability and inconsistent quality of energy-related data at finer spatial scales. Addressing this data gap is essential for enabling more open and robust energy system models.

In parallel, the implications of climate change for both energy generation and demand patterns must be more rigorously assessed, particularly in urban settings where vulnerabilities are often heightened. The growing frequency of extreme weather events and the emergence of geopolitical disruptions further underscore the urgency of developing resilient, adaptive energy systems.

This research aims to address two overarching questions:

1. How can robust and transparent models be developed to capture the complexity of coupled, urban-scale energy systems?
2. How can modeling and data infrastructures be strengthened to enhance resilience against unforeseen disruptions?

By focusing on these questions, this work seeks to contribute to the advancement of next-generation urban energy modeling frameworks. Furthermore, active engagement with interdisciplinary experts and stakeholders is essential to closing existing research gaps and ensuring that emerging tools align with real-world decision-making needs.

**POSTER SESSION 2**

15:00- 15:30

*ARIJIT ALIP UPADHYAY, ROBIN MUTSCHLER, BINOD KOIRALA, MATTHIAS SULZER, EMPA, SWITZERLAND*

## Charting the path to Net-zero: A case study of the Bündner Rheintal

Closely aligning with Switzerland's long-term climate policy, the canton of Graubünden is committed to achieving net-zero emissions by 2050 through the Aktionsplan Green Deal. This study investigates cost-optimal transition pathways for an urban-industrial cluster in the Rheintal valley of Graubünden. Due to the presence of waste incineration and the cement industry, the per capita CO2 emissions in the valley are around 11t per annum (2024), which is nearly three times as high as the Swiss average.

A sector-coupled, mixed-integer linear optimization (MILP) model is employed to evaluate the most cost-effective solution while complying with the emission targets of reaching net-zero targets. This study aims to answer two research questions: 1) How can we utilize synergies and interdependencies between different sectors within a regional energy landscape to achieve net-zero targets? and 2) What are the roles and impacts of CCS and district heating networks (DHN) in achieving net-zero targets for the Rheintal?

**POSTER SESSION 2**

15:00- 15:30

*WILLIAM VAN SPROLANT, CVS ÉNERGIES SÀRL, SWITZERLAND*

## Under Lake Infrastructure for thermal capture and Storage of Solar Energy (ULISSE) for district heating and cooling services

The ULISSE project (Under Lake Infrastructure for thermal capture and Storage of Solar Energy) aims to improve the performance of Thermal Lacustrine Networks (TLN) for district heating and cooling services. The ULISSE concept proposes very large reservoirs, invisibly screw-anchored on the lake bed, for seasonal storage of solar thermal energy. This “Directly” from the upper layer of the lake heated by the sun, using a “hydraulic pantograph” and “Indirectly” from air-conditioning services by the TLN. Each reservoir has a volume of 1 to 2 million m3 and a heat storage capacity of 60 to 125 TJ, for a temperature difference of 15 K between the ULISSE reservoir and the surrounding lake.

During the summer semester, the loading pumps and eventually the heat pumps for a waste heat temperature elevation, are supplied with photovoltaic electricity, which reducing undesirable peak-shavings (grid-overloads curtailment). Good seasonal net heat storage efficiency (≈ 80%) with a limited thermal isolation thickness could be achieved with a large ratio between the volume and the surface of the reservoir envelope, made of a mineral biocompatible “sandwich” of 3 layers fiberglass textile and inside, around 5 cm thickness cellular glass isolation blocs individually wrapped in basalt felt.

Furthermore, the heat loss would induce vertical convection currents outside the ULISSE reservoir over the entire water column of the lake. It could enhance nutrients circulation and the oxygenation of the bottom layer of the lake, which ultimately protects against Eutrophication and Asphyxia, the harmful effects of Global Warming of all the lakes (Not only Alpine glaciers are threatened).

During the winter semester, the water pumped from inside the ULISSE reservoir at 20°C instead ordinary from the lake bottom at 5°C, will double the efficiency or halve the power consumption of the heat pumps of the TLN. In addition, the round-trip temperature difference of the TLN from ordinary 3 to 15 K by the ULISSE reservoir, resulting in five times higher water thermal density (12.4 to 62.7 MJ/m3), which for a same heat furniture, reduces the hydraulic flow rate (-80%) and thus the energy for circulating the water through the TLN (-95%, proportional to the square of the flow rate). The ULISSE reservoir could also supply the CORSAIRE “free-heating” (exclusive winter temperature correction without heat pump) of the Potable Water Networks (PWN), reducing up to 10% the total heat demand of a current entire city’s building stock without any internal needed equipment.

In 2050, about 300 ULISSE Reservoirs (2 M m3/unit) distributed invisibly in the 15 largest Swiss lakes and connected on the TLN, in association with the CORSAIRE free heating of the PWN (including also outside the lake regions), could provide nearly 60 PJ or 30% of the 200 PJ of the national needs of heat energy for room heating and domestic hot water. For an investment of around 3 to 4 billion CHF, this would save 3 TWh of gross electricity production in the winter semester, or 1/3 of the 9 TWh structural winter electricity deficit (twice the winter production of the largest Swiss hydroelectric complex of Grande-Dixence: 2 x 1.5 TWh).

In the framework of the Swiss Energy Transition 2050 (SOUR Call 1-2021 “SWEET OUt the box Rethinking”), the exploratory study of the ULISSE project, at HEPIA as “host institute”, has been funded by the SFOE. The Next Step could be, beside complementary multidisciplinary investigations and developments (i.e., reduced scale basin tests), a Pilot + Demonstration ULISSE reservoir in the Léman connected to the TLN of the EPFL-UNIL campuses with observations by the LéXPLORE floating laboratory, and a P+D CORSAIRE facility on the Cité du Lignon (6,500 inhabitants) and (temporary for the test) supplied with waste heat from the waste water treatment plant of Aïre in Geneva.

Empa
Materials Science and Technology

# PANELS & WORKSHOPS

| September 1, 2025 | | | | |
|---|---|---|---|---|
| Time | Format | Session title | Organisers | Affiliation |
| 10:45-12:00 | Workshop | PowerHood: Playtesting a serious game for energy transition in neighborhoods | Marta Brkovic Dodig, Natasa Vulic | Empa. FHNW |
| 13:45-15:00 | Panel | From Forma Urbis to Forma Horta: Blue–Green Urban Futures in Dense, Heritage-Rich Cities | Paraskevi Alkistis, (Alcestis) RODI | University of Patras, University of Geneva & IOER |
| 15:30-17:00 | Panel | Sufficiency: Radical rapid societal transformation to ecosystem and human wellbeing | Sascha Nick, Mashael Yazdanie | EPFL, Empa, Sciences Po/IPCC, ZHAW |
| 15:30-17:00 | Workshop | From Insight to Impact: Transforming the Evidence-to-Policy Pipeline | Julio Paulos, Joanna Sleigh | ETH Zurich |
| 15:30-17:00 | Workshop | Gridly: Interactive engagement tool for Local Energy Community, market, and users' interconnectivity | Yousra Sidqi, Tania Lopez Garcia, Alba Arias, Martina Rechsteiner | Lucerne University of Applied Sciences and Arts, ZHAW |
| 15:30-17:00 | Workshop | Futuring cities: Participatory visioning for resilient futures | Nancy Andrea Ramirez Agudelo | United Nations University) |

**WORKSHOP**

10:45-12:00

NEST-MF

***ORGANISER:*** *MARTA BRKOVIC DODIG, EMPA, SWITZERLAND*

## PowerHood: Playtesting a serious game for energy transition in neighborhoods

The transition to sustainable energy systems in urban neighborhoods requires coordination among multiple stakeholders with diverse and often conflicting interests. Effective decision-making in this context must balance technical feasibility, economic constraints, and social acceptance. Serious analogue negotiation games offer a powerful method to support participatory decision-making, allowing stakeholders to simulate real-world constraints, evaluate trade-offs, and co-develop actionable transition strategies.

This workshop introduces and playtests The PowerHood: The Neighbourhood Energy Transition Game, a role-based analogue geogame designed to support inclusive and collaborative urban energy planning. Players assume roles such as homeowners, renters, architects, housing cooperative representatives, urban planners, municipal leaders, energy experts, NGOs, investors, and local businesses—each with unique objectives, resources, and constraints. The game uses Scenario Cards (e.g., solar PV, building retrofits, district heating), Challenge Cards (e.g., funding gaps, regulatory delays, social resistance), and a structured trade-off analysis phase. Through negotiation, players aim to reach a joint action plan that aligns individual goals with community-wide sustainability outcomes.

The workshop invites researchers, practitioners, and game designers to engage in live playtesting and critical discussion of the game's mechanics, decision structure, and stakeholder dynamics. Participants will contribute to the refinement of the game and explore its broader applicability as a participatory planning tool. Emphasis will be placed on the game's potential to foster cross-sector dialogue, empower underrepresented voices, and support the design of context-sensitive, low-carbon futures in urban neighborhoods.

**PANEL**

13:45-15:00

AKADEMIE

**PANEL:**
ALEXANDRE HEDJAZI (UNIVERSITY OF GENEVA)
HARIS BISKOS (INDEPENDENT ARCHITECT, URBANIST EXPERT)
GÉRARD HUTTER (LEIBNIZ INSTITUTE OF ECOLOGICAL URBAN AND REGIONAL DEVELOPMENT)
GEORGIOS PANETSOS (UNIVERSITY OF PATRAS)
ALCESTIS RODI (UNIVERSITY OF PATRAS)

***ORGANISER:*** *PARASKEVI ALKISTIS (ALCESTIS) RODI, UNIVERSITY OF PATRAS*

## From Forma Urbis to Forma Horta: Blue–Green Urban Futures in Dense, Heritage-Rich Cities

In compact cities—often urban palimpsests shaped by centuries of transformation—the pursuit of climate resilience must balance the ambition to maximise environmental performance with the imperative to minimise social and cultural disruption, all while preserving built heritage. Central to this challenge is the reintegration of blue–green infrastructure into the urban fabric, signalling a shift from Forma Urbis—a 'stone-and-mortar' conception of the city—to Forma Horta, an urban form interwoven with living ecological systems. Realising this transformation requires navigating spatial and aesthetic constraints, competing land uses, strict preservation mandates, and the complexities of fragmented governance.

Within these constraints lie latent opportunities for advancing climate resilience. For example, overlooked urban surfaces—such as rooftops, the building's 'fifth façade'—can be transformed into multifunctional blue–green infrastructure, supporting stormwater retention, urban cooling, biodiversity enhancement, and civic engagement, while maintaining architectural integrity and reinforcing local identity.

Alongside technological and governance innovations, the discussion will draw on vernacular traditions that integrated blue-green aspects into the urban fabric, resonating with Plato's vision of settlements shaped in harmony with fertile land, flowing water, and civic life. Building on this traditional wisdom, and integrating contemporary design and governance, the panel will explore culturally rooted, climate-adapted urban futures, with Citizen Science as a key participatory tool for assessing, co-designing, and evaluating interventions, thereby enhancing their legitimacy, inclusiveness, and capacity to inform transformative urban change.

More specifically, the discussion will be structured around four interconnected themes:

- Context specificity: Designing blue–green systems for dense, heritage-rich urban contexts, as opposed to urban open space or peri-urban contexts.
- Innovation in urban surfaces: Rethinking both public and private spaces within the urban fabric as underutilized blue-green infrastructure.
- Governance and Citizen Science: Harnessing data-driven and community-based processes to support equitable and widely accepted urban transitions.
- Interdisciplinary approach: Bridging urban design, environmental governance, policy, and heritage, offering a holistic systems perspective.

**PANEL**

15:30-17:00

AKADEMIE

**PANEL:**
SASCHA NICK (EPFL)
YAMINA SAHEB (IPCC/SCIENCES PO)
CHRISTINA MARCHAND (ZHAW)
HARALD DESING (EMPA)

***ORGANISER:*** *SASCHA NICK (EPFL), MASHAEL YAZDANIE (EMPA)*

## Sufficiency: Radical rapid societal transformation for ecosystem and human wellbeing

In a world where efficiency and technology alone cannot secure a liveable future, sufficiency offers an often-overlooked yet practical pathway to rapid transformation. This panel convenes leading experts, including contributors to IPCC reports and European thought leaders, to explore how sufficiency can shift societies toward resilience, justice, and wellbeing within planetary boundaries. Together, we will discuss what it takes to make sufficiency visible, actionable, and central to climate and sustainability strategies.

**WORKSHOP**

15:30-17:00

NEST-MF

***ORGANISER:*** *JULIO PAULOS, FUTURE CITIES LAB (FCL) & SMART CITY ZURICH (SCZ), ETH ZURICH, SWITZERLAND*

## From Insight to Impact: Transforming the Evidence-to-Policy Pipeline

This workshop explores how to reshape the process of translating research into actionable urban policy—moving beyond static formats like reports or policy briefs. Together with Smart City Zurich, FCL invites participants to rethink the “evidence to policy” pipeline and co-create more responsive, demand-driven knowledge practices.

Key questions include:

- How can we better align the supply of research with the demand for timely, usable insights?
- What makes co-produced knowledge credible and influential?
- How can we balance scientific rigour with the urgency and constraints of policymaking?

Workshop Structure (90 min):

- Welcome & Framing (5 min):
- Setting the purpose, flow, and ground rules for interaction.
- Paired Reflections (10 min):
- Participants share experiences where evidence succeeded or failed to influence a decision.
- Mapping Blockages & Levers (10 min):
- Key insights are collected on a shared board to surface patterns and entry points.
- Thematic Table Rotations (45 min):
- Participants move through three stations tackling core challenges (e.g., timing, formats, trust). Each offers a case, prompt, and task.
- Group Synthesis (15 min):
- Teams sketch a “next-gen” model or tool for policy translation.
- Wrap-up (5 min):
- Sharing takeaways and possible next steps.

This session is for researchers, policy actors, and practitioners seeking more effective, equitable ways to make urban knowledge actionable and impactful.

**WORKSHOP**

15:30-17:00

NEST-M2C

***ORGANISER:*** *YOUSRA SIDQI, TANIA LOPEZ GARCIA, ALBA ARIAS, LUCERNE UNIVERSITY OF APPLIED SCIENCES AND ARTS, SWITZERLAND*

## Gridly: Interactive engagement tool for Local Energy Community, market, and users' interconnectivity

During the workshop, we will present and experiment with the interactive engagement tool for Local Energy Community (LEC). This tool aims to solve the energy sale and purchase allocation problem in LECs, while considering fairness constraints in the proposed solution. In contrast to many previous works, which employ an open market, where bidders and sellers are matched based on their pricing preferences, this tool proposes a centralized matching mechanism with a fixed price, to maximize market efficiency.

The objective of the workshop is twofold. On the one hand, to present the work carried out. On the other hand, together with the participants in the workshop, to analyse the tool, evaluating its usefulness and scope, discussing strategies for its implementation but also how it can be improved to ensure its value and guaranteeing its utilisation among communities. For this reason, the workshop will be structured in three parts:

1. Presentation of the tool: how it works, scope, target group, variables taken into account, data used on the calculations, and type of outcomes that it gives
2. Individually, experimentation with the tool: attendees will be invited to experiment with the tool with the aim to understand by doing how it works. Facilitators will invite assistants to simulate different scenarios to see the potential of the tool
3. By groups, attendees will conduct participatory process of evaluation of the tool (pros and cons, limitations and usefulness of the tool). Afterwards, taking into account the evaluation carried out, they will focus on proposals for improvement and potential implementation of the tool. This stage will finish with a round of sharing the work done by each group, questions, and final comments.

**WORKSHOP**

15:30-17:00

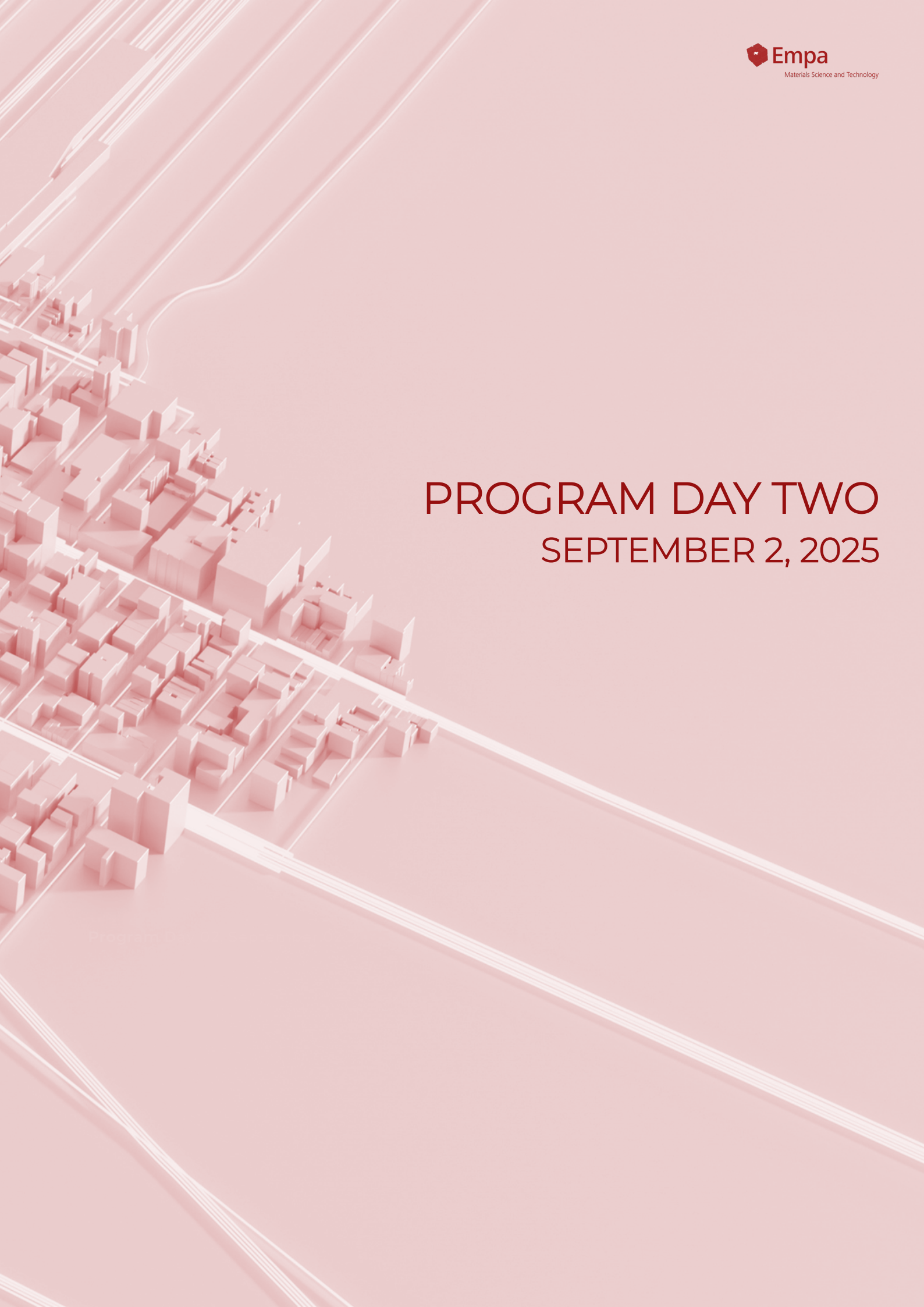
LB

***ORGANISER:*** *NANCY ANDREA RAMIREZ AGUDELO, UNITED NATIONS UNIVERSITY, GERMANY*

## Futuring cities: Participatory visioning for resilient futures

Urban areas are at the forefront of both climate impacts and solutions. However, climate change science and related actions are increasingly contested worldwide. This challenging context highlights the critical need to support further diverse urban stakeholders, including youth, Indigenous Peoples, local authorities, civil society, academia, and the private sector, to have the competencies and skills that support them in collaboratively envisioning and shaping climate-resilient futures on the ground. This workshop proposal presents training to develop the capacity for transformative change, good governance, and transparent communication by combining creative participatory methods with systems thinking and scenario planning. The training is structured around five modules for building a transformative coalition, understanding the local context, framing the city's future, inclusive and participatory visioning, and challenging assumptions for good governance. Expected outputs include insights on establishing a multistakeholder coalition with shared goals, which involves a creative documentation process to collect visual evidence and local insights, map policies and community perspectives, draft collaborative ideas for future actions, and reach a consensus on tracking and sharing progress. Furthermore, feedback from workshop participants will help in improving the workshop for its enhanced delivery at the next Climate Conference, COP30.

Empa
Materials Science and Technology



# PROGRAM DAY TWO

## SEPTEMBER 2, 2025

## Program Overview (Day 2)

| Time | Location | September 2, 2025 | | | | |
|---|---|---|---|---|---|---|
| 8:30-9:00 | Akademie Foyer | Registration | | | | |
| 9:00-9:30 | Akademie | Welcome address by the Head of the UESL (Dr. Georgios Mavromatidis) & "Swiss Strategy to Net Zero by 2050 and Implications for the Building Area" by the Swiss Federal Office of Energy (Andreas Eckmanns) | | | | |
| 9:30-10:15 | Akademie | **Keynote**: "Overshoot – the urban future no one is talking about." - Prof. Debra Roberts (IPCC/UNFCC) | | | | |
| 10:15-10:45 | Akademie Foyer | Poster session, NEST tour & coffee break | | | | |
| | | Parallel sessions | | | | Panel |
| 10:45-12:00 | (See session) | Participative, multidisciplinary and cross-border learnings (LB) | Hot & cold: from cooling to district heating (NEST-MF) | Digital approaches for urban planning and design (VE 102) | Circularity, materials, and embodied emissions (VE 202) | Enhancing Urban Resilience through Nature-based Solutions (NbS): Strategies for Reducing Disaster Risks (UNDP Geneva) (Akademie) |
| 12:00-13:00 | Akademie Foyer | Lunch | | | | |
| 13:00-13:45 | Akademie | **Keynote**: "Cities and Energy - A Systems View" - Prof. Nilay Shah (Imperial College London) | | | | |
| | | Parallel sessions | | | | Panel |
| 13:45-15:00 | (See session) | Reimagining cities: the role of communities, education, and co-benefits (NEST-MF) | Grids, networks, flexibility, and resilience (VE 102) | Justice, equity and urban governance (LB) | Modeling tools and technology for urban innovation (VE 202) | How to establish heavy-duty supply chains for low-carbon housing in Africa's emerging Mega- and Gigacities (Skat Consulting Ltd.) (Akademie) |
| 15:00-15:30 | Akademie Foyer | Poster session & coffee break | | | | |
| | | Workshops | | | | |
| 15:30-17:00 | (See session) | "My Neighbourhood": Building energy transition, one neighbourhood at a time (UN-Habitat) (Akademie) | Shaping the future of urban digital twins in Switzerland (EPFL) (NEST-MF) | Playing with the Business Model Assembler for clean energy urban hubs (University of St. Gallen) (NEST-M2C) | Bridging the gap: Fostering collaborations between social scientists and engineers for urban systems research (MIT) (LB) | |
| 17:00-17:30 | Akademie | **Special guest keynote**: Dani Arnold - world record-breaking, Swiss extreme mountaineer | | | | |

## Keynote Speakers

TUESDAY, SEPTEMBER 2, 2025, 9:30 – 10:45 AM CEST

### "Overshoot – the urban future no one is talking about."

Prof. Debra Roberts

IPCC AR6 WGII Co-Chair, UNFCCC Expert

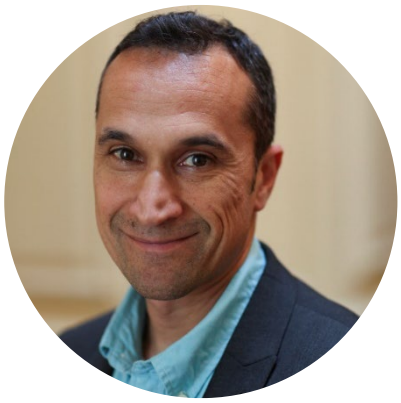
*Professor Debra Roberts is a scientist who has spent four decades working at the science-policy-practice interface at local and international levels. Prof. Roberts headed the Sustainable and Resilient City Initiatives Unit and Environmental Planning and Climate Protection Department in eThekwini Municipality (Durban, South Africa) between 1994 and 2024. She was elected as the Intergovernmental Panel on Climate Change (IPCC) Co-Chair of Working Group II for the sixth assessment cycle (2015–2023). Prof. Roberts has held several international advisory roles, for example advising: United Cities and Local Governments; ICLEI–Local Governments for Sustainability; Global Commission for SDG Urban Finance; and the WMO World Weather Research Programme. She was also a lead negotiator for the South African delegation involved in the United Nations Framework Convention on Climate Change (UNFCCC) negotiations. She is currently one of the experts working on UNFCCC's Global Goal on Adaptation indicators. She is an Honorary Professor at the University of KwaZulu-Natal and holds the Professor Willem Schermerhorn Chair in Open Science from a Majority World Perspective at the Faculty of Geo-Information Science and Earth Observation at the University of Twente. She is President of the AXA Research Fund Scientific Board and Chair of the Board of the Red Cross Red Crescent Climate Centre.*

TUESDAY, SEPTEMBER 2, 2025, 13:00 – 13:45 PM CEST

### "Cities and Energy – A Systems View"

Prof. Nilay Shah

Imperial College London



Professor Nilay Shah is a leading expert in sustainable energy and industrial systems at Imperial, where he is a Professor of Process Systems Engineering and Co-Director of the School of Convergence Science for Sustainability. His research focuses on sustainable processes, carbon capture and storage (CCS), hydrogen infrastructure, and whole-system energy modeling, with a particular emphasis on optimising low-carbon industrial processes and sustainable cities to support the transition to net zero. He has played a key role in large-scale energy transition projects, advising government and industry on the integration of CCS, hydrogen, and renewables. He is also a member of the UK Hydrogen Delivery Council, working alongside industry leaders to accelerate the deployment of clean hydrogen.

Empa
Materials Science and Technology

# ORAL PRESENTATIONS

Tuesday, September 2, 2025

**Parallel Sessions 10:45-12:00**

• Participative, multidisciplinary and cross-border learnings
LB

• Hot & cold: from cooling to district heating
NEST-MF

• Digital approaches for urban planning and design
VE 102

• Circularity, materials, and embodied emissions
VE 202

| September 2, 2025<br>10:45-12:00 | | |
|---|---|---|
| Time | Presentation title | Presenter |
| Participative, multidisciplinary and cross-border learnings (LB) | | |
| 10:45-11:00 | Building a cross-border territorial vision 2050: A multidisciplinary, multi-stakeholders consensus approach for Greater Geneva based on regenerative planning principles | Igor Andersen, Urbaplan |
| 11:00-11:15 | Enabling city transfer-learning by innovating evidence synthesis of climate solutions from 20,000 urban case studies | Simon Montfort, EPFL |
| 11:15-11:30 | Low-carbon housing supply chains and inclusive urban transformation models for Africa's emerging mega- and gigacities | Daniel Wyss, Skat Consulting Ltd |
| 11:30-11:45 | Universities in action: Leading sustainable construction across Latin America | Roger Walther, EBP Schweiz AG |
| Hot & cold: from cooling to district heating (NEST-MF) | | |
| 10:45-11:00 | The effect of urban microclimates on the cooling demand of Padova | Jacopo Vivian, University of Padova |
| 11:00-11:15 | Smart control of district heating networks: A case from Switzerland | Somil Miglani, Flemish Institute for Technological Research (VITO) |
| 11:15-11:30 | Assessment of uncertainties in the district heating decarbonization: Discussions around the Vienna case study | Iná Maia-Novak, Austrian Institute of Technology (AIT) |
| 11:30-11:45 | ULISSE "Under lake infrastructure for capture and storage of solar energy" for district heating and cooling services | William van Sprolant, CvS énergies sàrl |
| 11:45-12:00 | Data-driven personalized thermal comfort model for office workers in Switzerland | Arnab Chatterjee, Empa |
| Digital approaches for urban planning and design (VE 102) | | |
| 10:45-11:00 | Shaping urban futures: 3D simulations of urban planning regulations | Somaie Abolhasani, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL ) |
| 11:00-11:15 | Modelling and simulation towards resilient urban systems: Enabling sectoral interoperability through semantic web technologies | Andrea Bartolini, Singapore ETH Centre |
| 11:15-11:30 | UrbanTwin: Accelerating the transition to net-zero cities through integrated urban systems | Denisa-Andreea Constantinescu, Catarina Braz, Xavier Ouvrard, EPFL |
| 11:30-11:45 | Towards an Integrated Platform for Energy Planning: Connecting Data and Digital Services with Semantic Technologies in Digicities | James Allan, Empa |
| 11:45-12:00 | Integrating digital needs to cities: A holistic approach of sustainable computing | Sai Ravi, Eduardo Pina, Georgios Sarantakos, Xavier Ouvrard, EPFL |
| Circularity, materials, and embodied emissions (VE 202) | | |
| 10:45-11:00 | Mapping operational and embodied emissions in relation to household and ownership profiles: The case of Vaud, Switzerland | Ankita Singhvi, EPFL |
| 11:00-11:15 | Circular sanitation toolbox: Practical guides for resource-oriented sanitation | Rosanne Wielemaker, Eawag |
| 11:15-11:30 | Soil and construction spoil metabolism in New York City | Lynnette Widder, Columbia University |
| 11:30-11:45 | User-adapted design and optimization of a multi-purpose solar cooking stove for sustainable urban energy futures: A numerical and experimental study | Hemant Raj Singh, Manipal University Jaipur |
| 11:45-12:00 | Analysis of technical pathways and certification for carbon-based energy carriers | Jens Hunhevicz, Empa |

**PARTICIPATIVE, MULTIDISCIPLINARY AND CROSS-BORDER LEARNINGS**

10:45-11:00

LB

*IGOR ANDERSEN, URBAPLAN, SWITZERLAND*

## Building a cross-border territorial vision 2050: A multidisciplinary, multi-stakeholders consensus approach for Greater Geneva based on regenerative planning principles

The Cross-border Territorial Vision 2050 for Greater Geneva proposes an innovative approach to cross-border territorial planning based on regenerative planning principles within a collaborative, bottom-up and multidisciplinary methodology. This vision addresses ecological, economic, and social imperatives for the region by 2050, aiming to align urban development with ecosystem health and resilience. The vision-building process stands out for its participatory and iterative structure, engaging diverse actors, from political institutions and domain experts to local citizens, in shaping a sustainable and adaptable territorial model.

This contribution presents the unique methodology of this approach and its contributions toward building a strong, shared consensus. By mobilizing multidisciplinary teams, the project integrates socio-demographic analysis, mobility strategies, and strategic environmental assessments. Central to this approach is a regenerative framework that prioritizes ecological preservation and the enhancement of natural resources, guiding the development of a resilient territorial model.

The workflow was supported by three cycles of large-scale collaborative workshops held over two years, with regular oversight by an expert panel and a scientific advisory board. These bodies ensure methodological rigor and validate the selected orientations, grounding the project in data-driven, contextually relevant findings. Additionally, citizen engagement through public workshops has allowed local perspectives to inform the vision, ensuring its alignment with the values of the region.

The methodology is also distinguished by its systemic, cross-border framework, which aims to harmonize public policies across Switzerland and France while placing ecosystem protection and regeneration at the center of its strategic orientations. This regenerative planning approach seeks to align development with the preservation of natural resources, supporting the transition to a resilient, multipolar urban structure. By focusing on principles such as revitalization of built environments, sustainable land use, and circular resource cycles, the approach promotes both ecological transition and economic sustainability. Coordinated regeneration of infrastructure and promotion of local resource circularity serve as key pillars for achieving the vision's objectives.

In conclusion, the Cross-border Territorial Vision 2050 illustrates the effectiveness of an interdisciplinary and regenerative approach in constructing a strong consensus that transcends institutional and disciplinary boundaries. This approach may serve as a model for other cross-border projects, contributing to the literature on sustainable and collaborative territorial planning. It also provides valuable insights on stakeholder integration, decision-making in complex environments, and the creation of inclusive, long-term territorial visions.

**PARTICIPATIVE, MULTIDISCIPLINARY AND CROSS-BORDER LEARNINGS**

11:00-11:15

LB

*SIMON MONTFORT, EPFL, SWITZERLAND*

## Enabling city transfer-learning by innovating evidence synthesis of climate solutions from 20,000 urban case studies

**PARTICIPATIVE, MULTIDISCIPLINARY AND CROSS-BORDER LEARNINGS**

11:15-11:30

LB

*DANIEL WYSS, SKAT CONSULTING LTD, SWITZERLAND*

## Low-carbon housing supply chains and inclusive urban transformation models for Africa's emerging mega- and gigacities

African countries are among the fastest-urbanising in the world. By 2100, 13 of the world's 20 largest cities are expected to be in Africa. Many cities will merge to continuous metropolitan corridors along coastlines or highways. The Abidjan-Lagos corridor, for example, is projected to grow to a population of up to 500 million by 2100 — five to six times the population of the Tokyo-Fukuoka corridor.

While these urban areas will drive the continent's economic development, they also raise major environmental and social concerns, as most sub-Saharan cities sprawl horizontally with informal, low-rise housing. This consumes agricultural land and causes significant deforestation and $CO_2$ emissions, if buildings continue to be constructed using tree-fired clay bricks or informal concrete.

The fast pace of territorial expansion exceeds the capacity of most authorities to build basic infrastructure, resulting in large underserviced and labyrinthic neighbourhoods that are inaccessible to public transport, firefighters or the police. Congested traffic, long and CO2-intensive commuting, interrupted supply chains, flooding, settlement fires, and crime are among the key factors contributing to the economic and environmental underperformance of Africa's low-density cities.

Many governments' efforts to adopt denser, climate-responsive urbanisation models have failed due to a lack of safe, affordable, environmentally friendly building solutions for storied construction.

In 2013, SDC entrusted Skat with implementing the Swiss PROECCO project in Africa's Great Lakes Region (Rwanda, Burundi, and the Democratic Republic of the Congo), enabling the local building industry and authorities to develop climate-responsive supply chains for affordable urban housing to serve the densification of the region's numerous informal urban settlements.

Based on detailed mapping of locally available resources and local housing cultures, the project has identified and transferred technologies for producing nearly carbon-neutral bio-waste-fired bricks. The 'Smart Tafali Etage' (also known as the 'Swiss Cube System') is customisable and can be easily built by local SMEs with modest equipment and basic engineering capacities and is designed for the community-driven transformation of informal settlements.

When it was first demonstrated in 2017, it instantly created a fast-growing demand for storied housing and triggered significant investments in low-carbon brick production. Today, Rwanda's output of low-carbon bricks has increased 11-fold, raising its market share in Kigali from 5% to almost 50% and reducing >100,000 $tCO_2$ every year. Following a successful pilot rollout in the Mpazi neighbourhood in May 2025, the Rwandan authorities announced the city-wide application of Skat's participatory urban transformation model. In 2023, similar initiatives have been launched in Tanzania, Zimbabwe, and the Abidjan-Lagos Corridor, after UN-Habitat joined the (Swiss) Cubes' promotion across Africa.

**PARTICIPATIVE, MULTIDISCIPLINARY AND CROSS-BORDER LEARNINGS**

11:30-11:45

LB

*ROGER WALTHER, EBP SCHWEIZ AG, SWITZERLAND*

## Universities in action: Leading sustainable construction across Latin America

Launched in 2020, the CEELA project is a regional initiative aimed at reducing $CO_2$ emissions in the building sector across Peru, Mexico, Ecuador, and Colombia. With buildings accounting for nearly 40% of global $CO_2$ emissions, CEELA addresses this critical challenge through a comprehensive, three-pillar approach: demonstration projects, capacity building, and policy support.

*Showcases and Demonstration Projects*

CEELA collaborates with leading universities to design and construct model buildings based on the 15 EECA Principles (Energy Efficiency, Climate, and Comfort). These buildings are tailored to warm climate conditions and serve as real-world examples of climate-adapted, low-emission architecture. By demonstrating scalable and replicable solutions, CEELA bridges the gap between theory and practice, influencing both public and private sector construction.

*Capacity Building and Education*

A cornerstone of CEELA is its investment in human capital. Over 10,000 professionals have been trained in sustainable construction practices. The Zero Emissions University Network, comprising 30 universities, is a flagship initiative that promotes climate neutrality in higher education. Through digital learning platforms, pilot projects, and the CEELA Award, universities are developing decarbonization roadmaps and embedding sustainability into curricula, research, and campus operations.

*Policy and Regulatory Support*

CEELA works closely with national and local governments to strengthen building codes, align them with international standards, and create incentives for energy-efficient social housing. Universities play a key role in this process by piloting innovative governance models and contributing to evidence-based policymaking. These efforts aim to institutionalize energy efficiency and ensure long-term impact through regulatory frameworks.

*A Model for Regional Transformation*

CEELA demonstrates how regional collaboration, experiential learning, and institutional innovation can drive a just and sustainable transition in the built environment. By empowering universities, professionals, and policymakers, the project is laying the groundwork for climate-resilient urban development in Latin America. Its integrated approach offers a replicable model for other regions facing similar environmental and social challenges.

**HOT & COLD: FROM COOLING TO DISTRICT HEATING**

10:45-11:00

NEST-MF

*JACOPO VIVIAN, UNIVERSITY OF PADOVA, ITALY*

## The effect of urban microclimates on the cooling demand of Padova

In this study, we show preliminary results concerning the effects of microclimates on the cooling demand of Padua. The hypothesis is that local outdoor conditions affect the buildings' energy demand for space cooling significantly, based on their position in the city.

Here, we used EUReCA to simulate hundreds of buildings in different neighborhoods using weather data recorded from a sensor network recently installed by the Municipality of Padova.

**HOT & COLD: FROM COOLING TO DISTRICT HEATING**

11:00-11:15

NEST-MF

*SOMIL MIGLANI, FLEMISH INSTITUTE FOR TECHNOLOGICAL RESEARCH (VITO), BELGIUM*

## Smart control of district heating networks: A case from Switzerland

The main challenge that District Heating Network (DHN) operators face is high operational costs during peak load. These costs arise mainly because of the high prices for fuels (typically natural gas, oil ) used for the backup peak boilers. Often, peak boilers reach their maximum capacity during the coldest days, especially in case additional consumers are connected. This may result in loss of thermal comfort for the end consumers. Data driven control of DHNs using intelligent algorithms can provide an economic way to address such issues through peak load management. The STORM District Energy Controller is a technology that utilizes thermal flexibility in the buildings to shave peak load. Its advanced algorithms can forecast the network peak load and send individual control signals to each connected building in real-time (every 15 minutes) to activate the available thermal flexibility. This presentation shares the practical experience gained through the pilot implementation of the controller on heat networks across the EU, Switzerland, and China. Best practices that can help avoid operational challenges are also suggested. One case study is selected for the demonstration of the controller's operational behavior through snapshots of representative days. Qualitative and quantitative assessment of the controller's operational performance for the given case study is also described.

**HOT & COLD: FROM COOLING TO DISTRICT HEATING**

11:15-11:30

NEST-MF

*INÁ MAIA-NOVAK, AIT - AUSTRIAN INSTITUTE OF TECHNOLOGY, AUSTRIA*

## Assessment of uncertainties in the district heating decarbonization: Discussions around the Vienna case study

Vienna's district heating energy operator supplies about 460.000 households and generates annually about 6.000 MWh of thermal energy. In 2021, about 50% of the thermal energy was generated by a gas combined heat and power generation plant. The local energy supplier company (Wien Energie) has set goals to decarbonize the thermal energy generation by 2040 through a mix of measures. The present work aims to discuss the uncertainties related to their decarbonization strategy, in form of a techno-socio-economic qualitative risk assessment. This is also a preparatory work to perform Monte Carlo Simulation combined with the optimization model IESopt for generic energy systems analysis (Integrated Energy System Optimisation)(Strömer & Maggauer, 2024). Techno-socio-economic aspects as the building stock retrofitting activities and policy aspects behind it, energy price scenarios, sector coupling and climate change will be discussed and presented in a qualitative framework. Expected outcomes are the mapping of techno-socio-economic risks in terms of energy price volatility, CO2 tax introduction, and energy demand decrease through retrofitting and/or climate change. These will follow as input data in a future work that will quantitatively assess the district heating decarbonisation risks with a Monte Carlo Simulation framework. The present work is part of the EU founded project ENABLE DHC that aims at fostering the transformation of district heating and cooling networks according to the Energy Efficiency Directive by developing investment plans.

**HOT & COLD: FROM COOLING TO DISTRICT HEATING**

11:30-11:45

NEST-MF

*WILLIAM VAN SPROLANT, CVS ÉNERGIES SÀRL, SWITZERLAND*

## ULISSE "Under lake infrastructure for capture and storage of solar energy" for district heating and cooling services

As part of Switzerland's Energy Transition 2050, the Swiss Federal Office of Energy (SFOE) has launched the "SOUR Call 1-2021" (SWEET Out the box Rethinking) research projects. Best ranked from 77 proposals, the ULISSE project has been funded by the SFOE and made in collaboration with the HEPIA as “host institute”.

The ULISSE system (Under Lake Infrastructure for capture and Storage of Solar Energy) mainly aims to improves the heat pumps efficiency (twice) of Thermal Lacustrine Networks (TLN) for District Heating and Cooling services (DHC).

The ULISSE system consists of large seasonal heat storage reservoirs, made of biocompatible mineral fiberglass textile and only 5 cm foam-glass, invisibly anchored to the lake bed (unit capacity: 2 million m3 & 125 TJ @ ΔT = 15 K).

In summer, they are filled with temperate water, by a “hydraulic pantograph” either from the upper layer of the lake (Epilimnion) heated by the sun, or from industrial and air-conditioning waste heat. The loading pumps are supplied with photovoltaic electricity, reducing peak-shavings (grid-overloads curtailment).

Limited (20%) heat loss would induce vertical convection currents outside the ULISSE reservoir over the entire water column of the lake. It could enhance nutrients circulation and the oxygenation of the bottom layer of the lake, which ultimately protects against Eutrophication and Asphyxia, the harmful effects of Global Warming of all the lakes (Not only Alpine glaciers are threatened!).

The ULISSE reservoirs are a source of winter heat from the lake at around 20°C, instead of the usual 5-6°C. This doubles the efficiency of the heat pumps of the district heating network and halves their electricity consumption, reducing the volume of water by a factor of 5 and the electrical energy required to pump and circulate the water in the TLNs by 95%.

With the ULISSE heat resources, a complementary CORSAIRE "winter free heating" (heat exchange without heat pump) or winter temperature correction of the public Drinking Water Network (DWN) could reduce up to 10% the total winter semester heat demand of a current entire city’s building stock without any internal needed equipment!

As a result, around 300 ULISSE reservoirs spread invisibly across the 15 major Swiss lakes and, combined with CORSAIRE free heating (including outside the lake regions in case of local direct waste heat recovery), could supply almost 60 PJ or 30% of the 200 PJ of national energy-heat requirements for ambient heating and domestic hot water. For an overall investment of around CHF 3 to 4 billion (ULISSE reservoirs, CORSAIRE heat exchangers, pipelines), this would save 3 TWh of gross electricity in the winter semester 2050, i.e., 1/3 of the 9 TWh winter electricity structural deficit and equivalent to twice the winter production of Switzerland's largest hydroelectric complex, Grande Dixence (2 x 1.5 TWh).

**HOT & COLD: FROM COOLING TO DISTRICT HEATING**

11:45-12:00

NEST-MF

*ARNAB CHATTERJEE, EMPA, SWITZERLAND*

## Data-driven personalized thermal comfort model for Office workers in Switzerland

**DIGITAL APPROACHES FOR URBAN PLANNING AND DESIGN**

10:45-11:00

VE 102

*SOMAIE ABOLHASANI, SWISS FEDERAL INSTITUTE FOR FOREST, SNOW AND LANDSCAPE RESEARCH WSL, SWITZERLAND*

## Shaping urban futures: 3D simulations of urban planning regulations

**DIGITAL APPROACHES FOR URBAN PLANNING AND DESIGN**

11:00-11:15

VE 102

*ANDREA BARTOLINI, SINGAPORE ETH CENTRE, SINGAPORE*

## Modelling and simulation towards resilient urban systems: Enabling sectoral interoperability through semantic web technologies

Knowledge and domain expertise within urban sciences remain fragmented across disciplinary silos, with scientists and practitioners often operating within narrowly defined competence groups. This fragmentation hinders truly multidisciplinary approaches to modelling and simulation, posing a barrier to effective decision-making for the development of sustainable and resilient urban systems, particularly in the face of far-reaching challenges such as climate change.

To address this issue, there is a pressing need to bridge communication and data gaps across disciplinary boundaries, fostering interoperable knowledge domains. Such interoperability is a key enabler for integrated modelling and simulation frameworks capable of supporting robust, future-proof decision-making processes.

This work proposes a methodology leveraging semantic web technologies and ontology-based frameworks to address the challenge of cross-domain data interoperability, where these approaches have already demonstrated their effectiveness in resolving multi-domain integration problems across various scientific and technical fields.

We demonstrate our approach through a case study focused on the city of Singapore, where we establish semantic interoperability between two distinct knowledge domains: urban planning and urban form, and energy systems infrastructure. Data on land use and the built environment is semantically linked with information about urban energy systems through domain-specific ontologies. These are further integrated via a higher-level ontology representing urban metabolism, which provides the necessary conceptual cohesion for meaningful cross-domain reasoning.

The resulting knowledge graph enables both cross-domain applications and query capabilities, revealing insights into the interdependencies between urban form and infrastructure systems. Additionally, we illustrate how these semantic interconnections can support simulation-based “what-if” scenario analyses informed by user-defined hypotheses.

We conclude by showing how interoperable urban knowledge bases can be leveraged in modelling and simulation processes through a preliminary example. Furthermore, we suggest that the framework presented here lays the groundwork for broader initiatives aimed at integrating diverse domains into a unified analysis and decision-making process.

**DIGITAL APPROACHES FOR URBAN PLANNING AND DESIGN**

11:15-11:30

VE 102

*DENISA-ANDREEA CONSTANTINESCU, CATARINA BRAZ, XAVIER OUVRARD, EPFL EMBEDDED SYSTEM LABORATORY | EPFL ECOCLOUD, SWITZERLAND*

## UrbanTwin: Accelerating the transition to net-zero cities through integrated urban systems

Due to rising temperatures and climate change, urban areas face significant risks and impacts on livability. Cities are accountable for 75% of greenhouse gas emissions, which places them in a pivotal role in minimising the worst outcomes of climate change. They offer unique opportunities to integrate renewable energy sources, waste heat, wastewater, and buildings, providing the ideal setting to implement a transformative multi-sectoral approach to climate action.

UrbanTwin responds to ambitious goals outlined in the Swiss Energy Strategy 2050 by developing a modular decision-support tool for sustainable urban systems planning. By combining physics-based simulations, AI-driven modelling, and real-time sensing, UrbanTwin helps decision-makers create low-carbon, resource-efficient, and livable urban environments. Specifically, it supports climate mitigation by identifying emissions-reduction strategies in the high-impact housing and mobility sectors and climate adaptation through infrastructure models that simulate the impact of vegetation, reflective surfaces, and urban form on thermal comfort and resource demand.

The UrbanTwin provides a unified framework for modeling the interactions between energy, water, ICT, and human behavior and planning investment pathways for future city development. Demonstrators for tools, platforms, and methods are under development for the city of Lausanne and the EPFL campus:

- REHO: open-source tool for sustainable urban energy infrastructure planning, optimizing multi-energy integration across buildings and districts;
- Water portal: balance and runoff models for adaptive management and sponge-city implementation;
- SENSEI platform: low-power, low-cost Edge AI sensing and compute node for decentralized environmental monitoring, enhancing data privacy and scalability, crucial for bringing smart sensing to cities of all sizes;
- CEO-DC: sustainable scaling of data centers and integration with renewable energy.

UrbanTwin is a joint initiative of the Board of the Swiss Federal Institutes of Technology, in the strategic areas of Energy, Climate and Environmental Sustainability and Engagement and Dialogue with Society, led by Prof. David Atienza at EPFL. It links local insights with national energy transition scenarios, providing authorities with pathways toward climate neutrality by 2050, aligning with Switzerland's goals for sustainable urbanization and resilient infrastructure. The project is a collaborative effort by EPFL, ETH Zurich, EMPA, Eawag, and WSL, demonstrating how digital twins can turn climate goals into coordinated, data-informed urban action.

**DIGITAL APPROACHES FOR URBAN PLANNING AND DESIGN**

11:30-11:45

VE 102

*JAMES ALLAN, EMPA, SWITZERLAND*

## Towards an Integrated Platform for Urban Energy Planning: Connecting Data and Digital Services with Semantic Technologies in Digicities

The digital transformation of urban energy systems requires platforms that can effectively integrate heterogeneous data sources while supporting complex decision-making processes. The Digicities project addressed this challenge by developing a modular, cloud-based platform that leverages semantic technologies to create and manage accurate digital representations of real-world energy assets and systems. This presentation demonstrates how semantic layers function as the foundational architecture within the Digicities platform, enabling seamless integration of diverse data sources and services while allowing stakeholders to configure scenarios for specific use cases.

An energy planning use case will showcase the complete workflow, from service definition to results generation. The demonstration will cover ontology reuse and extension mechanisms that enable the platform to adapt to different requirements and domains while maintaining semantic consistency. Scenario configuration is illustrated by selecting and combining semantic data products, creating tailored analytics where components and their attributes are semantically linked within a knowledge graph. The presentation will show how scenarios can be configured to meet the API requirements of digital services in the energy planning domain and demonstrate the platform's flexibility in supporting third-party analytical tools.

The potential of semantic technologies and linked data for energy planning is highlighted through three key capabilities: conceptual inference that enables automated reasoning about energy system relationships, linked concepts that provide rich contextual information across different scales and domains, and enhanced interoperability that allows diverse stakeholders to collaborate using shared vocabularies and data models. The presentation will conclude by outlining planned platform expansions and consideration of new use cases, demonstrating how the Digicities framework represents an advancement in urban energy planning tools where the aim is to bridge the gap between data and actionable insights.

**DIGITAL APPROACHES FOR URBAN PLANNING AND DESIGN**

11:45-12:00

VE 102

*SAI RAVI, EDUARDO PINA, GEORGIOS SARANTAKOS, XAVIER OUVRARD, EPFL ECOCLOUD, DESL AND IPESE, SWITZERLAND*

## Integrating digital needs to cities: A holistic approach of sustainable computing

The future of urban planning and decision making is increasingly shaped by digitalization, requiring efficient data handling across a three-layer computational architecture: sensors, edge computing, and centralized datacenters. However, beyond performance efficient computing infrastructure must support urban sustainability, prompting a rethinking of datacenters to transform them from energy-intensive facilities to energy hubs that synchronize consumption with renewable generation and valorize the heat produced for local services.

At EPFL, the EcoCloud research center is at the forefront of this intersection between sustainability and digital infrastructures, by focusing on both IT for sustainability and sustainability in IT.

Among our current initiatives, three major projects contribute directly to the vision of Urban Futures: among its major projects, the Heating Bits project is going to be presented in this talk by Sai Ravi, Dr Eduardo Pina, Georgios Sarantakos, and Dr Xavier Ouvrard.

Heating Bits is a project financed by EPFL Solutions 4 Sustainability. It is led by Prof. Mario Paolone (EPFL-DESL) and involves six laboratories of EPFL and EcoCloud.

Heating Bits proposes a holistic approach to datacenter design and its optimal integration into the local energy system. This approach is based on the optimal control of a battery energy storage system (BESS) aiming at minimizing the carbon footprint of datacenters through increase of renewable energy utilization, efficient real-time estimation of the carbon content of the electricity from the power grid, through an intelligent computation workload management and some advanced heat reuse strategies, but also with an efficient DC/DC energy distribution system.

Heat reuse is based on a two seasonal strategy: in winter, waste heat is directly consumed by EPFL's central heating system, and during summer, heat powers a tailored made Organic Rankine Cycle (ORC) system for cogeneration, converting fatal heat into electricity. Key to this is an innovative cooling technology with custom-engineered cold plates with micro-channels tailored to the targeted processors. These cold plates with a properly designed cooling loop allow higher outlet temperatures---around 75°C---enhancing heat recovery efficiency and more valuable reuse.

This project is based at the EcoCloud experimental facility, ideally located adjacent to the main datacenter of EPFL and directly above the campus's central heating infrastructure. The facility serves as a living lab for cutting-edge IT sustainability research, especially in the fast-evolving IT cooling technologies like direct liquid cooling and immersion cooling.

During this talk, we will highlight the key technological and urban design implications of the Heating Bits project, and how such integrated datacenter models can contribute to the sustainable transformation of our cities.

**CIRCULARITY, MATERIALS AND EMBODIED EMISSIONS**

10:45-11:00

VE 202

*ANKITA SINGHVI, HERUS LAB, EPFL, SWITZERLAND*

## Mapping operational and embodied emissions in relation to household and ownership profiles: The case of Vaud, Switzerland

The built environment is one of the major contributors to global resource extraction and greenhouse gas emissions, however a lack of attention to socio-spatial context has been identified as a key challenge for informing local decision-makers on how to implement decarbonisation and circular economy policies. We conducted a bottom-up, spatially explicit building stock analysis of residential buildings in the canton of Vaud, Switzerland, quantifying their material composition, embodied carbon, and operational energy demand. Furthermore, we incorporated the heterogeneity of ownership and household profiles into our analysis, to determine the actors most affected by, and capable of influencing, the building stock. We find patterns in ownership across construction period and building type, and variation in operational energy demand across the urban-rural gradient. Our findings suggest that resource management strategies focused only on recycling and material reuse are insufficient, and should be complemented by energy efficiency retrofits and sufficiency measures tailored to the social and spatial diversity of the housing stock.

**CIRCULARITY, MATERIALS AND EMBODIED EMISSIONS**

11:00-11:15

VE 202

*ROSANNE WIELEMAKER, EAWAG, SWITZERLAND*

## Circular sanitation toolbox: Practical guides for resource-oriented sanitation

With the increasing recognition of the value of resources in our (domestic) wastewater, there is a need to simplify access to knowledge on resource management strategies and technologies for resource recovery. Various practitioners are looking for know-how on how to implement resource recovery across scales and in different contexts. We will present our recently launched Circular Sanitation Toolbox. The toolbox is a portfolio of implementation strategies and technological solutions that help practitioners (e.g., planners and architects) navigate the option space for resource-oriented, decentralized sanitation and to aid them in decision-making for context-appropriate sanitation systems. Currently sewered sanitation is an end of pipe solution, requiring one pipe to exit a building. Circular sanitation, however, with source-separation and decentralized treatment and recovery technologies, presents new infrastructural and spatial challenges. The toolbox provides stakeholders, beyond the environmental engineer, with considerations for sanitation of our future cities.

**CIRCULARITY, MATERIALS AND EMBODIED EMISSIONS**

11:15-11:30

VE 202

*LYNNETTE WIDDER, COLUMBIA UNIVERSITY, NYC, MASTER'S OF SUSTAINABILITY MANAGEMENT PROGRAM, UNITED STATES*

## Soil and construction spoil metabolism in New York City

Soil shifting - excavation, backfill, regrading - remains largely invisible in New York City. The city's 28% increase in commercial area since 2010 has supercharged a regulatory system that transports spoil outside city limits, then reimports it after nominal certification. Current infrastructure projects surface deep-strata soils, then comingle them with man-made spoil. Regulation ignores the value of this naturally-occurring "tabula rasa" material.

NYC spoil follows different pathways: transfer stations or national soil brokerages; soil washing for recovery for engineering capacity; or, in bespoke quantities, the circularity of a city-run soil bank program. Quantitative research, expert interviews and new photographic documentation are used here to describe the expanses, technologies and environmental implications of soil shifting in New York.

**CIRCULARITY, MATERIALS AND EMBODIED EMISSIONS**

11:30-11:45

VE 202

*HEMANT RAJ SINGH, MANIPAL UNIVERSITY, JAIPUR, INDIA*

## User-adapted design and optimization of a multi-purpose solar cooking stove for sustainable urban energy futures: A numerical and experimental study

The development of effective and sustainable cooking solutions is essential for addressing global issues of energy consumption and environmental impact. The objective of the present work is to provide a comprehensive cooking solution for a single rural household of western India. A Scheffler-type solar concentrator-based cooking system is conceptualized for the above requirement due to its unique feature of a stationary Receiver. Prime attributes of the proposed system are stationary cooking place, thermosiphon-based system and low cost which makes this suitable for rural applications. The proposed system consists of a Scheffler dish operated Stove (rectangular box of 55 cm × 35 cm × 20 cm) having two customized vessels viz. cooking vessel 2.5-liter capacity and a cooking pan(griddle) of 25 cm diameter made of SS 304 and cast iron respectively. Thermosiphon effect is used to carry the heat from the receiver to the stove using thermic fluid (Shell Thermia 'S2'). Based on the mathematical model developed, the approximate thermosiphon flow rate comes out to be 0.80 LPM or 2.63 cm/s for a pipe diameter of 1 inch. To check thermosiphoning and thermal feasibility of the system, CFD analysis was done for four different configurations to find the optimum configuration using ANSYS Fluent. After finalizing the design, a prototype experimental setup was developed and tested using an induction heater to ensure proper thermosiphon of HTF and boiling process in the cooking vessels. Experimental results showed close resemblance to the simulation results of thermosiphon for a thermosiphon height of 0.63 m

**CIRCULARITY, MATERIALS AND EMBODIED EMISSIONS**

11:45-12:00

VE 202

*JENS HUNHEVICZ, EMPA, SWITZERLAND*

## Analysis of technical pathways and certification for carbon-based energy carriers

In the quest for a carbon-negative society, the idea of creating carbon sinks by combining the removal of carbon dioxide from the atmosphere with its storage, e.g., in the built environment, is gaining momentum. At the same time, carbon-based energy carriers based on green hydrogen provide an opportunity to link this with the global renewable energy transition. Towards such a future, aligning regulations and incentives with circular carbon pathways is essential. Therefore, we are exploring in our ongoing research how certification can boost scalable, trusted solutions and business models. By analyzing international developments and technical pathways, we intend to develop the foundation to understand certification systems that link carbon sinks with clean hydrogen production and conversion into synthetic fuels, chemicals, and other materials. We will present the latest results of our research, including an overview of identified pathways and certification schemes, and a discussion of current opportunities and limitations related to certification schemes in this context.

Tuesday, September 2nd, 2025

**Parallel Sessions 13:45-15:00**

• Reimagining cities: the role of communities, education, and co-benefits
NEST-MF

• Grids, networks, flexibility and resilience
VE 102

• Justice, equity and urban governance
LB

• Modeling tools and technology for urban innovation
VE 202

| September 2, 2025<br>13:45-15:00 | | |
|---|---|---|
| Time | Presentation title | Presenter |
| Reimagining cities: the role of communities, education, and co-benefits (NEST-MF) | | |
| 13:45-14:00 | Co-benefits of climate-change mitigation in cities | *Kushagra Gupta, Chalmers University of Technology* |
| 14:00-14:15 | Reimagining urban futures: The role of religion in eco-sustainability and public health | *Dawrell Rich, Montclair State University* |
| 14:15-14:30 | Reimagining Alexandria's streets through landscape pedagogy and cultural memory (virtual) | *Sarah Enany, Alexandria University* |
| 14:30-14:45 | Work-from-home and residential energy demand: A machine learning analysis for Swiss households | *Yang Gao, TU Wien* |
| 14:45-15:00 | Regenerative African urban futures through alternative design | *Kevin Kimwelle, School of Explorative Architecture* |
| Grids, networks, flexibility and resilience (VE 102) | | |
| 13:45-14:00 | Flexibility-aware planning of electricity distribution network reinforcements | *Nikolaos Savvopoulos, ETH Zurich* |
| 14:00-14:15 | Integrating sustainability and resilience aspects into the assessment of power systems in urban futures | *Henning Wigger, Institute of Networked Energy Systems (DLR)* |
| 14:15-14:30 | GridPLAN & BOMES: Geometric planning and Bayesian optimization of multi-energy grids | *Alexander Fuchs, ETH Zurich* |
| 14:30-14:45 | Flexibility opportunities and regulations for distributed resources in the EU countries | *Jose Pablo Chaves Avila, Comillas Pontifical University* |
| 14:45-15:00 | The potential of cost-optimal demand-side flexibility in pharmaceutical industry clusters | *Michel Obrist, Empa* |
| Justice, equity and urban governance (LB) | | |
| 13:45-14:00 | Data-driven circularity: Visualizing urban heat inequity for just green transitions | *Wanyun Ling, RWTH Aachen University* |
| 14:00-14:15 | Integrative infrastructure planning in Al Muhaisnah 2: A multiscalar approach to urban resilience and social equity | *Anoushka Kolahalu, Politecnico di Milano* |
| 14:15-14:30 | Resilient cities, inclusive futures: Rethinking affordable housing in African cities | *Juliet Chika Chinemelu, Akanu Ibiam Federal Polytechnic* |
| 14:30-14:45 | The effect of global environmental justice on preferences for the location of climate policy implementation | *Gracia Brückmann, University of Bern* |
| 14:45-15:00 | When systems decide: Infrastructure, justice, and agency | *Vanja Djinlev, Empa* |
| Modeling tools and technology for urban innovation (VE 202) | | |
| 13:45-14:00 | From Prototype to Practice: Key Enablers in Operationalising the Urban Climate Model PALM-4U | *Bettina Steuri, Climate Service Center Germany (GERICS), Helmholtz-Zentrum hereon GmbH* |
| 14:00-14:15 | On future envelope construction: Robots and people | *Christoph Waibel, Flemish Institute for Technological Research (VITO)* |
| 14:15-14:30 | ReSIM: A simulation platform for urban energy systems | *Philippe Buchecker, ETH Zurich* |
| 14:30-14:45 | FlexECO: A multi-energy optimal dispatch and planning software tool | *Turhan Demiray, ETH Zurich* |
| 14:45-15:00 | Digitalized design-build-deploy-operate based on platform-based design and emerging ASHRAE Standards 231P and 223P | *Michael Wetter, Lawrence Berkeley National Laboratory* |

**REIMAGINING CITIES: THE ROLE OF COMMUNITIES, EDUCATION, AND CO-BENEFITS**

13:45-14:00

NEST-MF

*KUSHAGRA GUPTA, CHALMERS UNIVERSITY OF TECHNOLOGY, SWEDEN*

## Co-benefits of climate-change mitigation in cities

As cities strive toward net-zero emissions by mid-century, climate mitigation efforts present a unique opportunity to deliver significant co-benefits beyond greenhouse gas reduction. This study explores the range of co-benefits associated with urban climate action, such as enhanced air and water quality, improved public health, increased resource efficiency, and shifts toward sustainable behaviors. Integrating co-benefits into city-level climate planning can strengthen stakeholder support, promote equity, and optimize the cost-effectiveness of policy interventions. However, mitigation measures may also produce unintended adverse effects, including rising housing costs due to green space expansion and increased non-exhaust emissions from heavier electric vehicles. The research highlights the importance of quantifying co-benefits within energy systems planning—particularly in the heating and transportation sectors—and accounting for socio-economic disparities that influence the distribution of impacts across urban areas. The study aims to identify and quantify both positive and negative outcomes of climate action at city and sub-city scales, providing a framework to inform equitable and effective urban climate strategies.

**REIMAGINING CITIES: THE ROLE OF COMMUNITIES, EDUCATION, AND CO-BENEFITS**

14:00-14:15

NEST-MF

*DAWRELL RICH, MONTCLAIR STATE UNIVERSITY, UNITED STATES*

## Reimagining urban futures: The role of religion in eco-sustainability and public health

As the urban future unfolds, it presents opportunities and challenges for us to consider the interdependence between humans and the environment. The expanding urban phenomenon necessitates a reevaluation of environmental sustainability, smart design, policy, community-driven planning, and equitable distribution of natural resources in the context of urban living. This presentation delves into the intersection of religion, ecology, and urbanism, advocating for a critical reimagining of urban futures that places religious institutions at the forefront of moral, communal, and spatial contributions. The urban phenomenon is a growing socio-political reality, with cities serving as dense nodes of resources, relationships, and risks. In the face of mounting concerns about climate change, pollution, and health disparities, it's important to recognize that religious institutions, despite being underutilized, have the potential to be transformative actors in the urban landscape. These institutions, far from operating on the fringes of urban centers, offer deeply rooted moral frameworks—based on care, justice, and stewardship—that can challenge macrostructures and steer urban development towards more equitable outcomes.

This presentation introduces and expands the concept of 'eco-religious architecture'—a framework that integrates spiritual purpose with ecological design. It looks at how some churches are reimagining their role as urban-environmental interventionists. Some examples include solar-paneled sanctuaries, community gardens on church grounds, religious-environmental activism, and energy-efficient buildings. These sites do more than beautify the cityscape—they enhance community resilience, provide public health benefits, and reframe urban space as sacred ground. By highlighting the role of religion and its institutions in urban futures, I emphasize how urban health is ecologically and spiritually created. It calls for a renewed understanding of the "Right to the City"—including access to green space, environmental dignity, and collective meaning-making.

As the presentation concludes, it's important to highlight the role of collaboration in sustainable urban development. I share examples of churches that have formed broad-based coalitions, interpreted scripture through environmental lenses, and drawn upon ancestral epistemologies to devise solutions to urban environmental hazards. This collaborative approach offers a hopeful vision for the urban future, one that incorporates religious frameworks and provides the necessary religious, sociological, architectural theory, and ethical framework for constructing urban spaces that honor both humans and the earth. As the world's population continues to grow and urbanization becomes more prevalent, it's crucial for scholars, clergy persons, architects, and politicians to work together to ensure the availability of natural resources to support future public health.

**REIMAGINING CITIES: THE ROLE OF COMMUNITIES, EDUCATION, AND CO-BENEFITS**

14:15-14:30

NEST-MF

*SARAH ENANY, ALEXANDRIA UNIVERSITY – FACULTY OF FINE ARTS, DEPARTMENT OF ARCHITECTURE & LANDSCAPE DESIGN & PLANNING PROGRAM (JOINT WITH FACULTY OF AGRICULTURE), EGYPT*

## Reimagining Alexandria's streets through landscape pedagogy and cultural memory (virtual)

This presentation shares a design-based educational project developed with third-year students in the Landscape Design & Planning Program at Alexandria University. Rooted in a people-centered pedagogical approach, the project encouraged students to reimagine public streets in Alexandria not merely as functional corridors, but as cultural landscapes shaped by memory, identity, and everyday life.

The process unfolded in three phases: a visual documentation exercise during Ramadan to explore emotional connections to public spaces; a participatory site analysis using tools such as Survey123, ArcGIS, and cognitive mapping; and finally, the development of redesign proposals using platforms like Streetmix. Students reflected on walkability, greenery, safety, and the cultural role of landscape elements such as native plants and shaded areas.

By integrating digital tools and personal narratives, the project empowered students to understand urban design as a dialogue between past and future, memory and intervention. It also demonstrated how landscape pedagogy can be a powerful tool to bridge generational perspectives and foster more inclusive urban futures.

**REIMAGINING CITIES: THE ROLE OF COMMUNITIES, EDUCATION, AND CO-BENEFITS**

14:30-14:45

NEST-MF

*YANG GAO, RESEARCH UNIT OF BUILDING PHYSICS AND BUILDING ECOLOGY, TU WIEN, AUSTRIA*

## Work-from-home and residential energy demand: A machine learning analysis for Swiss households

The COVID-19 pandemic has accelerated the global adoption of hybrid working strategies, with work-from-home (WFH) becoming a prevalent practice post-pandemic (PayScale, 2024). While these shifts significantly affect energy systems, existing research largely focuses on commuting and office energy use, with limited attention to residential energy consumption (Hook et al., 2020).

Switzerland's residential sector accounted for over 30% of total energy demand (2000-2022), ranking as the second-largest consumer after transportation (ODYSSEE-MURE, 2025). The post-pandemic surge in WFH adoption since March 2020 has fundamentally altered traditional consumption patterns. However, the quantitative relationship between household characteristics and WFH-associated energy consumption patterns in Swiss residential buildings remains poorly characterized.

This study addresses these shortcomings by developing a machine learning approach to evaluate the impact of WFH on energy demand patterns of Swiss households. The study builds on questionnaire data of 2000 households from the city of Winterthur, with the aim of addressing three key research questions:

1. What sociodemographic factors make people more likely to work from home, and how do different sociodemographic factors influence the behavior of working from home?
2. What are the energy use patterns associated with working from home?
3. How do different household characteristics with different frequencies of WFH exhibit different energy use behaviors, and what impacts do these behaviors have on energy consumption?

The method of this study is based on machine learning approaches including regression and clustering algorithms to quantify heterogeneous WFH energy relationships across different household types. Practically, the findings provide critical insights into how evolving WFH trends impact energy systems, supporting evidence-based decision-making for Switzerland's Energy Strategy 2050 through identifying target groups for energy efficiency interventions and grid flexibility measures. In advancing both methodological frameworks and policy insights on WFH-energy systems, this study not only bridges critical knowledge gaps but also provides actionable foundations for Switzerland while offering scalable solutions for future sustainable energy planning worldwide.

**REIMAGINING CITIES: THE ROLE OF COMMUNITIES, EDUCATION, AND CO-BENEFITS**

14:45-15:00

NEST-MF

*KEVIN KIMWELLE, SCHOOL OF EXPLORATIVE ARCHITECTURE, SOUTH AFRICA*

## Regenerative African Urban Futures through Alternative Design

This presentation explores how alternative design can shape regenerative urban futures in Africa. Grounded in over two decades of interdisciplinary practice—spanning architecture, development studies, business economics, and material technology—it addresses the social, ecological, and economic complexities of rapid urbanisation. It positions design not merely as a technical act but as a civic, collaborative process for inclusive development, ecological resilience, and community empowerment.

*Context:* Africa is urbanising rapidly, much of it through informal, underserved settlements. Conventional, top-down planning often ignores the agency, resourcefulness, and embedded knowledge of these communities—producing fragmented urban systems and deepening inequalities. A paradigm shift is required: to see cities as evolving, co-produced systems. Alternative design offers a responsive framework that integrates local realities into forward-thinking urban development.

*Method / Approach:* The work applies a transdisciplinary Research, Development, and Innovation (RDI) methodology grounded in:

Alternative Materials & Technologies: Using recycled, local materials to reduce carbon impact and improve affordability

Community-Centric Design: Participatory approaches that empower residents as co-designers.

Circular Economy Logics: Embedding regenerative, resource-efficient principles into the urban fabric.

This approach is iterative, relational, and site-responsive, attuned to the socio-material dynamics of each context.

*Case Studies*

1. Food Pavilion, V\&A Waterfront (Cape Town): Built from 98% recycled construction waste, the pavilion reimagines public space through circular, low-carbon architecture.
2. House Selinah (Isuzu House): A low-cost housing prototype made with 90% repurposed motor vehicle parts, merging sustainability, affordability, and cultural specificity.
3. Joe Slovo Community Project (Port Elizabeth): Created with 80% community-mapped waste materials, this climate-resilient infrastructure was co-designed with local stakeholders and global partners.

Each demonstrates the power of design to drive material innovation, participatory governance, and spatial justice - challenging extractive, top-down models of development.

*Impact / Recognition*

These initiatives have garnered international acclaim, including multiple South African Institute of Architects awards and a nomination for the 2024 Barcelona Construmat Awards. They have been featured in The Guardian, CNN, and Deutsche Welle, and have contributed to academic discourse on design for social transformation.

**GRIDS, NETWORKS, FLEXIBILITY AND RESILIENCE**

13:45-14:00

VE 102

*NIKOLAOS SAVVOPOULOS, RESEARCH CENTRE FOR ENERGY NETWORKS ETH ZURICH (FORSCHUNGSSTELLE ENERGIENETZE - FEN), SWITZERLAND*

## Flexibility-aware planning of electricity distribution network reinforcements

The increased penetration of distributed energy resources (e.g., solar PVs), and electrification of demand for heating and mobility results in higher loading of the medium- and low-voltage electricity distribution networks, often beyond their design limits. Electricity distribution utilities need to anticipate this evolution and take timely actions to ensure that the new flow patterns can be accommodated by their networks. That is, under all operating conditions, (i) network components (transformers, cables, lines) shall not be overloaded, and (ii) nodal voltages shall lie within acceptable limits.

Clearly, network reinforcements and/or network expansion are the ultimate ways of ensuring operational feasibility. However, such actions are associated with the following challenges:

1. They are costly. Especially if the expansion investments are not properly coordinated, with each other but also, potentially, with other infrastructure investments.
2. They need time until they are materialized. Hence, they need to be planned well before the problems appear.
3. Since the appearance of network problems is heavily dependent on the investment choices of the end customers, the utilities face a high degree of uncertainty.

A potential (provisional or permanent) alternative to network reinforcement is for a utility to set up mechanisms allowing it to procure flexibility services from its customers, so that network violations are managed by actively engaging all the network resources. End-customer flexibility could be provided either by controlling the active and reactive (P/Q) injections or withdrawals of customers' active components, such as PV inverters, batteries, or chargers of electric vehicles (EV), or by time-shifting the customers' demand for electricity (or simply reducing it at a given moment).

As a matter of fact, there is increasing regulatory pressure on electricity distribution utilities to also consider end-customer flexibility potential into their network planning processes. However, such a consideration faces the challenge that, while a network hardware investment is a measurable action completely at the hands of the utility, reliance on availability of customer flexibility is difficult for a utility to quantify (especially as part of its long-term planning process).

We will present a methodology for "flexibility-aware distribution network planning" used in projects with Swiss electricity utilities. Results from selected such projects will be presented, and general findings will be articulated. In a nutshell, the method consists of an algorithm which iterates between (i) solving the network power flow equations, (ii) identifying required grid reinforcements and (iii) utilizing the flexibility resources to alleviate network violations. It is applied in scenarios corresponding to different evolution pathways of electrification of heating and mobility, and PV penetration in a district, municipality, or neighborhood.

**GRIDS, NETWORKS, FLEXIBILITY AND RESILIENCE**

14:00-14:15

VE 102

*HENNING WIGGER, DLR - INSTITUTE OF NETWORKED ENERGY SYSTEMS, GERMANY*

## Integrating sustainability and resilience aspects into the assessment of power systems in urban futures

The transition of the energy system is characterized by the trends of decarbonization, digitization, and decentralization in order to achieve the agreed Paris climate goals. Since the majority of measures are established at an urban grid level, the grid planning has not only to consider aspects of security of supply, but also apply a more holistic view on the selected alternatives, matching economic, environmental, and social requirements for future urban system designs. Even though both sustainability and resilience are relevant, they are often separately considered in studies, potentially leading to inefficient system designs. For instance, higher environmental costs may be accepted for only a marginal improvement of the security of supply. Therefore, this contribution proposes a framework for the integrated assessment of resilience and sustainability of power systems by using deterministic simulation and life cycle approaches (Netz et al. 2023). The framework is applied to a low voltage reference grid assuming various disruptive events, different penetration shares of electric vehicles, photovoltaics and battery energy storages systems at household level as well as grid storage solution in several energy system scenarios. It was shown that trade-offs between resilience and sustainability aspects have to be considered in system designs, because the improvement of system's resilience can reduce the overall sustainability at the same time. In future studies, particularly at an urban context, it is recommended not only to include resilience, but also sustainability aspects into decisions on system designs weighing the benefits and drawbacks against each other, especially in terms of material resource efficiency for resilience measures.

Netz, Henrik und Schönwandt, Ingo und Wigger, Henning und Brand-Daniels, Urte und Lichte, Daniel und Vogt, Thomas (2023) Integrating sustainability and resilience aspects into power system technology assessments. In: 2023 IEEE PES Innovative Smart Grid Technologies Conference Europe, ISGT-Europe 2023. 2023 IEEE PES Innovative Smart Grid Technologies Conference Europe, 2023-10-23 - 2023-10-26, Grenoble, Frankreich. doi: 10.1109/ISGTEUROPE56780.2023.10407277 .

**GRIDS, NETWORKS, FLEXIBILITY AND RESILIENCE**

14:15-14:30

VE 102

*ALEXANDER FUCHS, ETH ZURICH, SWITZERLAND*

## GridPLAN & BOMES: Geometric planning and Bayesian optimization of multi-energy grids

Most of the available work on green-field or brown-field energy grid planning relies on exact methods, often based on mixed-integer linear programming. While these methods offer elegant mathematical formulations and optimality guarantees, they often provide poor scalability properties. As realistic case studies may consist of tens of thousands of nodes, exact methods do not present a valid alternative. In addition, many approaches optimize the design of energy grids by choosing from a predefined set of candidate lines, without considering the possibility of allocating intermediate nodes or choosing new routes.

We present a new method that breaks the combinatorial complexity of designing new energy grids, leveraging two distinct general methods and tailoring them to the urban energy system design task.

First, a new scalable heuristic for geometric energy planning (GridPLAN) is presented. The method robustly finds a locally cost-optimal grid design by clustering the energy demand nodes and building a hierarchical network of Steiner trees. Using the example of (but not limited to) urban heat grids and established industry design criteria, the algorithm determines the best path to transport heat between different sources to the end customers and aims to minimize the grid costs per unit of energy delivered. The algorithm, that has been demonstrated for problems with tens of thousands of households in the city of Zurich, also accounts for resilience constraints to ensure that the planning result is secure against the outage of critical pipelines as well as uncertain demand.

GridPLAN involves many tuning parameters, like the cluster radius or the location and size of the heat sources, that cannot be searched and optimized exhaustively with the geometric planning algorithm. Therefore, a second method is leveraged, using Bayesian optimization for multi-energy system planning (BOMES) to perform high-level tuning. The algorithm builds a surrogate model to probe the design space and select the next candidate point using an acquisition function. BOMES thereby reveals surprising insights and design choices, but most importantly, drastically reduces the number of tuning iterations.

We are excited to present GridPLAN and BOMES, previously developed in independent projects, for the first time in joint action! The combined method is applied to the municipality of Losone, in the southern part of Switzerland, demonstrating the practicality of the tool for the holistic energy system planning with real-world design constraints. The quantitative results propose a lifetime cost-optimal combination of centralized heating with a regional heat grid, decentralized heating, electricity supply, and RES integration. The method and results are made available for exploration through an interactive graphical web-based visualization.

**GRIDS, NETWORKS, FLEXIBILITY AND RESILIENCE**

14:30-14:45

VE 102

*JOSE PABLO CHAVES AVILA, COMILLAS PONTIFICAL UNIVERSITY, SPAIN*

## Flexibility opportunities and regulations for distributed resources in the EU countries

The energy transition in the European Union (EU) is deeply reshaping the traditional roles within power systems, driving a shift from centralized generation to a model increasingly reliant on distributed energy resources (DERs). This evolution introduces new opportunities for flexibility, as DERs such as rooftop photovoltaics, electric vehicles, battery storage, and smart appliances can respond dynamically to system needs. However, unlocking this potential depends not only on technological capabilities but also on the development of appropriate regulatory frameworks and market designs that can support their integration.

The presentation explores the current landscape of flexibility opportunities for distributed resources across EU Member States, focusing on how regulation either enables or constrains their active participation in electricity markets and system services. References to selected countries, such as Spain, the UK, Italy, and the Netherlands, highlight differences in grid codes, network tariffs, flexibility platforms, and aggregation models. Emphasis is placed on the extent to which current regulatory arrangements permit distributed flexibility to be accessed by Distribution System Operators (DSOs) and Transmission System Operators (TSOs), and on the mechanisms used to procure and remunerate these services.

The EU-level legislative framework provides a common reference point for Member States, especially through the Clean Energy for All Europeans Package and its key legal instruments, including the Electricity Directive (EU) 2019/944 and the Electricity Regulation (EU) 2019/943. Further, Network Codes such as the one under development on Demand Side Response (NC DSR) and methodologies for Flexibility Needs Assessment aim to harmonize and facilitate cross-border and local flexibility services. However, implementation varies significantly at the national level. For instance, while some countries have launched local flexibility markets and DSO-TSO coordination protocols, others remain at early stages of experimentation or rely on rigid cost-based network planning processes.

The paper also discusses the role of regulatory sandboxes, pilot projects, and EU-funded initiatives (e.g., OneNet, BeFlexible, CoordiNet) in accelerating the learning curve and identifying practical barriers to flexibility uptake. Based on this empirical evidence, we propose a set of policy recommendations to improve regulatory alignment, reduce entry barriers for aggregators, and ensure fair cost allocation mechanisms.

**GRIDS, NETWORKS, FLEXIBILITY AND RESILIENCE**

14:45-15:00

VE 102

*MICHEL OBRIST, EMPA, SWITZERLAND*

## The potential of cost-optimal demand-side flexibility in pharmaceutical industry clusters

The contribution of the industrial sector to reach climate and energy efficiency targets is essential. One technique that allows higher penetration of renewable electricity generation in the grid is demand-side management (DSM). Additional benefits from DSM include the economic benefit for the consumer, which is to profit from low electricity prices, and the better utilization of the existing infrastructure. However, the potential demand response from industry in general, and from the pharmaceutical industry in particular, is still unexplored. The present study approaches this research gap by implementing a mathematical formulation of load-shifting to the district energy system modeling tool EhubX. With this novel model, a real-world pharmaceutical cluster is analyzed. The results show that with day-ahead refrigeration and compressor load scheduling at selected industrial sites, electricity costs can be cut by 1.5% to 9%. However, a business case for the companies and the corresponding regulations must be implemented to exploit this potential.

**JUSTICE, EQUITY AND URBAN GOVERNANCE**

13:45-14:00

LB

*WANYUN LING, RWTH AACHEN UNIVERSITY, GERMANY*

## Data-driven circularity: Visualizing urban heat inequity for just green transitions

Urban green infrastructure is increasingly recognized as a tool for climate adaptation and social well-being. However, green transitions risk reinforcing spatial inequities if they are not informed by data on who benefits—and who is left behind. This presentation introduces a research project that uses interpretable machine learning models (XGBoost and FCN-GNN) to quantify and visualize urban heat exposure across different sociodemographic groups in major North American cities. By integrating spatial datasets (NDVI, land use, building density) with social vulnerability indicators and road network patterns, the study reveals how environmental burdens are unevenly distributed and identifies design scenarios that mitigate both heat and inequality. The project also incorporates social media network analysis to map local discourse on climate and environmental justice, offering a participatory layer to the data-driven process. The findings demonstrate how open data, spatial analysis, and digital tools can support circular, inclusive, and adaptive planning frameworks that work across human and ecological dimensions.

**JUSTICE, EQUITY AND URBAN GOVERNANCE**

14:00-14:15

LB

*ANOUSHKA KOLAHALU, POLITECNICO DI MILANO, ITALY*

## Integrative infrastructure planning in Al Muhaisnah 2: A multiscalar approach to urban resilience and social equity

In Dubai's rapid urban expansion, Al Muhaisnah 2 emerges as a site for integrated infrastructure planning. This labour housing district for low-income migrant workers has evolved into a dense residential area severed from the city by grey infrastructural networks and a lack of ecological connections. With a predominantly male (99%), transient population and limited access to social infrastructure, the district's residents remain systemically excluded from Dubai's socio-economic fabric and opportunities.

This research proposes a strategic urban framework for integrated infrastructural planning of mobility, biodiversity, economic opportunity, and participatory governance. Through a multi-scalar, cross-disciplinary lens, the paper links the hyperlocal conditions of Al Muhaisnah 2 to wider urban systems incorporating GIS and participatory digital tools to inform spatial equality. These tools support collaborative planning, empowering local voices in identifying infrastructural deficits and opportunities for adaptive spatial interventions.

The proposal reimagines infrastructure as a support network, ecologically and socially. Ecologically, inclusive green infrastructure regenerates native biodiversity, combats heat-island effect, and rewilds degraded voids; socially, interventions legitimise informal economies and small-scale entrepreneurship through adaptive zoning and micro-finance platforms. Initiatives including cooperative kitchens and street vendors diversify income and reduce dependency on private employers.

The research identifies discrepancies in infrastructure between low-income residents and adjacent government compounds, proposing integrated mobility solutions in reconnecting isolated road systems, strengthening public transport, and de-privatising informal transit modes (shared vans and minibuses). These strategies foster physical connectivity and equitable access to opportunities across the district's 110,000 residents.

Grounded in the UN Urban Agenda, Lefebvre's "Right to the City," and social life theory, the paper critiques the spatial neglect of Al Muhaisnah 2 as a threat to urban resilience. Emphasising the need for social infrastructure in schools, cultural spaces, and inclusive landscapes in housing policies. A multi-scalar policy framework is proposed to coordinate planners and communities through participatory design charrettes, local councils, and digital systems. These mechanisms codify access to housing, mobility, and public space as enforceable rights rather than speculative allowances.

Advocating for radical redefinition of infrastructure as a physical resource, a medium of inclusion, ecological continuity, and political imagination, with the case for infrastructural planning that is not only integrated but integrative: embedding marginalised populations and neglected ecosystems into the core of Dubai's urban infrastructure planning for the future, advancing climate resilience, social cohesion, and economic plurality.

**JUSTICE, EQUITY AND URBAN GOVERNANCE**

14:15-14:30

LB

*JULIET CHIKA CHINEMELU, AKANU IBIAM FEDERAL POLYTECHNIC UWANA AFIKP NIGERIA, NIGERIA*

## Resilient cities, inclusive futures: Rethinking affordable housing in African cities

As African cities rapidly urbanize, the lack of inclusive and affordable housing exacerbates social inequality, environmental vulnerability, and informal urban expansion. This presentation explores the intersection of urban resilience and housing justice by examining the structural barriers and policy gaps that hinder affordable housing delivery in cities like Lagos and Nairobi. Drawing on original PhD research, the study uses spatial data analysis, stakeholder interviews, and policy reviews to assess how urban governance frameworks influence housing outcomes for low-income communities.

The findings reveal that while resilience is often discussed in relation to climate change and infrastructure, housing must be central to the resilience agenda. The presentation advocates a shift toward a value-chain approach to affordable housing that integrates land reform, participatory planning, finance accessibility, and climate-smart design. It also highlights innovative practices in digital mapping and citizen engagement that can make housing policy more transparent and responsive.

By reframing affordable housing as both a human right and a tool for resilient urban futures, this presentation offers actionable insights for policymakers, planners, and development actors. It calls for governance models that prioritize equity, community-led upgrading, and data-informed planning to ensure that no one is left behind in Africa’s urban transformation.

**JUSTICE, EQUITY AND URBAN GOVERNANCE**

14:30-14:45

LB

*GRACIA BRÜCKMANN, UNIVERSITY OF BERN, SWITZERLAND*

## The effect of global environmental justice on preferences for the location of climate policy implementation

Given climate change, all countries must reduce their greenhouse gas (GHG) emissions. Opposition towards domestic climate policies in high-income, high-emission countries makes emission reductions in developing countries, where the cost-efficiency of climate policy is higher, more attractive. While high-emitting countries reduce emissions, even counting towards domestic decarbonization goals (Paris Agreement, Art. 6), developing countries generate revenues through selling these abatements and materializing local benefits, such as better local air quality. As one example, local air quality increases are of high interest for urban areas, which are growing globally, especially in developing countries.

So far, few countries have used international transfers of mitigation outcomes, often attributed to home bias, doubts about the effectiveness of projects implemented abroad, or environmental justice, as all countries share differentiated responsibilities. Currently, Switzerland is one of the first countries to reduce its domestic GHG emissions abroad to meet its climate goals under the Paris Agreement. While Switzerland's emissions in the transport sector are only slowly decreasing, Switzerland also reduces its GHG emissions by replacing fossil-fueled buses with battery-electric buses in Bangkok, Thailand.

This study shows how environmental justice considerations shape public preferences for emission reductions abroad. A large-scale (n=1500) survey experiment performed in Switzerland examines how environmental justice considerations shape public support for policies to achieve climate goals through domestic implementation or implementation in a developing country, vis-à-vis support for climate aid (supporting developing countries with their effort to mitigate and adapt to climate change). Studying the prominent differences between the preferences of urban and rural dwellers in Switzerland provides essential insights to policymakers and scientists on how preferences for locations of decarbonization policies are shaped.

**JUSTICE, EQUITY AND URBAN GOVERNANCE**

14:45-15:00

LB

*VANJA DJINLEV, EMPA, SWITZERLAND*

## When Systems Decide: Infrastructure, Justice, and Agency

Infrastructures are often considered to be neutral technical systems or passive channels for delivering energy services. However, in the context of heating, infrastructure plays an active role in shaping who can participate in the energy (heating) transition, who benefits, and who is excluded. This presentation critically examines the politics of heating infrastructure, arguing that justice is embedded and may therefore be denied through the system's design.

Drawing on qualitative research conducted across eight European countries, the study compares individual heating systems (such as heat pumps and boilers) with collective systems (including district heating and thermal energy communities). While collective systems can promote efficiency and equity, they might limit user autonomy and transparency. In contrast, individual systems offer flexibility but may exacerbate exclusion and energy poverty by shifting responsibility and financial burden onto households with unequal capabilities.

Framed through the lenses of Energy Justice and the Capability Approach, the analysis highlights how infrastructures both reflect and reproduce patterns of (in)justices. Achieving a just heat transition requires recognizing that infrastructure does not simply enable change, but it determines whose futures are possible.

**MODELING TOOLS AND TECHNOLOGY FOR URBAN INNOVATION**

13:45-14:00

VE 202

*BETTINA STEURI, CLIMATE SERVICE CENTER GERMANY (GERICS), HELMHOLTZ-ZENTRUM HEREON GMBH, GERMANY*

## From Prototype to Practice: Key Enablers in Operationalising the Urban Climate Model PALM-4U

Cities worldwide face growing pressure to adapt to climate change while maintaining livability, social equity, and resource efficiency. Urban climate models can be powerful tools to support evidence-based decision-making, yet they often remain locked within academia. This contribution shares the transformative journey of PALM-4U, a high-resolution turbulence-resolving climate model, from a transdisciplinary research project to a practice-oriented product now entering operational use.

PALM-4U is now making the rare transition from an academic research project to an operationalized product, ready to become an integral part of urban planning processes. Co-developed over the past years with municipalities, planners, and researchers using a Living Lab approach, the model was shaped to ensure that scientific rigor meets real-world needs through iterative, user-centered development. As PALM-4U moves beyond its initial funding and development phase, a structured continuation strategy has been launched. This includes a centralized service desk, a growing community forum, a dedicated user and development hub, and coordinated capacity-building measures. Together, these efforts aim to support long-term use, foster innovation, and secure the institutional embedding and sustainability of this complex modelling tool.

This contribution offers insights into what it takes to embed a complex scientific model in practice: not just technological readiness, but also governance models, service infrastructure, and trust-building among stakeholders. It will reflect on key success factors, remaining challenges, and the potential of PALM-4U to become a cornerstone of climate-resilient urban planning in Germany and beyond.

By sharing our experience, we aim to contribute a forward-looking example of how research-driven tools can be transformed into operational services that empower cities to act. Our perspective bridges science and practice, and we seek dialogue with fellow innovators working across disciplines to shape the future of urban sustainability. Together, we can explore how to turn scientific insight into urban impact.

**MODELING TOOLS AND TECHNOLOGY FOR URBAN INNOVATION**

14:00-14:15

VE 202

*CHRISTOPH WAIBEL, FLEMISH INSTITUTE FOR TECHNOLOGICAL RESEARCH (VITO), BELGIUM*

## On future envelope construction: Robots and people

The built environment is a major contributor to global pollution and resource consumption, a well-known fact that is being addressed by renewable energy technologies and energy efficiency measures. Furthermore, it is increasingly being recognized that barriers on the uptake of such technological measures are not only to be found in techno-economic reasons, but are often (if not mainly) of societal and behavioural origin. What is somewhat less widely communicated though is the fact that the construction sector is one of the most dangerous sectors to work in, with a worldwide shocking three times higher risk to be killed at as a construction worker than a worker in other occupations (EU-OSHA).

In this short talk, the aforementioned themes, 1) energy design, 2) the peoples' dimension and 3) safety are connected by presenting recent research on Construction Robotics and Innovative Building envelopes (CRIB), focussing on low to mid-rise building renovation, due to its significance in the European context. The starting point is given with novel AI- and Computer Vision-driven methods for generative façade design that enable automation in prefabrication and mass-customization, satisfying the need for individualized yet affordable aesthetics. The peoples' dimension is addressed through insights from the EU "OpenLab" project, a large-scale living lab initiative for Positive Energy Neighbourhoods across Europe. Here, stakeholder interaction and public and private engagement proved vital in identifying successful implementations, as well as outlining challenges around user acceptance, expectation management, bounded rationality, and other behavioural factors. The next generation of building renovation processes is ushered by autonomous construction robotics: Novel systems will be presented that are developed as part of three EU projects on PV panel disassembly and recycling, non-sequential prefab panel installation, and autonomous self-positioning and anchoring systems for façade panels – technology aimed at improving construction efficiency but also worker safety. The talk will conclude with a forward-looking perspective on envelope innovation that is unlocked by automation and AI, and hypothetical glimpses into the near future of a robotized construction sector.

**MODELING TOOLS AND TECHNOLOGY FOR URBAN INNOVATION**

14:15-14:30

VE 202

*PHILIPPE BUCHECKER, ETHZ FEN, SWITZERLAND*

## ReSIM: A simulation platform for urban energy systems

ReSIM, a district-level multi-energy system simulation framework and collaboration platform, developed by the Research Center of Energy Networks of ETHZ will be presented, with emphasis on key functionalities, ways of utilization and specific examples.

ReSIM is a modularly designed software which allows to build digital prototypes of studied energy systems. Using ReSIM, an urban energy system designer can put together, in a consistent manner, all aspects of the designed system that are required for the investigation, such as (i) physical models of all the involved components and sub-systems, (ii) control algorithms and other operational rules, (iii) timeseries/profiles of energy demand and renewable generation, (iv) timeseries of prices of energy carriers, tariffs, etc.

ReSIM's strength lies in its software architecture, which enables a seamless integration of models and other inputs from a plurality of sources, each contributing an expertise into the overall picture. This makes ReSIM a well-suited collaboration platform, between different research groups, industry partners (such as technology and solution providers, or network operators) and software users (such as urban energy system designers). Overall, ReSIM features a selection of component and network models, control algorithms, and an archive of demand and renewable generation data. The software can interconnect with other software tools if needed. It is highly modular and open for the addition of new models, algorithms, and data.

ReSIM has been utilized as the base platform in a range of case studies, a selection of which will be briefly described in this presentation. An indicative list of such case studies is provided below:

- Study of scenarios with high penetration of rooftop PV, electromobility and heating by means of building-level heat pumps for a municipality low voltage distribution network. Emphasis on the thermal modelling of the buildings and the appropriate control of heat pumps for provision of flexibility without compromise of the customers' comfort. In this study, which was a collaboration between groups from ETHZ, Empa and HSLU, ReSIM is used as the platform to integrate models of electricity networks, buildings and heat pumps, software tools for solving the electricity power flow equations, and data representing passenger mobility, solar irradiance, base electricity demand, and ambient temperature. The study is performed in the context of SWEET PATHFNDR.
- Study of the provision of heat by means of a district heating system, featuring large-scale heat pumps, water thermal energy storage, electrolyzers, hydrogen storage and fuel cells. The associated models, provided by a collaboration between groups in ETHZ, HSLU and PSI, are integrated via ReSIM. The resulting operation of the system under different configurations is emulated and design-related findings (such as required dimensioning of technologies) are derived. The study is performed in the context of SWEET PATHFNDR.

**MODELING TOOLS AND TECHNOLOGY FOR URBAN INNOVATION**

14:30-14:45

VE 202

*TURHAN DEMIRAY, ETH ZURICH, SWITZERLAND*

## FlexECO: A multi-energy optimal dispatch and planning software tool

The Research Center for Energy Networks of ETHZ has developed a software tool (FlexECO) which enables to model an energy system in a “sector coupled” manner. FlexECO is an optimization tool which allows to represent a set of different energy carriers, energy conversion and storage technologies, energy users and energy resources in one single problem formulation. It performs an optimal dispatch of these technologies over a user-defined time horizon. FlexECO is a very efficient software, written in C, which is used on a computer cluster to solve large problems in a time-efficient manner.

FlexECO is a highly modular tool, which is used for multi-energy system modelling and optimization at the entire chain, from large-scale inter-continental modelling, where the representations are aggregated at country or transmission node level, down to modelling of local systems, such as cities and neighborhoods, where each individual component and energy sector is represented in the model. The optimization performed in FlexECO can simultaneously consider energy carriers such as electricity, heat, methane and hydrogen, energy storage, conversion among energy carriers, as well as demand side flexibility. By means of FlexECO, an optimal system operation or planning can be performed, considering all synergies and trade-offs.

This presentation will illustrate uses of FlexECO in optimization-based multi-energy system analyses, by presenting results from two types of analysis with reference to previous projects: a small-scale system, with a quartier modelled as an “energy hub”, and a large-scale system, where cities are aggregated to come up with general country-level findings.

The first case will illustrate the study of a quartier, modelled as a system with local sources of electric energy and of heat exchange, different types of local energy demand, such as heating and cooling at different temperature levels as well as electricity demand for various uses, as well as the capability for local thermal energy storage. This modeled quartier is connected with utility-scale distribution of electricity and heat. The multi-energy analysis will identify which energy carriers are more worthwhile to invest in and how sector coupling can be of value at local scale.

In the second case, the modelling will focus on country-level representation, where FlexECO will be used to identify optimal coordination between three interconnected energy systems: electricity, methane gas, and hydrogen. In this case, these three systems are modelled in a coupled manner, hence allowing for optimal conversions among them. The multi-energy analysis will illustrate how, and under which conditions, these three systems complement each other, providing flexibility and energy storage capabilities in a coordinated manner.

**MODELING TOOLS AND TECHNOLOGY FOR URBAN INNOVATION**

14:45-15:00

VE 202

*MICHAEL WETTER, LAWRENCE BERKELEY NATIONAL LABORATORY, BERKELEY, CA, UNITED STATES*

## Digitalized design-build-deploy-operate based on platform based design and emerging ASHRAE Standards 231P and 223P

Designing grid flexible energy systems to heat, cool and power communities of buildings entails complex sequential decision making. Today's process often leads to suboptimal system architectures and problematic installations that can take years to get to operate robustly.

We present a design process called Platform Based Design that structures this decision making sequentially into discrete layers,

starting with high levels of abstractions and progressing toward high level of design refinements. The high abstractions are used early on to keep model complexity tractable for multi-objective optimization, the output of which will quantitatively compare performance of candidate solutions. These solutions are then refined to verify design and control using detailed dynamic Modelica simulations of the energy and control systems that includes physics and dynamics that were not present in higher-level decision making. The control implementation is such that control logic in the model complies with ASHRAE Standard 231P. This enables a fully digitalized, performance based design-build-install process using the open Modelica standard and an emerging ASHRAE standard.

We present this workflow based on a feasibility study of an energy system that serves around 20 buildings. The study compares decentralized solutions with a 5th generation combined heating and cooling system using Mixed Integer Linear Programming. The best suited solution is then de-risked using detailed dynamic Modelica simulation and verification.

Tuesday, September 2nd, 2025

## Poster Sessions

AKADEMIE FOYER

Poster session 3:
10:15 – 10:45 AM

Poster session 4:
15:00 – 15:30

| September 2, 2025 | | |
|---|---|---|
| Time | Presentation title | Presenter |
| | Poster Session 3 | |
| 10:15-10:45 | Why are we still not retrofitting? A systemic review of barriers and enablers for urban-scale energy retrofits | *Hossein Jadidi, Concordia University* |
| | Kypseli superblock: A multi-scale vision for climate adaptation, social inclusion & urban livability in Athens | *Yeseul Choi, Luna Michalea Dutli, Ronan Carvill, Victoria Mosquera Barros, Wonbin Lee, Vanda Keom, Xuan Ng, University of Geneva* |
| | A transnational NbS network of cities and followers – the GreenScapeCE experience | *Rita Martino, ALDA+ SRL Benefit Corporation SB* |
| | Activation of social potential through environmentally sound strategies: A case study of courtyards in the Kypseli Neighborhood, Athens | *Nadezda Bobyleva and Ronan Carvill, University of Geneva* |
| | Poster Session 4 | |
| 15:00 -15:30 | Waste heat utilisation from edge data centres integrated in tertiary buildings | *Anna Jenny Hansson* |
| | Eco-district “Les Plaines du Loup”: Achieving urban sustainability and equity through experimentations | *Valérie Randon, City of Lausanne* |
| | Integrating the design and operation of energy systems | *Cara Koepele, Empa* |

**POSTER SESSION 3**

10:15-10:45

*HOSSEIN JADIDI, CONCORDIA UNIVERSITY, CANADA*

## Why Are We Still Not Retrofitting? A Systemic Review of Barriers and Enablers for Urban-Scale Energy Retrofits

Energy retrofitting—particularly deep energy retrofitting (DER)—is essential for decarbonizing the built environment. Yet, cities continue to experience low adoption rates, even when retrofits are technically viable and appear financially beneficial. This poster presents the findings of a structured literature review investigating the systemic barriers and enabling conditions for DER in urban settings, focusing on three key dimensions: finance, policy, and uncertainty.

Key challenges identified include: financial barriers such as high upfront investment requirements, limited access to long-term financing, and perceived risk of poor returns; policy misalignment and fragmentation across municipal, provincial, federal, and utility levels, often coupled with administrative burdens and program uncertainty; and decision-making under uncertainty, with volatile energy prices, uncertain performance outcomes, and evolving regulations all discouraging action.

The methodology involves a review of over 100 peer-reviewed articles, technical reports, and program evaluations, analyzing financial mechanisms, policy design, and risk modeling approaches to develop a conceptual framework linking adoption barriers and systemic enablers.

Emerging opportunities include: innovative financing tools such as credit enhancements, ESCO models, and probabilistic cash flow modeling (e.g., Monte Carlo simulations); integrated policy-finance frameworks that streamline access and align incentives across levels of government; and decision-support systems that incorporate uncertainty modeling (e.g., real options analysis, Bayesian updating) to inform and empower stakeholders.

Conclusions and recommendations: accelerating urban retrofitting requires a systems approach that combines financial innovation, adaptive policy, and robust uncertainty modeling. Cities should develop unified decision-support platforms and leverage climate action plans to convert marginal retrofits into viable investments. This work supports the transition from fragmented efforts to coordinated, high-impact strategies for energy retrofitting in the built environment.

**POSTER SESSION 3**

10:15-10:45

*YESEUL CHOI, LUNA MICHALEA DUTLI, RONAN CARVILL, VICTORIA MOSQUERA BARROS, WONBIN LEE, VANDA KEOM, XUAN NG, UNIVERSITY OF GENEVA, SWITZERLAND*

## Kypseli superblock: A multi-scale vision for climate adaptation, social inclusion & urban livability in Athens

Athens faces acute urban challenges amplified by climate change, including an intensifying urban heat island effect, increasing water scarcity, and weakening social cohesion. To address these complex urban challenges, this interdisciplinary project proposes the implementation of the superblock model in the Athenian neighborhood of Kypseli. The project is structured around four scales: community, streetscape, voids, and buildings.

*Community*

At the community level, this project analyzed how people experienced the area, where they preferred to socialize, and the main challenges they faced daily. It did this through surveys and interviews within the planned superblock, gathering insights directly from residents and local business owners that would be affected by the implementation of a superblock. The goal was to understand not only patterns of socialization and space use but also how diversity, green spaces, and gentrification impacted daily life, always taking into account the locals' opinions.

*Streetscape*

Streetscape design interventions can improve livability, walkability, and sustainability within Kypseli's dense urban fabric. There are several urban challenges: narrow sidewalks, car dominance, lack of greenery, and low-quality infrastructure. The goal is to analyze these conditions using a combination of GIS mapping, traffic counting, surveys, and demographic estimations. Data sources included OpenStreetMap(OSM) and ELSTAT, and direct observation. In response, we propose pedestrian-first improvements: sidewalk widening, increased tree planting, strategic placement of street furniture, and green infrastructure. These interventions are designed to enhance comfort, accessibility, and social interaction within the public realm.

*Voids*

The courtyards were found to have high potential for climate adaptation through the establishment of microparks and through their natural passive cooling microclimate characteristics, which can address the urban heat island effect. In addition, they could be used to enhance social connectivity and create entirely new social/cultural spaces in Kypseli. We propose the unifying of these fragmented and underutilized spaces and establishing shared community green spaces, micro-blue infrastructure, and rainwater harvesting cisterns.

*Buildings*

The common building type within the chosen superblock is the polykatoikia — a typical Greek-style multiplex housing to accommodate rapid urbanization in vertical layers. Our analysis revealed key challenges: underused external elements, such as rooftops and balconies, limited accessibility, and low social engagement. Our intervention focuses on revitalizing buildings through bottom-up transformation, creating multifunctional rooftop spaces, balconies with greenery, and white coatings to mitigate heat. These interventions support community gardens, participatory design, and renewable systems like solar panels and rainwater collection.

**POSTER SESSION 3**

10:15-10:45

*RITA MARTINO, ALDA+ SRL BENEFIT CORPORATION SB, ITALY*

## A transnational NbS network of cities and followers – the GreenScapeCE experience

The Poster aims at providing a visual representation of the multi-stakeholder engagement roadmap proposed within the GreenScapeCE project and the creation of a transnational NbS network of cities and followers.

The tested solutions and best practices will be the evidence that supports a coherent methodology including appropriate tools. From raise-awareness events targeting public officials or citizens, informative material supporting Citizens to be protagonists of the renaturing of their urban area - DIY Guide - meeting with financing institutions or organizations supporting the access to any funding mechanism. Furthermore communicating to potential replicating cities through a package pitch which includes tools, knowledge and tested solutions. Finally disseminating a space for the co-creation: the GreenScape CE Visual Mapping Platform: an interactive map-based platform designed to support the development of pilot actions in the five pilot areas. The platform provides three tools: accessibility, NbS and connectivity and is accessible here: https://greenscapece.visualmapping.eu/about/index.html

All these steps are part of the overall strategy aiming at creating a transnational NbS network of cities and followers.

Why NbS: they are addressing urban challenges, such as climate adaptation, biodiversity conservation, and sustainable development, by integrating natural processes into urban planning, and being innovative.

GreenScapeCE experience: The GreenScapeCE Interreg Central Europe Project, co-funded by the European Union, is committed to enabling the wider uptake of NbS in pilot urban areas by strengthening policy learning and multilevel governance structures. The Project focuses on integrating nature-based solutions (NbS) and green infrastructure (GI) in the grey infrastructure in 5 Central European urban areas, significantly affected by aggravating urban heat island effect: Milano Metropolitan Area, Ptuj, Szeged, Warsaw and Zagreb through peer-to-peer learning, transnational capacity building and participatory decision-making.

5 NbS/GI action plans together with a ‘ Joint strategy on Strengthening NbS Implementation in CE’, have been developed so far and are available here: https://www.interreg-central.eu/projects/greenscape-ce/?tab=outputs

Pilot actions using jointly developed solutions are being tested within the pilot cities, focusing on Citizen engagement and co-creation model, Technical and tendering solutions and financing models. The main beneficiaries of the project results are local governments and citizens.

**POSTER SESSION 3**

10:15-10:45

*NADEZDA BOBYLEVA AND RONAN CARVILL, UNIVERSITÉ DE GENÈVE, SWITZERLAND*

## Activation of Social Potential Through Environmentally Sound Strategies: A Case Study of Courtyards in the Kypseli Neighborhood, Athens

Athens faces significant urban challenges in the context of climate change, particularly the intensifying urban heat island effect and growing water scarcity. By 2050, heatwave days in the city are expected to triple, while rainfall may decrease by 12%. In densely populated neighborhoods like Kypseli, these issues are worsened by a lack of green space and widespread soil sealing. Kypseli's compact urban fabric leaves minimal room for parks or tree canopy cover, with green areas accounting for only 2.8–3% of the city. Like much of Athens, the neighborhood offers just 2–2.5 $m^2$ of green space per inhabitant—one of the lowest ratios globally.

One underutilized feature of Athens' urban landscape with high potential for climate adaptation is the network of internal courtyards in residential buildings, or akalyptos. In May 2025, a pilot study was conducted in a subsection of Kypseli, covering 24 courtyards of varying sizes. A methodological framework was established, comparing baseline microclimate simulations with on-site measurements and calibrations. Using ENVI-met software, alternative scenarios were generated incorporating greening strategies to reduce temperatures and achieve Physiological Equivalent Temperature (PET) comfort standards.

Microclimate data collected included air temperature, wind speed, light intensity, and PM2.5 air pollution. Fieldwork also included aerial drone imaging, standard photography, and opportunistic interviews with local residents. Observations covered microclimate, land use, environmental conditions, and morphological characteristics.

The study found that most courtyards are fragmented into small (<10 m) plots, often underused or abandoned. Interviews revealed a lack of cultural or social practices around shared courtyard use. Nonetheless, preliminary microclimate findings showed that courtyards were consistently cooler than adjacent streets by 1–4°C, and also exhibited lower air pollution and light intensity. Vegetation coverage was typically low, and soil sealing was high, with minimal tree canopy present.

Recognizing the overlooked potential of akalyptos, it is proposed to transform these spaces into communal green areas as a first step toward broader social and ecological revitalization. The strategy aims to unify fragmented courtyards into semi-private microparks accessible to block residents climate-resilient sanctuaries featuring enhanced passive cooling.

Key interventions would include soil unsealing, tree planting, and the integration of micro blue infrastructure. Buried rainwater harvesting cisterns would be installed to support greywater use and irrigation during droughts and heatwaves, essential measures in the Mediterranean context.

Through these actions, Kypseli could significantly mitigate heat risks, enhance social cohesion, and serve as a replicable model for climate-adaptive neighborhood transformation across Athens.

**POSTER SESSION 4**

15:00- 15:30

*ANNA JENNY HANSSON, EMPA, SWITZERLAND*

## Waste heat utilisation from edge data centres integrated in tertiary buildings

This study compares two cooling systems in a small-scale data centre integrated into a tertiary building. This comparison is enabled by modelling the different systems using the energy system optimisation tool EhubX, which is used for sizing and operation of energy systems. The air-cooled data centre feeds waste heat into the space heating grid, and the liquid-cooled data centre feeds into the domestic hot water grid. The scenarios utilise different types and sizes of technologies, resulting in higher and lower initial investment costs. The results show that even though liquid-cooling systems' capital expenditure is about 2 times higher than air-cooling, this type of system does not require a heat pump, which decreases the overall system cost compared to air-cooling systems. Using a liquid-cooling system also slightly achieves a higher degree of coverage and a lower payback period. However, this result depends on the cost and efficiencies of the technologies, and further studies should be performed to create even more conclusive results.

**POSTER SESSION 4**

15:00- 15:30

*VALÉRIE RANDON, CITY OF LAUSANNE, SWITZERLAND*

## Eco-district “Les Plaines du Loup”: Achieving urban sustainability and equity through experimentations

For the design of the eco-quartier, the City of Lausanne, through its industrial services (SiL), has set the goal of implementing an efficient heating concept, in line with the objectives of the 2000 watts society. The development of the eco-quartier, has largely benefited from the collaborative support of the local communities. Thermal energy is obtained through innovative vertical geothermal probes 800 meters deep. These are then coupled with heat pumps. In order to supplement the available resource, heat from wastewater is also recovered. To operate these devices, a supply of 100% renewable electricity is planned, partially coming from the photovoltaic solar panels installed on the roof (between 15% and 20%). Substations are linked via an anergy network. This new complex infrastructure based on multiple renewable energy sources using new technologies is being implemented through a contracting model.

**POSTER SESSION 4**

15:00- 15:30

*CARA KOEPELE (1)(2), PHILIPP HEER (2), AND JOHN LYGEROS (1), (1) ETH ZURICH, (2) EMPA, SWITZERLAND*

## Integrating the design and operation of energy systems

The rise of distribution-side energy generation and storage technologies empowers consumers to use energy more sustainably. Designing energy systems for these consumers requires the long-term decision of which devices and their capacities to purchase. Current research decouples the design of these systems from their intended operation. This is because development of the latter is its own branch of research resulting in sophisticated controllers with planning horizons and objectives that differ from the design stage. However, not considering the comprehensive operational behavior may result in oversized or undersized components.

To design energy systems that fully capitalize on their operation algorithms, we will study how to compute energy device sizes to near-optimality for a given control scheme. This can be formally described in a bi-level optimization framework, with the upper level representing the design problem and the lower level containing the operation. Since the design must be optimal over the life of the energy system, the number of decision variables and constraints including the complex operation makes the bi-level problem intractable. The long time span also introduces challenges in characterizing and handling uncertainties in weather and demand forecasts.

Our ongoing research first examines the case of designing an energy system intended to be operated with economic model predictive control (eMPC). As a starting point, we will look into estimating gradients of the upper-level design problem to perform gradient descent, such as in [1], for a linearly modeled energy system. Next, we will explore how stochastic methods can be appropriately implemented on the upper and lower levels of the bi-level formulation. Furthermore, the practicality of expanding this method to mixed-integer design and operation spaces will be investigated. Alternating algorithms between an optimal design problem and true operation to reach a consensus on the design will also be considered. The financial and environmental performance of the developed methods will be benchmarked with real energy systems and existing energy system design algorithms.

Empa
Materials Science and Technology

# PANELS & WORKSHOPS

| September 1, 2025 | | | | |
|---|---|---|---|---|
| Time | Format | Session title | Organisers | Affiliation |
| 10:45-12:00 | Panel | Enhancing Urban Resilience through Nature-based Solutions (NbS): Strategies for Reducing Disaster Risks | Rajeev Issar | UNDP Geneva |
| 13:45-15:00 | Panel | How to establish heavy-duty supply chains for low-carbon housing in Africa's emerging Mega- and Gigacities | Daniel Wyss | Skat Consulting Ltd. |
| 15:30-17:00 | Workshop | "My Neighbourhood": Building energy transition, one neighbourhood at a time | Pinar Caglin | UN-Habitat |
| 15:30-17:00 | Workshop | Shaping the future of urban digital twins in Switzerland | Denisa-Andreea Constantinescu | EPFL |
| 15:30-17:00 | Workshop | Playing with the Business Model Assembler for clean energy urban hubs | Dr. Monica Barroso | University of St. Gallen |
| 15:30-17:00 | Workshop | Bridging the gap: Fostering collaborations between social scientists and engineers for urban systems research | Christine Gschwendtner | MIT |

**PANEL**

10:45-12:00

AKADEMIE

***PANEL:***
RONALD JACKSON (UNDP) (MODERATOR)
MARIANNE KJELLEN (STOCKHOLM UNIVERSITY)
TURAL ALIYEV (EAWAG)
DAVID JACOME-POLIT (ICLEI)
ABISHEK NARAYAN (EAWAG)

***ORGANISER:*** *RAJEEV ISSAR, UNDP GENEVA, SWITZERLAND*

## Enhancing Urban Resilience through Nature-based Solutions (NbS): Strategies for Reducing Disaster Risks

Against the dual backdrop of climate change and rapid urbanization, cities—particularly small and medium-sized ones in the Global South—face increasingly severe risk crises. UNDP has extensive experience in development policy and practice in urban settings. This session explores how NbS can be integrated into urban DRR to enhance resilience.

Participants will focus on two types of risk scenarios—heat/heatwaves and water-induced risks such as urban floods—bringing together experts to explore how NbS, when combined with physical/built infrastructure and tailored to the socio-economic fabric of urban areas, can maximize synergistic outcomes across multiple sectors.

The session also offers grounded insights for urban researchers and provides cross-sectoral perspectives from diverse backgrounds, aiming to address the escalating challenges and generate shared value.

**PANEL**

13:45-15:00

AKADEMIE

**PANEL:**
VINCENT KITIO (UN HABITAT)
JULIET CHIKA CHINEMELU (AKANU IBIAM FEDERAL POLYTECHNIC, UNWANA)
KEVIN KIMWELLE (SCHOOL OF EXPLORATIVE ARCHITECTURE)
ANDREA SAGLIETTE (RIETER MORANDO)
NILS HAVELKA (EPFL)
**DANIEL WYSS (SKAT CONSULTING LTD.)**

***ORGANISER:*** *DANIEL WYSS, SKAT CONSULTING LTD., SWITZERLAND*

# How to establish heavy-duty supply chains for low-carbon housing in Africa's emerging Mega- and Gigacities

Although Africa's urban population will not peak until around 2150, the highest annual demand for construction will already have been reached by 2080. This equates to 400 new housing unit equivalents (HUe) per day in Kigali, 2000 HUe per day in Dar es Salaam and more than 10,000 HUe per day in the Abidjan-Lagos Corridor, and allow 100 medium-scale factories to profitably produce blocks and bricks in Kigali, around 600 in Dar es Salaam, and up to 3500 in the Abidjan-Lagos Corridor.

If most African cities are to be built with storied buildings, up to 80% of these factories will need to be established within the next 30 years. This equates to 2-3 new factories every year in Kigali, 8-12 in in Dar es Salaam and 30-50 between Abidjan and Lagos, allowing numerous technology firms to profitably supply factory and construction machinery, while training centres would train thousands of engineers, production managers and skilled labour.

However, if the industry fails to grow in sync with demand, the supply gap will be filled by informal construction, as is widely the case today. This may result in up to a billion tons of evitable $CO_2$ emissions, in Kigali, Dar es Salaam and the West African corridor alone, as well as social and economic challenges.

Conclusion: The present generation will determine what the future mega- and gigacities will look like and how much greenhouse gas they will emit.

**WORKSHOP**

15:30-17:00

AKADEMIE

***ORGANISER:*** *VINCENT KITIO, YASSINE MOUSTANJIDI, UN-HABITAT*

## "My Neighbourhood": Building energy transition, one neighbourhood at a time

Cities play a key role in driving the energy transition, and this process begins at the neighbourhood scale, where energy use is shaped, daily routines take form, and urban design directly influences behaviour. This training session introduces UN-Habitat's "My Neighbourhood" as a framework for achieving integrated planning throughout the analysis, planning, and transformation phases of urban development. Participants will explore how neighbourhood-scale planning can improve energy efficiency, curb demand, and reduce emissions through coordinated spatial strategies. The session will be supported by case studies from diverse urban contexts, and complemented by a demonstration of the "My Neighbourhood" card game, a participatory tool designed to engage communities, planners, and other stakeholders in strategic thinking around key urban principles (i.e. Compact City, Connected City, Inclusive City, Vibrant City, Resilient City) and how these can combine to create energy-efficient neighbourhoods.

**WORKSHOP**

15:30-17:00

NEST-MF

***ORGANISER:*** *DENISA-ANDREEA CONSTANTINESCU, EPFL, SWITZERLAND*

## Shaping the future of urban digital twins in Switzerland

The UrbanTwin project—led by EPFL, ETH Zurich, EMPA, Eawag, and WSL—is developing a decision-support tool for sustainable urban systems planning to help Switzerland achieve climate neutrality by 2050. The tool integrates research across climate, energy, mobility, water, IT, and social sciences to enable data-driven urban simulations, investment planning, and edge AI sensing. Demonstrators are currently being developed in the City of Lausanne to showcase how the tool can support the creation of resilient, efficient, and livable cities. As the project concludes its research phase, we are seeking input from potential users and stakeholders to refine deployment strategies for long term support and ensure the project outcomes meet real-world needs.

In this workshop, we aim to co-develop a roadmap for deploying the UrbanTwin tool and platforms in a new Swiss city. We will explore strategies for implementing urban digital twins, with a focus on computing infrastructure such as edge/on-premise systems, Swiss-based cloud solutions, and hybrid or alternative models. Interactive sessions will include scenario-based discussions to examine deployment trade-offs and risks, as well as polling to gather input on scalability, cost, governance, and data sovereignty—helping to identify common priorities and local needs. We also welcome feedback on how research outcomes should be delivered to ensure accessibility and impact.

**WORKSHOP**

15:30-17:00

NEST-M2C

***ORGANISER:*** *DR. MONICA BARROSO, UNIVERSITY OF ST. GALLEN, SWITZERLAND*

## Playing with the Business Model Assembler for clean energy urban hubs

As part of the EU Horizon ASCEND consortium, our team developed a practical tool to support cities in designing sustainable business models for clean energy solutions. The Business Model Assembler Card Set represents not only a methodological innovation but also a mindset shift within public administration—towards a more agile, multistakeholder, and impact-oriented approach to implementing urban innovation. Although originally designed for Positive Clean Energy Districts (PCEDs), the tool can be applied more broadly to support any urban hub aiming to meet clean energy and sustainability goals.

The Card Set helps cities build or refine business models by combining diverse, real-world business model patterns, considering local context and stakeholder maturity. In the context of PCEDs and smart cities, where cross-sector collaboration and long-term financial viability are key, business models become crucial for attracting private investment and aligning stakeholder incentives. The innovation lies not in inventing new models from scratch, but in creatively recombining proven ones to meet new challenges.

In this 2-hour interactive workshop, participants will be introduced to the business model concept in a dynamic and playful format. Through short group exercises and role-play using the Card Set, they will explore how to structure scalable and context-sensitive business models that serve economic, environmental, and social goals. The tool can also be used alongside the City Business Model Canvas for deeper strategic alignment.

The session is aimed at urban planners, public decision-makers, and stakeholders involved in sustainable city-making, providing them with hands-on experience in using business model thinking to accelerate the clean energy transition at city level.

**WORKSHOP**

15:30-17:00

LB

***ORGANISER:*** *CHRISTINE GSCHWENDTNER, MIT, UNITED STATES*

## Bridging the gap: Fostering collaborations between social scientists and engineers for urban systems research

This workshop explores how to strengthen collaboration between social scientists and engineers to address complex urban systems challenges—such as sustainable mobility or energy transitions—that require both technical and behavioral insights. While engineers often rely on optimization and quantitative models, social scientists bring essential understanding of human decision-making, including qualitative approaches. Yet collaboration can be hampered by disciplinary silos.

This workshop will be structured around small-group discussions between social scientists and engineers. Participants will identify barriers to collaboration (e.g., lack of shared language, unclear relevance), reflect on how each discipline can support the other's work, and co-develop actionable strategies for more integrated research—such as interdisciplinary seminars, joint methods training, or new project formats.

The outcomes include identifying key challenges and opportunities for collaboration between social scientists and engineers, concrete ideas for fostering joint research efforts, and actionable next steps for participants to pursue interdisciplinary work in their own projects.

# Committees

Thank you very much for attending the Urban Futures Symposium from our organising committee:

Dr. Georgios Mavromatidis | Head of the Urban Energy Systems Laboratory

Dr. Binod Koirala | Group Leader, Buildings & Cities

Dr. Mashael Yazdanie | Group Leader, Macro-Energy Systems

Ana Bendiek Laranjo | PhD student, Buildings & Cities, Chair of Circular Engineering for Architecture (ETH Zurich)

We'd also like to extend our thanks to the advisory committee who helped guide us in setting up this hopefully very insightful and engaging event:

Pinar Caglin & Dr. Vincent Kitio | UN-HABITAT
Prof. Dr. Evelina Trutnevyte | University of Geneva (Switzerland)
Prof. Dr. Stefan Pfenninger | TU Delft (Netherlands)
Dr. Salvador Acha | Imperial College London (United Kingdom)
Dr. Koen van Dam | Imperial College London (United Kingdom)
Dr. Christine Gschwendtner | MIT - Massachusets Institute of Technology (USA)
Dr. Michael Wetter | LBNL - Lawrence Berkeley National Laboratory (USA)
Prof. Dr. Jinyue Jerry Yan | The Hong Kong Polytechnic University (China)
Yong Chen | IRENA - International Renewable Energy Agency (until Feb. 2025)
Prof. Dr. Bert Blocken | Heriot-Watt University (United Kingdom)
Prof. Vicente Carabias-Hütter | ZHAW (Switzerland)
Prof. Dr. Ulrike Sturm | HSLU (Switzerland)
Deepshi Kaushal | EBP Schweiz AG | Innosuisse (Switzerland)
Prof. Dr. Jose Pablo Chaves Avila | Comillas Pontifical University (Spain)
Prof. Dr. Sven Eggimann | The Hebrew University of Jerusalem (Israel)
Prof. Dr. Selin Yilmaz | University of Lausanne (Switzerland)
Prof. Dr. Natasa Vulic | FHNW (Switzerland)
Dr. David Parra | Iberian Center für Energy Storage Research (Spain)
Dr. Thomas Bauwens | Rotterdam School of Management, Erasmus University (Netherlands)
Prof. Dr. Fazel Khayatian | The University of Texas at San Antonio (USA)
Dr. Jorge Andres Moncada Escudero | VITO (Belgium)
Dr. Javanshir Fouladvand | Utrecht University (Netherlands)
Martina Rechtsteiner | Future City Alliance (Switzerland)
Dr. Tural Aliyev | Eawag (Switzerland)
Dr. Iná Maia-Novak | Austrian Institute of Technology - AIT (Austria)
Dr. Matias Quintana | Singapore-ETH Centre -SEC (Singapore)

## Sponsors & Partners

The Urban Energy Systems Lab and in particular the organizing committee of the Urban Futures Symposium would like to extend a heartfelt thank you to the sponsors of this event, without which this symposium would not have been possible.

### Gold sponsor:

Kanton Zürich
Baudirektion

### Supporters:

Stadt Dübendorf

sgsw
St.Galler Stadtwerke

Empa
Materials Science and Technology

# URBAN FUTURES SYMPOSIUM 2025
## CONFERENCE VENUE