

SWICE + LANTERN CONFERENCE FRIBOURG

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Abstracts in **English**

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Session 1 - 10:00 - *Maltese et al.*

Evaluating building and mobility energy impacts of emerging working models: a decision support tool

Sebastiano Maltese, Evelyn Kägi-Lobsiger, Jasmin Oberkalmsteiner, Uroš Tomic, Stephanie Moser, Rafaël Weissbrodt, Jessica Marques

The transition towards flexible and remote working models presents unique opportunities for energy sufficiency, particularly by rethinking how we use and size office spaces. As part of Work Package 5 (WP5 – Energy in Work) of SWEET Lantern, we introduce a decision support tool that enables the assessment of impacts of different working model arrangements on building operations and employee mobility.

The true value of this research lies in generating scenarios to guide practical interventions within companies and future real estate developments. As teleworking, reduced working hours and 4 day weeks increase, maintaining traditionally sized and operated offices becomes highly inefficient. By simulating the effects of reducing the floor area of offices, we highlight how remote work can and must influence the total surface area required and, as a key innovative aspect of the tool, the operating hours for business operations and how these work patterns influence mobility demand.

To leverage this potential, decision-makers and facility managers must implement concrete structural and managerial changes. Effective strategies include shutting down entire wings or building floors on days with lower attendance, subletting excess space, and structurally reducing physical surfaces during retrofitting. We validate the decision support tool in collaboration with three companies and will show results of the analysis and the impact on the design of working models that include spatial and energy sufficiency to improve work related impacts on mobility and building energy.

Methodologically, the tool employs a dual-engine approach to assess of how work policies affect building and mobility areas simultaneously. For the building component, it relies on a hybrid method pairing pre-calculated dynamic thermal simulations from EnergyPlus with customized user inputs regarding building systems. This efficiently translates ideal thermal loads into primary energy consumption and carbon emissions. Concurrently, the mobility engine calculates the impact of commuting, business trips, and private travel using Swiss Microcensus data. It adjusts travel distances based on employee teleworking frequencies and the specific structure of their working week. Furthermore, the tool is highly adaptable and can be specifically tailored to the needs of companies that have their own data available, allowing them to integrate custom inputs for their specific energy systems, conversion factors and mobility aspects. Ultimately, the tool aggregates these annualized building and mobility metrics to compute the combined primary energy demand and total carbon footprint. By directly comparing a current baseline situation against tailored target configurations—such as increased remote work or specific office closures—it provides decision-makers with a clear, quantified evaluation of potential environmental savings.

Working next door: A Mixed-Method Evaluation on Commuting and Living-Space Demand of a Coworking-Space Intervention in a Living-Lab

Noah Balthasar, Timo Ohnmacht, Jana Z'Rotz

Teleworking is often promoted as a strategy to reduce commuting-related emissions. However, research increasingly highlights rebound effects such as increased residential floor space and additional ICT infrastructure. Residential coworking spaces (CWS), workplaces located within residential neighbourhood, provide an alternative to working from home by allowing teleworkers to work close to home while maintaining spatial separation between work and private life. This presentation presents results from a real-world intervention conducted in the Suurstoffi Living Lab in Rotkreuz, Switzerland, implemented within the SWEET-SWICE research programme. In the experiment, 13 residents received free access for three months to the coworking space "SPACES" located within the Suurstoffi neighbourhood. The study examined whether residential CWS can reduce commuting-related mobility while supporting well-being and flexible work practices. The evaluation combines pre- and post-intervention surveys with GPS-based mobility tracking for a subsample of participants. Participants used the CWS on average 1.6 days per week. Compared with the baseline situation, the intervention resulted in 17% lower commuting-related CO₂ emissions, a 39% reduction in commuting distance, and a 28% reduction in commuting time. Mobility tracking suggests slightly shorter daily travel distances and increased walking activity on CWS days. Participants also reported qualitative benefits such as improved daily structure, social interaction, and clearer separation between work and private life. Eight of the thirteen participants indicated that access to neighbourhood coworking spaces could influence future housing decisions by allowing smaller living spaces. The findings illustrate how residential CWS may contribute to sufficiency-oriented mobility systems and highlight the potential as part of sustainable urban mobility and housing strategies.

Reducing Demand, Expanding Possibilities: A Human-Centered Digital Twin of the Swiss Residential Building Stock

Til Sommer, Fatih Topak, Kristina Orehounig

Switzerland's residential decarbonization increasingly requires tools that capture the interplay between buildings, households, lifestyles, and everyday practices in shaping energy demand and emissions. This contribution presents a human-centered digital twin of the Swiss residential building stock and its translation into a decision-support framework for assessing sufficiency measures across scales. The underlying modelling architecture combines representative municipalities, residential building archetypes, household profiles, and lifestyle segments. Dynamic building energy simulations were used to evaluate the effects of behavioral, spatial, and technical measures across regions and climate scenarios, enabling comparison of final energy demand, emissions, and implementation-relevant trade-offs within a unified analytical framework.

A central contribution of the digital twin is that it links theoretical reduction potentials with potentials constrained by household acceptability. Survey-derived acceptability rates were mapped to household and lifestyle profiles, enabling estimation of both the theoretical potential of intervention scenarios, and their likely uptake across different population groups. Sufficiency scenarios are not framed here as imposed behavioral change, but as shifts in practices whose energy and emission effects can be assessed if realized. The evidence base, developed through analysis at municipality, building, and household levels, was consolidated into an interactive decision-support framework that allows different stakeholders to explore residential heating and cooling demand under alternative combinations of demand-side practices. By aggregating results from upscaled simulations of the Swiss residential stock, the underlying dashboard provides quantitative comparisons between sufficiency scenarios and conventional retrofit-focused pathways. It enables the energy demand and emission reduction effects of current and potential future practice-change scenarios to be examined across municipalities, building types, and household groups, thereby supporting more tailored assessment and policymaking across Swiss regions.

The results of our analysis show that household-level sufficiency measures can yield substantial reductions in final energy demand and emissions, particularly through behavioral and spatial measures and with lower embodied impacts than more conventional retrofit-focused approaches. By connecting sufficiency, wellbeing, and energy demand in a single multi-scalar structure, the digital twin provides the analytical basis for exploring implementation assumptions and identifying locally relevant intervention pathways, while the framework enables their use in municipal-level decision making.

Session 1 - 11:30 - Sharma et al.

A Switzerland-wide sufficiency pathway for renovation, housing accessibility, 8-min neighborhoods, de-sprawl, and mobility decarbonization

Esha Sharma, Sascha Nick, Andrew Sonta

How can sufficiency-oriented renovation move beyond isolated buildings and support a wider transformation of settlement structure, accessibility and everyday life? Building on earlier algorithms that operationalized neighborhood accessibility for the canton of Geneva and proposed national scaling as a key next step, our work develops a Switzerland-wide framework for transforming inhabited areas toward functional 8-minute neighborhoods.

We combine hectare-level population and service accessibility analysis with a second-generation robust genetic algorithm to identify spatially explicit renovation and reorganization pathways under strong social constraints. The approach is designed to both improve averages and ensure territorially just outcomes: all inhabited hectares must exceed a minimum accessibility threshold, while the national average reaches levels comparable to the best-connected Swiss urban areas today. In this way, the model addresses sufficiency as a reconfiguration of the built environment that reduces the need for high-energy mobility while improving everyday access to essential services, with likely co-benefits for inclusion, wellbeing, and health.

The results suggest that a rapid and socially compatible transformation is technically and materially achievable with existing building stock, workforce capacities, and public transport infrastructure. The modeled pathway shows how Switzerland could simultaneously reduce sprawl, alleviate structural housing pressure through space reconfiguration and sharing, and enable the near-complete decarbonization of everyday mobility demand without relying on speculative technologies or disruptive territorial reorganization. Importantly, the analysis is spatially explicit, allowing trade-offs and benefits to be examined across urban, peri-urban and more dispersed areas.

Beyond the technical result, our research develops a decision-support framework for sufficiency-oriented renovation policy. It helps identify where adaptive reuse, local densification, service clustering, public space redesign and mobility restructuring are most effective, and where governance attention is needed to avoid uneven territorial outcomes, i.e. leave no-one behind. The presentation will discuss methodological advances, show Switzerland-wide results, and implications for renovation strategies, housing and mobility policy, spatial planning and municipal implementation.

Between efficiency and sufficiency: Minergie P retrofit, thermal comfort and energy behaviours in a housing cooperative

Julie Vuignier, Martin K. Patel

High-performance energy retrofit is widely regarded as a key lever for the energy transition, promising significant reductions in energy demand through improved building envelopes, insulation, and heating systems. Yet technical efficiency does not automatically translate into sufficiency behaviours. While retrofit interventions reduce the energy required to maintain a given level of comfort, they do not necessarily prompt residents to reconsider their comfort expectations or consumption patterns; on the contrary, a part of the energy savings is typically lost by higher indoor temperatures and/or continuous heating of all rooms. This gap between technical performance and residents' energy behaviours has received growing attention, yet the conditions under which efficiency may foster sufficiency behaviours remain poorly understood.

This contribution explores this tension through the case of the Coopérative La Cigale (Geneva), whose residential buildings were renovated to the Minergie P standard, one of the most stringent energy performance labels in Switzerland. We argue that high-performance retrofit may, under certain conditions, create favourable conditions for sufficiency behaviours: by improving thermal comfort at lower temperatures, residents may become more willing to accept reduced heating setpoints without experiencing this as a sacrifice. Whether this potential is realised, however, depends on how residents perceive and experience the post-retrofit indoor environment.

Drawing on energy consumption data, a survey of approximately 150 residents covering thermal comfort, willingness to reduce heating temperatures, and perceptions of the costs of the energy transition, as well as interviews on the technical and economic dimensions of the retrofit, we examine the extent to which a high-performance intervention creates (or fails to create) conditions conducive to more sober energy practices. The cooperative model provides a distinctive organisational context for this analysis: as co-owners who share collective values and participate in governance decisions, residents may relate differently to questions of energy use and collective responsibility than tenants in conventional housing.

The results presented are preliminary and aim to open a discussion on the conditions under which efficiency and sufficiency can be mutually reinforcing, and on the role that organisational models, resident perceptions, and building performance jointly play in shaping energy demand in the Swiss residential sector.

Sharing Model Explorer - Simplify implementing Shared Living with the Sustainable Business Model Canvas for sharing solution

Felix Bucher, Fabienne Keller, Flavio Sütterlin

Increasing demand for space, excess demand in city centers and a shortage of supplies are putting increasing pressure on the housing market. One possible solution is the shared use of rooms, objects and vehicles (integrated shared living). For tenants, this creates ecological, economic and social advantages that strengthen the exchange within a housing community and contribute to a more sustainable lifestyle. However, we found that in non-cooperative housing projects the risk for stakeholders to realize shared living seems to be quite high. The reason for this being the perceived low acceptance of shared living among the target group. This hinders the wide adoption of shared living.

We analyzed shared living projects in Switzerland with the objective of exploring whether shared living is more likely to be accepted when users participate in the process of organization and the outcome. Our aim was to provide guidance on how to successfully set up and run such projects by identifying patterns. For this, we collected, characterized, and analyzed around 50 shared living projects. Furthermore, we developed the prototype of a digital tool to support building owners and planners in integrating shared living in their building projects – the Sharing Model Explorer.

Our results include a set of business model patterns for integrated shared living. These patterns can support stakeholders in the building industry to successfully implement shared living. To facilitate their application, we developed a prototype of the Sharing Model Explorer. The tool will be further developed with the aim of reducing perceived risks for planners and developers and, hence, increase diffusion of integrated shared living in Switzerland. With established integrated shared living solutions, residents can reduce their environmental impact and increase social interaction. The aim is to create a higher quality of life for residents and thus generate added value. At the same time, we expect that the number of residents in building projects can be increased, and affordable housing can be realized profitably.

We are currently building a consortium with interested partners, who are expected to actively participate in the further development of the future Sharing Model Explorer. As a next step, we would like to expand the data set and further concretize the visual representation. To this end, the Excel format is converted into a web tool to increase usability and enable more precise analyses. Furthermore, project-specific filter options and resulting suggestions for action are to be integrated so that the Sharing Model Explorer can be used in a targeted manner.

Promoting holiday sufficiency: Can AI and peer-to-peer interaction increase environmental awareness and reduce holiday air travel? Evidence from a digital nudging experiment

Leonardo Ventimiglia, Francesca Cellina, Linda Soma, Pasquale Granato, Alessandro Tavoni

To transition to a post-carbon society, it is essential to reduce emissions from holiday air travel, which accounts for a relevant share in emissions in Western countries (in Switzerland, 13%). While the costly alternative technological solutions cannot enable zero emission aviation before 2050, behavioral solutions can offer a complementary approach to cutting emissions in the short term.

This contribution presents the short-term results of a randomized controlled trial (RCT) conducted in Switzerland (pre-registered on the AsPredicted platform with ID 220688, N=146), designed to estimate the effect of a multi-component green-digital nudging intervention targeting frequent flyers. The intervention aimed at promoting behavioral changes towards “sufficient holidays” (those that involve travelling on the ground to closer destinations, thus reducing carbon emissions), by acting on the key psychographic constructs that, according to the Model of Action Phases, drive behavior change processes. The digital nudging tool leveraged Generative Artificial Intelligence (GPT-3.5) to provide personalized suggestions on sustainable holiday destinations, combined with peer-to-peer sharing of sufficient holiday experiences and social interaction possibilities, while simultaneously increasing user engagement through individual and collective feedback, and gamification mechanisms. Those features were designed to leverage key psychographic factors identified by behavioral theories as key drivers of behavior change—such as perceived behavioral control, social norms, personal norms, and attitudes towards air and train travel.

We assessed the short-term effect of Treeps through two before and after surveys, conducted over a period of three months, in May and August 2025. Using a fixed effect panel regression model, we estimated if and to what extent use of the Treeps digital tool impacted the psychographic variables and carbon emissions from holiday air travel in the three months before the survey. We found a statistically significant effect in the increase of descriptive pro-environmental social norms and the decrease of participants’ attitudes towards air travel. Given the short-term nature of the analysis, no significant effect was instead found in reducing CO₂ emissions.

In the short term, use of the Treeps digital nudging features combined with peer-to-peer interaction appeared to be useful for fostering antecedents of pro-environmental behavioral change. On the contrary, they did not manage to tangibly reduce carbon emissions stemming from air travel. This might be due to the short duration of the Treeps intervention and the seasonality of air travel. In fact, previous financial commitment and booking of flights during the intervention period may have acted as a structural constraint precluding short term behavioral change. Longer-term analyses will clarify whether, besides acting on behavioral determinants, use of the Treeps tool will also produce an effect on air travel behavior and the related carbon emissions.

Preliminary results relating recreational mobility patterns with lifestyles through mobile sensing

Moreno Colombo, Julien Nembrini, Debora Frei, Bernadette Sütterlin

Increased usage of collective transportation modes have demonstrated beneficial influence on CO₂ impact per km for routine weekday travels. Subsequently, the CO₂ impact of recreational mobility may show an increase due to remaining individual car usage, possibly due to flexibility needs and expectations during leisure time. As the SWICE WP1 hypothesizes the presence of spillover effects, both negative or positive, in peoples' behavioural patterns depending on their lifestyles, the presented approach investigates whether mobility behaviour during recreational activities with confront to weekday mobility patterns is mediated by people's lifestyle.

To understand the differences between recreational and routine mobility patterns, this study uses a specific mobility dataset produced through a novel, privacy-preserving acquisition methodology involving mobile sensing. This method uses a mobile application that combines in-device analysis of GPS traces with physical heuristics to produce an accurate estimate of users' mobility patterns. It generates data in the form of (1) pseudonymized transport mode segmentation per individual trips and (2) anonymous mode-specific outdoor presence at aggregated time periods. To preserve privacy, only limited information is communicated to research servers for analysis; as an example for each transport mode segmented trip: departure and arrival 6-digit geo-hashes (approx 1 km²), transport mode and duration. Using this approach within the Smart Living Lab and the Living Lab Lokstadt, 112 participants have contributed their mobility activity between September 2024 and February 2026, thereby recording over 37,000 individual modal trips. In addition to passive mobility monitoring, users completed specific surveys, enabling the sample to be stratified according to users' lifestyles. This dataset therefore enables an in-depth comparison of weekday and weekend/holiday patterns within the sample, as well as an analysis of the relationships between specific behaviours. For example, it can answer questions such as whether CO₂-conscious behaviour during the week has a negative spillover effect on mobility behaviour during leisure time, for instance when using an electric car results in increased mileage for recreational activities compared to using a conventional car within a similar lifestyle.

Due to the specificities of the living labs considered, the recruitment procedure mainly involves either academic researchers or inhabitants of sustainable settlements. This results in an under-representation of car owners in the recorded data, compared to the Swiss population, and an over-representation of public transport usage. Nevertheless, the approach confirms standard mobility patterns, such as the morning and evening peak hours, with the asymmetry towards the evening, displaying participants' additional activities (e.g., shopping or sports). Similarly, an increased car usage is notable over weekends/holidays. More interestingly, the approach is able through a within-group analysis to highlight relationships between lifestyle, weekday routines and weekend /holiday mobility.

The presentation will demonstrate the richness of the approach for mobility monitoring by showcasing current results from the analysis of the recorded dataset.

Gridly: An Interactive Framework for Assessing and Communicating the Environmental Impact of Mobility Behavior

Stefano Gioia, Igor Torshin, Yousra Sidqi

Passenger transport contributes approximately 10% of global greenhouse gas emissions, making it a critical sector for achieving decarbonization goals and improving environmental sustainability, public health, and urban livability. Beyond scenario assessment, there is a growing need to raise awareness of how routine mobility and recreational travel behaviors directly shape energy demand and emissions, and to do so through tools that are easy, immediate, and intuitive to use.

In this context, this work introduces Gridly Mobility, part of the broader Gridly framework, which investigates behavioral shifts in both mobility and household energy consumption. The platform is designed not only as an analytical tool but also as an interactive and accessible interface through which users can explore the environmental consequences of their everyday travel choices. By allowing users to input modal shifts and instantly visualize their effects, Gridly Mobility provides clear and engaging feedback on emission reductions and changes in modal shares, fostering greater awareness and supporting more informed decision-making among individuals, researchers, and policymakers.

At the analytical core of the framework lies a data-driven methodology to quantify the potential of different emission reduction strategies, spanning modal shifts, technological improvements, and new service models. A novel agent-based modeling approach is proposed to simulate realistic behavioral variability without relying on complex transport network or routing models. Synthetic populations are generated by sampling key behavioral variables—such as travel distances and modal shares—directly from empirical distributions, enabling robust scenario exploration while reducing model complexity and uncertainty.

Numerical experiments based on Swiss Microcensus data evaluate a wide range of hypothetical scenarios, including modal shifts, impact shifts (i.e., changes in emissions and energy intensity per passenger-kilometer), and their combinations. To ensure comparability, emissions and energy consumption are assessed across life cycle phases. Preliminary results for the use phase indicate that the most impactful measures are those targeting internal combustion engine vehicles, followed by measures aimed at improving rail energy efficiency.

Aligned with the conference theme “Recreational Practices, Sustainable Mobility & Energy Demand,” this work highlights how mobility systems—closely linked to everyday activities and quality of life—also drive energy demand and environmental impact. By combining behavioral modeling with an intuitive user interface, the Gridly framework bridges the gap between quantitative assessment and public engagement, supporting more sustainable travel behaviors and contributing to the transition toward low-carbon mobility systems.

Lokstadt Move: Insights from a Mobility Visualization Intervention in the Living Lab Lokstadt

Debora Frei, Bernadette Sütterlin, Evelyn Lobsiger, Jasmin Oberkalmsteiner, Moreno Colombo, Julien Nembrini

Mobility decisions are made repeatedly throughout the day, yet they are rarely the result of conscious reflection but rather the product of habits. At the same time, individuals often have only a limited understanding of the impact of their travel choices on CO₂ emissions and the beneficial effects of using more environmentally friendly modes of transport, as reflected in the carbon intensity of those choices. The Lokstadt Move project addressed this issue by providing residents in the Living Lab Lokstadt with direct feedback about their mobility behavior in terms of distance covered by the chosen means of transport and related CO₂ emissions. This intervention tested whether direct feedback about one's mobility behavior increases awareness of the environmental impact of one's mobility behavior, encourages more thoughtful travel choices, and promotes shifts towards more sustainable modes of transport.

Over the course of a baseline month and an intervention month, participants used the mobility tracking feature of the SWICE app developed in WP1. The mobility tracking feature provided near real-time feedback on transport modes chosen, travel distances and associated CO₂ emissions. This visualization of CO₂ emission was aimed to raise awareness about the environmental impact of own mobility behavior and to facilitate identification of more sustainable options by putting them in relation to less environmentally friendly options. Furthermore, it visualizes the positive effect of switching to a more environmentally friendly means of transport, thus increasing perceived self-efficacy which is an important driver of pro-environmental behavior. Additionally, pre- and post-surveys were conducted to evaluate the potential impact on other environmentally relevant behaviors and behavioral drivers. A total of 37 participants (22 of whom provided complete data) tracked their daily mobility between May and July 2025. This resulted in 5,042 recorded trips, covering a total distance of 62,962 km and generating 7,195 kg of CO₂ emissions. Baseline results indicated largely sustainable mobility patterns, with short trips predominantly undertaken on foot and longer distances primarily covered by train. However, total emissions were disproportionately driven by infrequent but carbon-intensive modes of transport, particularly air travel and car use. The introduction of the CO₂ visualization resulted in only limited behavioral change. Apart from an increase in recorded trips, no significant shifts in modal split or travel distances were observed. Overall, the findings suggest that, while individualized mobility feedback may increase awareness, it has a limited direct impact on mobility behavior in populations that are already oriented towards sustainability. Given the small, non-representative sample size and possible seasonal influences, the results should be interpreted as exploratory.

Heat, mobility and the reconfiguration of everyday practices: evidence from two Swiss living labs

Julien Forbat, Noah Balthasar, Marlyne Sahakian, Timo Ohnmacht

Rising temperatures and more frequent heat waves increasingly disrupt everyday practices in cities, not merely individual behaviours, but the interplay of materialities, competencies, and norms that shape how people move, rest, and use public space. Understanding how heat reconfigures social practices is crucial for designing climate-resilient, low-carbon, and sufficient urban environments that sustain wellbeing without driving energy demand upward, notably through increased reliance on air conditioning. This contribution examines heat-related practice disruption and adaptation through the lens of social practice theory, drawing on evidence from interventions in two Living Labs within SWEET-SWICE. Each Living Lab foregrounds different dimensions of adaptation, one more centred on neighbourhood-scale material interventions in public space, the other more on individual-level cooling equipment, enabling a cross-case analysis of how structural and personal strategies interact.

Living Lab la Jonction (City of Geneva) is a urban district, where neighbourhood-scale interventions such as shading structures, misting systems, and temporary “micro-oases” directly modified the material conditions of public space. There, heat-related adaptations were strongly shaped by the availability of shaded and cooled environments, concentrating activity in thermally comfortable areas and enabling outdoor use. This contrasts with the Living Lab Suurstoffi (Municipality of Risch-Rotkreuz), a mixed-use, largely car-free neighbourhood designed around proximity, density, and high public transport accessibility. The neighborhood offers green and blue elements as well as shaded areas. Comparing these two cases is analytically relevant because they foreground different entry points of adaptation. This contrast allows to examine how the material environment conditions the effectiveness of individual strategies.

In the Living Lab la Jonction (Geneva), a mixed-methods study conducted during summer 2025 combined in-situ surveys (n=313 adults, n=52 children), in-depth interviews (n=13), and ethnographic observations (n=48) across seven public space sites equipped with temporary cooling installations (micro-oases, shading structures, mist systems). Results show that heat fundamentally alters the material conditions of walking and outdoor use: highly mineralised spaces become rapidly uncomfortable, while shaded parks function as thermal refuges concentrating social activity. Residents adapt through temporal reorganisation and spatial navigation, seeking shaded itineraries rather than shortest routes.

In the Suurstoffi Living Lab, twelve households received a personal cooling kit (handheld fan, spray bottle, cooling towel). A follow-up survey assessed use patterns, perceived usefulness, and behavioural adaptations during hot weather. Results indicate that heat significantly influences daily routines: respondents report reducing or slowing walking trips, shifting travel to cooler times of the day, and seeking shaded routes. The distributed tools were widely used and perceived as helpful, yet participants consistently emphasised that individual equipment alone could not compensate for structural heat-related constraints in the built environment.

Taken together, the two cases demonstrate that maintaining active mobility and outdoor public life during heat events requires integrated interventions acting simultaneously on materialities (shaded pathways, micro-oases, cooling infrastructure), competencies (knowledge of cool routes, use of personal equipment, adaptive skills), and norms (flexible work schedules, school calendar adaptation, cultural legitimization of slow mobility). The comparison underscores the limits of individualised approaches and the complementary importance of structural, place-based design for climate adaptation aligned with energy sufficiency goals.

The potential of street experiments in urban environments for reducing mobility demand: Evidence from a sustainability-oriented district in a Swiss city

Uros Tomic, Christof Knoeri

Urban spaces around the world are increasingly transformed with the goal to make cities more liveable and contribute to the paradigm shift from “streets for traffic” to “streets for people”. In addition to applying more rigorous urban planning concepts, such as 15 Minutes City or Superblocks, urban spaces are used as experimental environments for temporary, disruptive interventions often being referred to as “tactical urbanism”, having as a goal to trigger incremental change in a low-commitment context. These interventions have mostly been analysed from the perspective of their potential to promote active mobility, improve traffic safety or boost social interaction. While from the mobility perspective the focus has been placed on modal shift from the motorised to active and slow mobility, their potential to avoid trips by offering attractive local environment has largely been underemphasized. This survey-based study assesses the impact of closing the street for cars for two months and setting up a pedestrian zone with possibility to organise pop-up activities and events in a sustainability-oriented, cooperatively managed district of the Swiss city of Winterthur. The results demonstrate the potential of such an intervention to foster social interaction, motivate the residents to spend more time in the district and raise awareness of positive consequences of using the streets for social activities rather than for car traffic. However, in the given context, our results show that the avoided trips would have been short and made by low-carbon or carbon-free means of transport anyway implying a rather low intervention impact on the CO₂ emissions. Moreover, the respondents do not expect that they would avoid a part of their trips even if a studied intervention would be permanent. Hence, to maximise the impact on traffic reduction, future interventions should target activities associated with car use and larger distances and populations with corresponding mobility routines.

Teleworker Types and Mobility Behaviour: A Typology of Teleworking Practices and Their Energy Implications

Thao Vu, Timo Ohnmacht, Bernadette Sütterlin, Debora Frei, Tobias Arnold, Rachel Linley

Teleworking is often treated as a uniform behavioural change with predictable environmental benefits. However, teleworkers differ substantially in their motivations, attitudes and everyday practices. Understanding these differences is essential for designing effective mobility and energy policies. This presentation presents a typology of teleworkers based on attitudes, motivations and behavioural patterns derived from survey data collected in Switzerland. The analysis identifies three teleworker types: pragmatic teleworkers, sceptical-individualistic teleworkers, and environmentally conscious-innovative teleworkers. Pragmatic teleworkers represent the largest group and primarily value teleworking for its flexibility and practical benefits. Sceptical-individualistic teleworkers emphasise efficiency and convenience and show relatively low engagement with sustainability considerations. Environmentally conscious-innovative teleworkers are motivated by sustainability concerns and are more open to experimenting with new tools and practices. The typology reveals that teleworkers are not inherently more environmentally oriented than the general population. Differences between the identified groups are reflected in mobility practices and access to transport resources such as public transport season tickets and private cars. These findings suggest that policies aiming to reduce energy demand through teleworking should adopt target-group-specific strategies rather than assuming uniform behavioural responses. Incorporating behavioural segmentation can improve the effectiveness of policies designed to support sustainable mobility transitions.

Teleworking, Energy Demand and Well-Being: Interactions Between Mobility, Housing and Digital Infrastructure

Jana Z'Rotz, Timo Ohnmacht, Dimitri Marincek, Patrick Rérat

Teleworking has become a key element of contemporary work and mobility systems and is often associated with reduced commuting-related emissions. However, the overall energy implications of teleworking remain complex. While fewer commuting trips may reduce transport emissions, teleworking can simultaneously increase residential energy demand through larger living spaces and additional ICT infrastructure. This presentation examines the interactions between teleworking, mobility behaviour, energy consumption and well-being using empirical evidence from Switzerland generated within the SWEET-SWICE research programme. Previous analyses show that teleworking can reduce commuting-related emissions by decreasing work-related travel. At the same time, teleworking often leads to increased residential floor space consumption, as many teleworkers maintain a dedicated home office. Additional ICT-infrastructure such as monitors, desktop computers and printers further contributes to energy demand. Beyond energy considerations, teleworking has important implications for well-being and work–life balance. The findings suggest that spatial separation between work and private life plays a crucial role in maintaining well-being. Teleworking arrangements that combine flexibility with opportunities for spatial separation – such as neighbourhood coworking spaces – appear particularly promising. The results highlight the importance of analysing teleworking from a systemic perspective that considers mobility, housing, digital infrastructure and well-being simultaneously. The presentation concludes by discussing how teleworking policies, workplace strategies and urban planning can be designed to maximise sustainability benefits while minimising rebound effects.

Customer Segmentation for Demand Response Using Smart Meter Data and Surveys

Jan Sigrist, Arnab Chatterjee, Philipp Heer

The rising integration of decentralized renewable energy sources (RES) and the electrification of transport and heating are straining electricity grids worldwide, creating volatility in supply and demand that challenges grid stability. Demand response (DR) programs offer a promising solution by incentivizing flexible consumption, but their success hinges on precise customer segmentation to target households with high flexibility potential. This work leverages high-resolution smart meter data and detailed survey responses from 1,273 households in Winterthur, Switzerland, to develop a scalable framework for identifying distinct consumer segments.

The dataset, collected within the SWEET LANTERN project initiative, combines 15-minute interval electricity consumption profiles from 2024 with sociodemographic, technical, and attitudinal survey data. Analysis was stratified by dwelling type (flats vs. houses) to account for structural differences in metering scope and technology adoption. Data preprocessing involved outlier detection, temporal aggregation into normalized annual, daily, and seasonal hourly load profiles, and feature extraction of key technical attributes such as heat pumps (HP), photovoltaic (PV) systems, electric boilers, and electric vehicles. Three unsupervised machine learning algorithms were evaluated: K-Means (load profiles only), K-Prototypes, and K-Medoids (mixed numerical-categorical data). K-Medoids, using a weighted distance matrix ($\alpha=0.25$ prioritizing time series), outperformed others with silhouette scores of 0.83 for flats (4 clusters) and 0.41 for houses (6 clusters). Distinct patterns emerged: flats exhibited electric boiler-driven nighttime peaks and appliance-dominated daytime loads; houses showed characteristic PV midday dips, HP evening ramps, and higher overall variability. These clusters strongly correlated with installed technologies and sociodemographic factors like household size and employment status.

DR potential was quantified via peak-to-average ratios (PAR >1.5 indicating high flexibility) and survey-based acceptance rates (>65% for smart controls and local energy communities, LECs). Flats offer moderate flexibility through shiftable appliances (boilers, washers); houses demonstrate superior potential via PV-HP synergies and storage, ideal for LECs and price-based DR. The framework enables utilities to design targeted incentives, predict load shifts, and enhance grid resilience amid Switzerland's smart meter rollout. This work could be directly relevant for utilities such as SWW, as it provides valuable insights into their customer base and technical and social flexibility potential offered by different household segments. Moreover, the findings can be generalized, with some approximation, to other utilities (i) with a similar consumer base as SWW and/or (ii) operating in comparable geographical and climatic contexts.

Session 3 - 11:30 - Lopez-Garcia & Torshin

Assessment of local electricity community potential: Swiss case studies

Tania B. Lopez-Garcia, Igor Torshin

The transition toward decentralized and renewable energy systems has accelerated interest in local energy communities, in Switzerland this refers to virtueller Zusammenschluss zum Eigenverbrauch (vZEVs or regroupement virtuel pour l'autoconsommation or RCPv). This paper evaluates the viability of vZEV implementation across Switzerland by analyzing how geographical context, building characteristics, and grid constraints influence their performance and economic potential. Five representative case study locations are selected to capture the diversity of Swiss landscapes, including urban, peri-urban, and rural environments.

For each case study, geospatial data is extracted from the Maps of Switzerland database within a defined radius around a central point, reflecting the technical limitation imposed by the point of common coupling (PCC). This ensures that only buildings capable of participating within the same low-voltage network are considered. The dataset includes detailed building attributes such as floor area, number of floors, building use type (GWR classification), construction period, and photovoltaic (PV) potential.

Using these inputs, synthetic PV generation profiles and electricity demand profiles are generated for each building. These profiles serve as inputs to the Gridly tool, which models energy exchange dynamics within the vZEV. The tool enables the analysis of intra-community energy trading, self-consumption rates, grid dependency (autarky), and economic outcomes for individual participants.

A large number of simulations are performed to explore optimal configurations of vZEV systems. Key parameters include PV system penetration, battery storage integration, and the mix of residential and non-residential building types. The results are used to identify conditions under which vZEVs are most effective, focusing on load diversity, temporal complementarity, and financial benefits.

The findings provide a comparative assessment of vZEV feasibility across different Swiss contexts and offer insights into the spatial and technical factors that drive successful energy community formation. This work contributes to the understanding of decentralized energy systems and supports policy and planning decisions for accelerating local energy transitions in Switzerland.

Renewable Adoption and Economic Performance: How Local Governance Unlocks Energy Community Potential

Cédric Terrier, Dorsan Lepour, Arthur Chuat, Ziqian Wang, François Maréchal

Since the beginning of 2026, the federal act on a secure electricity supply enables the formation of energy communities to coordinate the local self-consumption of renewable electricity. The objective is to promote grid-friendly behaviour while retaining economic benefits at the local level. However, the effectiveness of energy communities in assisting the Swiss energy strategy 2050 strongly depends on local implementation and energy governance models that are adopted.

Over the fourth year of the Swice project, a collaboration between WP7, focusing on energy system modeling, and WP3, analysing neighborhood governance, enabled assessing the impact of diverse energy community models alongside socio-economic and urban contexts. Building on this work, the presentation will evaluate how local governance shapes the systemic contribution of energy communities to renewable penetration and cost reduction. Three scenarios are analysed: uncoordinated investments across neighborhoods which represents the baseline scenario, a profit-driven coordination by an external stakeholder, and a locally-governed structure. The results reveal that siloed implementations undermine economies of scales, achieving sub-optimal economic performances. In parallel, the profit-driven governance is detrimental to energy justice, since profit is mostly made at the expense of tenants, while landlords of small buildings face reduced returns on their investments. Only the locally-governed model fully harnesses the adoption of renewables and the economic potential of energy communities. In addition, this structure preserves the financial gains for local actors (such as landlords and tenants), although the extent of these benefits remains context-specific and depends on supportive regulation, such as subsidies.

The presentation underscores that local acceptance and social legitimacy would require transparent energy governance that distributes benefits fairly among community members. Moreover, the analysis reveals critical interdependencies between energy community structures and broader energy system outcomes. Finally, from an energy policy standpoint, regulation is needed to ensure that private third parties do not seize the whole benefits of renewable energy adoption. At the same time, utility companies should define their strategic position in relation to the disruption that energy communities pose to both the energy system and existing business models.

Governance of an energy community: Églantine case

Florinel Radu

The Églantine case is the starting point of our research on energy communities. The conception between 2015 and 2017 and realization process of the neighborhood, led by the developer Losinger Marazzi, was innovative in terms of both energy concept and social design. According to the recent Swiss law (2023), it can be considered a prototypical local energy community because it has an electrical microgrid that enables self-consumption of local solar, geothermal, and wastewater heat production between all buildings. On the other hand, it has the features of a sustainable neighborhood and is now the scene of a vibrant social life, stimulated by an Inhabitants' Association committed to sustainability. However, the ongoing project in the Églantine Living Lab shows that its potential for reducing energy consumption and improving residents' well-being is not fully exploited. The solution we are developing with the Inhabitants' and Owners' Associations involves integrating the separate energy and social management systems.

Our complementary research on energy communities, including a literature review and case studies, shows that Églantine's main challenges are general. The social/transformational meaning of energy communities was primarily evident in the early stages of smaller, semiprofessional, and even grassroots projects. Meanwhile, through gradual market introduction, these types of initiatives were replaced by projects prioritizing technological and economic/instrumental meaning (Bauwens et al., 2022). The knowledge and know-how gap between the involved actors, particularly the lack of knowledgeable managers among groups of stakeholders (citizens, landowners, and building managers), is explained by the fact that energy community is a new organizational form. In Switzerland and abroad, the period between 2018 and today can be considered a testing phase that should be consolidated, expanded, and refined based on initial experiences. This raises the question: How can these examples of niche innovation be replicated and scaled?

To address these challenges, we changed our perspective on local energy communities (LECs), shifting from a technical/economic focus to a holistic one. We now consider the implementation of LECs at the neighborhood level to be the most adequate approach for simultaneously achieving energy transition, sustainability, and resilience objectives. The specificity and complexity of each neighborhood require us to abandon the idea of simply implementing a standard technical LEC solution. The right question is how to adapt the solution to the context (Bukovszki & Balázs, 2026):

- Identify the levers, barriers, and unintended consequences through a system diagnosis.
- Organize a participatory process that favors the inclusion of stakeholders by considering their various interests, such as affordability, autonomy, political credibility, technical learning, and business opportunities.
- Involve trusted intermediary actors to coordinate and mediate conflicts (our role in Églantine LL).
- Establish a neighborhood governance structure that perpetuates actors' engagement. Funding and technology are necessary, but an appropriate policy should also support social engagement.

We argue that holistic neighborhood governance is suitable for organizing and functioning within an energy community and for achieving a sustainable and resilient transformation process. In political and economic domains, holistic governance coordinates and integrates diverse actors and activities (Perri et al., 2002). It moves beyond siloed approaches to optimize resource allocation, enhance resilience, and drive sustainable value creation (Brimco, 2025). Holistic neighborhood governance allows for a synergistic approach in the planning phase, combining the advantages of bottom-up and

top-down methods by aligning citizens' needs and desires with the city's broader vision (Gattupalli, 2023). Holistic governance enables more transparent and effective decision-making processes, a central subject of several studies on energy communities (Maître, 2021). For example, Enercoop adopted holacracy, an integrative decision-making process that ensures proposed changes are anchored in the organization's needs beyond individual subjective positions (Brian, 2016; Debizet & Pappalardo, 2022).

We also advocate for incorporating a neighborhood energy community (NEC) process into sustainable and resilient urban transformation because it is mutually beneficial. On the one hand, NECs have transformative potential (Bauwens et al., 2022), which can trigger neighborhood transformation processes. The benefits are not only the development of an "energy community as a mere energy trader," but also the development of citizens' attitudes and capacities that contribute to "the ultimate goal of promoting sustainable choices" (Cristóbal et al., 2023). Second, a sustainable and resilient urban transformation process responds to the needs of residents and other local stakeholders. If the NEC is part of this process, its form and organization will also respond to their needs. In this case, the dynamic is reversed; local stakeholders no longer need to adapt to a technical solution because the technical part of an NEC is adapted to the community's profile and goals. "Social acceptance," considered in the literature a prevalent barrier, is replaced by "technical adaptation," a challenge that specialists can easily overcome. Thus, a NEC should be viewed not as a reproductive model, but as a co-creation process in which local stakeholders engage to improve their collective well-being. A tailored NEC will be more effective and have a greater impact thanks to this engagement. Most importantly, combining the two processes paves the way for replicating and scaling energy community examples of niche innovation.

In conclusion, to achieve the strategic objective of the Federal Act on a Secure Electricity Supply from Renewable Energy Sources (2023) and expand Switzerland's energy production from renewable sources, we recommend the following neighborhood-level actions: adapting the legal framework and defining funding instruments (Confederation and Cantons); incorporating local climate and energy policies into urban, infrastructure, social, housing, and integration development strategies; initiating LLs to create NECs in vulnerable neighborhoods (Municipalities); organizing associations of residents and owners; and establishing holistic governance involving residents, owners, and the Municipality.