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Bundesamt für Energie BFE
Sektion Energieforschung und Cleantech

Mobility Research and Innovation in Switzerland

Tuesday, 12 September 2023

Switzerland Innovation Park, Biel/Bienne

Workshop programme

08.45–09.15	Registration & welcome coffee
09.15–10.35	1st plenary session
	C. Bauer: “Synthetic fuels and their role in achieving net zero targets” S. Nick: “Towards climate-neutral global aviation: less flights, more wellbeing” M. Raubal: “E-bike City – a vision for sustainable mobility”
	Short coffee break
10.50–12.05	Thematic sessions 1 (rooms S228 and S246)
12.05–13.45	Lunch (optional tours of the BFH battery research labs)
13.45–15.00	2nd plenary session
	N. Mathys: “Transport Outlook 2050: back to the future” P. Rérat: “The rise of the e-bike: towards an extension of cycling?” B. Hintermann: “E-Biking in Switzerland”
	Coffee break
15:30-16:30	Thematic sessions 2 (rooms S228 and S246)
16:30–17:00	Closing session (plenary)
	P. Caliandro: “Li ion battery technology development and trends” L. Castiglioni: “International and national funding programmes”
17:00-18:30	Apéro & Networking

Plenary Speakers

Christian Bauer	Technology Assessment Group, PSI
Dr. Sascha Nick	Laboratory of Environmental and Urban Economics, EPFL
Dr. Nicole Mathys	Head fundamental policy questions, ARE
Prof. Dr. Martin Raubal	Institute of Cartography and Geoinformation, ETH Zürich
Prof. Dr. Patrick Rérat	Institute of Geography and Sustainability, Université de Lausanne
Prof. Dr. Beat Hintermann	Public Finance, Universität Basel
Dr. Priscilla Caliandro	Energy Storage Research Centre, BFH
Dr. Luca Castiglioni	Head mobility research, SFOE

Thematic sessions

Vehicle-Grid Integration (V2G) and Smart Charging (10:50h, room S228)

Mathieu Boccard	SunnYparc project – large clusters of public chargers as a flexibility asset
Severin Nowak	EVFlex Project - Providing flexibility services with a bidirectional electric car-sharing fleet
Christian Pons-Seres de Brauwer	Rolling Solar Storage: Market acceptance of corporate energy rosumers for smart solar EV charging at work
Sandro Schoper	V2X Suisse – car-sharing and bidirectional charging
Xin Yanan	Mobility-Aware Vehicle-to-Grid Integration with Car-Sharing

Mobility Behaviour (10:50h, room S246)

Ursa Bernardic	Increasing Electrical Vehicle Adoption with personalized nudging
Davide Cerruti	Impact of monetary incentives on the adoption of direct load control electricity tariffs by residential consumers
Tiziano Gerosa	Making night train services a valuable alternative to air travel: insights from mobility patterns of night train users in Switzerland
Jakup Kwapisz	Mobile Charging Stations with Battery Energy Storage for EV Charging with Renewable Energy
Valentino Piana	Policies for sustainable mobility leveraging bounded rationality: some results from the PROBOUND project

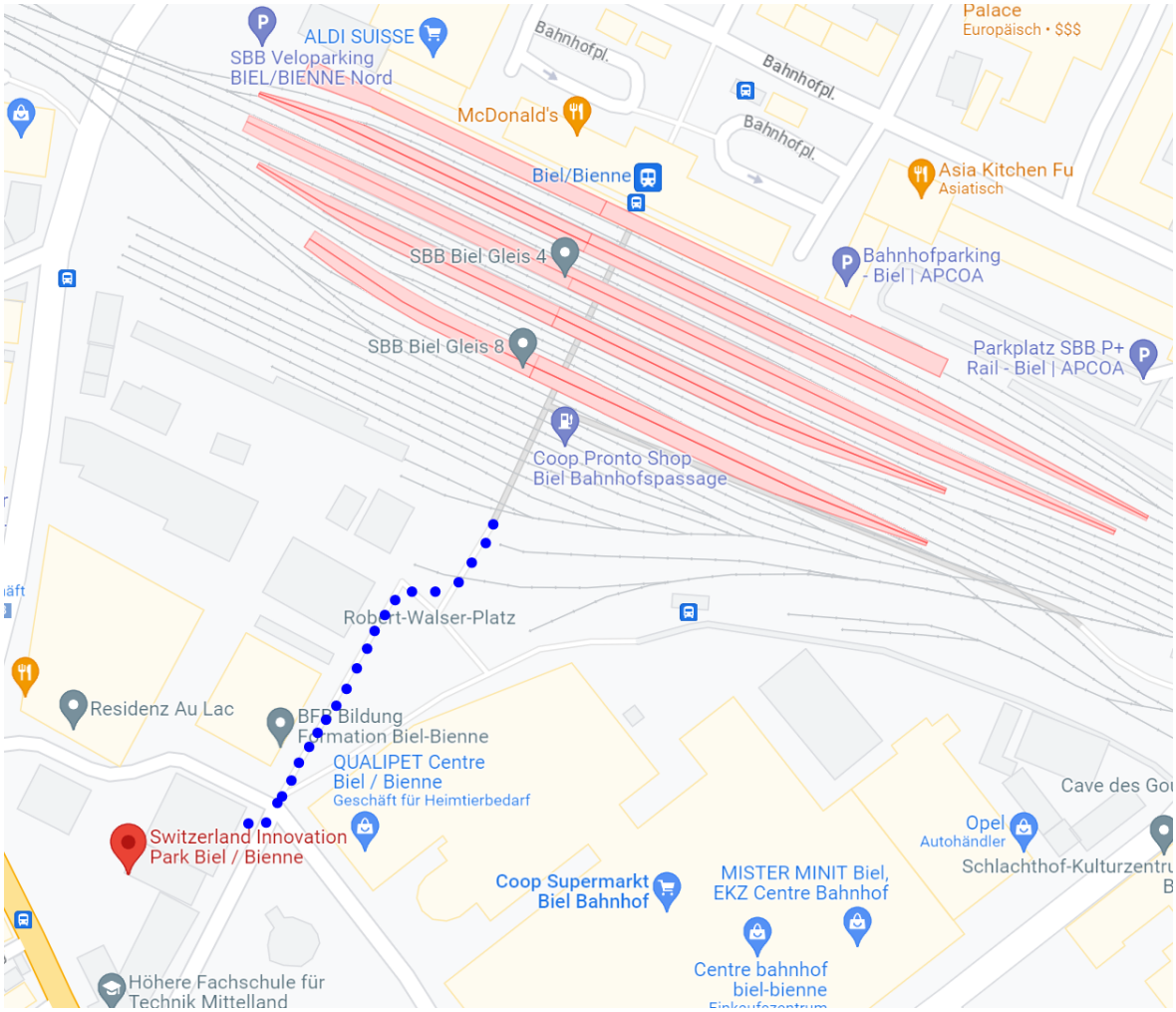
Transport System, multimodal mobility, digital solutions (15:30h, room S228)

Francesca Cellina	Leveraging Carpooling to Enhance Multi-Modality: Learnings from Co-Design of a Mobility-as-a-Service Tool
Uros Tomic	Do multimodal travellers intend to increase the use of public transport and shared micro-mobility? Evidence from Switzerland
Gioele Zardini	Co-Design of Future Mobility Systems
Chenyu Zuo	Interactive Interface for Mobility Data Visual Analysis

Heavy-duty and non-Road Transport (15:30h, room S246)

Marc Albert	From Urban Mobility to Global Freight: A Simulation Framework for Advancing Sustainability in Maritime Transportation
Fenja Feitsch	The role of HVO in SBB's decarbonisation strategy
Markus Halder	BIENE Battery Manager – a railway sector approach
Manasa Sridhar	A multipronged approach to achieving sustainable heavy-duty transport

Location



Switzerland Innovation Park Biel/Bienne is just a 3 mins walk from the railway station Biel/Bienne, take the south exit towards the lake.

Organisation

Mobility Research Programme of the Swiss Federal Office of Energy SFOE
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Thematic Session

Vehicle-Grid Integration (V2X) and Smart Charging

SunnYparc project – using large clusters of public chargers as a flexibility asset

Mathieu Boccard

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The SunnYparc project involving 5 Swiss companies aims to explore the synergies between local renewable energy production and electric mobility. By the end of 2025, 250 charging stations for electric vehicles will be implemented on the Y-PARC site in Yverdon-les-Bains. Already 25 stations (5 of which being bi-directional) are operational since the end of 2022 in the municipal P+R car park. These terminals will be connected to local industrial consumers and to a large photovoltaic production through an intelligent microgrid. Within this microgrid, several modes of control and pricing based on the smart meter architecture will be explored by actively involving electric vehicle owners. The aim is to demonstrate that intelligent charging of these vehicles – in particular through *vehicle-to-grid* [i] (V2G) technology – has the potential to relieve the Swiss electricity grid, reduce the risk of blackouts and reduce dependence on fossil fuels.

Our current developments include

- ensuring safe and reliable communication between the parties (user, vehicle, charger, EMS, flexibility aggregator, grid operator). Some data is sensitive due to data protection; some data is hard to access; some data is sensitive due to grid safety. Not all actors include a communication interface by default. The circulation of information can be discussed at the workshop.

- Opportunities for sustainable business models for V2G with public chargers and challenges with current legal framework. Whereas increasing self-consumption of PV electricity offers a possible business, unloading a car battery to feed the grid is currently poorly remunerated for the energy. The flexibility services can be better paid but the presence of a car cannot usually be guaranteed. The split of revenues and responsibilities between the different actors can be discussed at the workshop.

EVFlex Project - Providing flexibility services with a bidirectional electric car-sharing fleet

Severin Nowak, Braulio Barahona, Martin Friedli, Antonios Papaemmanouil,

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The electrification of the transport sector creates many opportunities to use electric vehicles (EV) as additional storage resources to support the reliable and efficient operation of electric energy systems. The typical usage patterns of EVs and their large energy storage capacity may provide significant flexibility to energy systems, and could enable additional revenue streams for EV owners. Therefore, there is an increasing motivation in offering flexibility services to transmission system operators (TSOs), distribution system operators (DSOs), and local energy communities (LEC) from EVs. The research project EVFlex investigates the provision of flexibility via bidirectional charging technology by aggregating EVs from a car-sharing fleet. Implementing bidirectional charging within an electric car-sharing fleets is a multifaceted undertaking due to the involvement of various components and stakeholders. To support the implementation of bidirectional charging projects with car sharing fleets, EVFlex first analyses the necessary data and technical requirements. The context of our study is a business environment that includes the fleet operator, the charge point operator, the grid services aggregator, and the grid operators. Second, the state-of-the-art and limitations of current protocols for handling bidirectional charging are analysed. Third, a comprehensive simulation environment was developed in order to validate the various use cases and illustrate their benefits for different stakeholders. Results illustrate the provision of flexibility by the car fleet in order to optimize self-consumption in a LEC with solar generation while simultaneously reducing the peak load. In addition, a car fleet spread across a distribution system is simulated and its impact on distribution grid loading based on various charging policies is implemented. Metrics to evaluate the economic benefit when providing flexibility services are also quantified based on specific power and feed-in tariffs. In this way it is possible to estimate revenue when proving flexibility with a car-sharing fleet. An outlook of other use cases and simulation scenarios for TSO services is presented.

Rolling Solar Storage: Market acceptance of corporate energy prosumers for smart solar EV charging at work.

Cristian Pons-Seres de Brauwer

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The electrification of passenger vehicles stands as an important pillar for reducing Switzerland's carbon emissions from transportation. A particularly promising solution lies in leveraging individual work commuting patterns to 'smart solar' charge EVs at the workplace, as today over half of Swiss commuters drive to work instead of using public transport. By combining a solar PV system in a company's premises with V2G charging infrastructure at work, companies can leverage the aggregated battery storage capacity from its workforce's EVs to increase their electricity self-consumption and shave their peak electricity demand during the day. In doing so, corporate energy consumers can provide valuable grid ancillary services to electricity network operators (e.g. demand flexibility via load shifting) and receive compensatory remuneration for it. At the same time, company employees can "solar charge" their EVs at work and shave their own evening peaks at home by self-supplying some of their electricity demand at night. This 'rolling solar storage' concept thus offers an innovative means to support the grid integration of renewables while simultaneously facilitate a user-centric electrification of road transportation.

Yet to unlock the 'rolling solar storage' potential of EVs as a viable business model, greater understanding is needed on the value creation aspects from a) avoided electricity costs, and b) secondary revenue streams; and of their impacts on the financial performance of a company's technology/infrastructure investments. In other words, do the cost-savings and additional revenue streams from increased solar self-consumption (i.e. avoided grid electricity costs, demand flexibility provision) justify a company's investment on V2G charging infrastructure?

At the same time, due consideration must address the behavioural component of EV users such that workplace charging patterns can support (rather than obstruct) a more symbiotic relationship between intermittent RES-E generation and flexible electricity demand. To do so, the willingness to accept third-party access of one's EV battery at work needs to be thoroughly understood such that compensatory schemes can be designed to lower/overcome EV user trade-offs from a company's workforce and enhance their participation. In other words, what aspects of a firm's smart solar charging can help ensure that its workforce's EVs are at the time/location needed to make them a complementary, rather than competing, asset for the grid integration of RE?

The project presented here addresses these key considerations through an in-depth examination of the key socio-economic parameters affecting the investment decision-making process of company executives, as well as of the most salient behavioural markers triggering employee 'buy-in'. The project involves a network of collaborators with DSOs, solar PV developers, e-mobility providers, and various 'case' companies interested in the 'rolling solar storage' model for future adoption. Empirical results will serve to inform policy-prescriptive recommendations on the design of sector coupling policies to integrate the electrification of passenger vehicles into a renewables-based energy system as an integral component of Switzerland's Energy Strategy 2050.

V2X Suisse: car-sharing and bidirectional charging

Marco Piffaretti, Projektleiter V2X Suisse
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The Mobility Cooperative is working with several partners to test the potential of electric cars as energy storage devices, to see how they might contribute to grid stability. The pilot project is set to run until spring 2024, and has already proved that the technology works – but there's still a lot of work to be done in Switzerland before it can be used on a widespread basis.

In future, electric cars could be used to balance out fluctuations in the grid by feeding power back into the network when they aren't being driven. This is certainly possible from a technological standpoint, as Switzerland's own "V2X Suisse" pilot project, which is being led by Mobility, recently demonstrated. Launched in 2022, the project has been able to show in tests that it meets the technical requirements set by Swissgrid, the operator of the country's national grid. Specifically, this means that the system platform is able to respond to a signal to begin compensating for fluctuations in the grid within two seconds. With the increasing risk of power shortages and energy bottlenecks, this is a major achievement that underlines the potential that this technology has to offer.

The idea behind bidirectional charging is simple: stationary vehicles are used as mobile power banks that can be linked together to form energy storage units and smooth out power peaks. Mobility's current fleet of 3'000 vehicles alone could, in theory, theoretically supply 60 megawatts – more than the Peccia pumped-storage power plant in Ticino, for example.

Making the most of valuable insights during the winter months
The V2X Suisse project is exploring various regulatory and technical issues surrounding the use of vehicles for bidirectional charging. It is the largest test of its kind to be carried out in Switzerland to date – involving 50 of Mobility's "Honde e" vehicles that are available for regular car sharing at 40 stations across Switzerland. Customers have already covered more than 400'000 kilometres in these vehicles, with many more to come. This summer, it was decided to extend the project by six months until the end of March 2024. The reason for this that developing the platform was a complex process and building the V2X infrastructure took longer than expected. Now that the full project set-up is available, the aim is to make the most of the valuable insights to be gained from the winter months.

The focus is now on economic efficiency
The technical feasibility of the system has now been proved. The main task now is to look into the economic viability of the technology involved. There are still some hurdles to overcome before that is the case. In the initial phase, the project has already shown that several distribution grid operators are not really prepared for feeding power back into the grid from dual-use batteries. Among other things, solutions are needed to establish the proof of origin of the electricity that is fed back into the grid. However, it does look as if the Swiss parliament will soon abolish double grid fees, and this will lay the foundations for economically sensible implementation.

ABOUT V2X

Seven companies are involved V2X Suisse, with Mobility as the project lead. They are: automotive manufacturer (Honda), software developer (sun2wheel), charging station developer (EVTEC), aggregator manufacturers (tiko), and scientific support providers (novatlantis, in collaboration with ETH). The project is supported by the pilot and demonstration programme run by the Swiss Federal Office of Energy (SFOE).

For details, see: www.mobility.ch/en/v2x

ABOUT MOBILITY

Mobility is the car sharing market leader in Switzerland. The cooperative offers its 261'000 customers 2'960 vehicles across a range of categories at 1'570 stations. Using state-of-the-art technology, the system offers simple, inexpensive and fully automated car sharing with a strong, sustainable foundation. Car sharing as part of a combined mobility approach saves space and reduces traffic and environmental impact: each Mobility car replaces 11 privately owned vehicles.

Mobility-Aware Vehicle-to-Grid Integration with Car-Sharing

Yanan Xin[1*], Nina Wiedemann[1], Lorenzo Nespoli[2], Esra Suel[3], Vasco Medici[2], Martin Raubal[1]

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In this talk, I will present the insights we gained from the SFOE-funded research project, V2G4CarSharing. The project assessed the potential economic and technical benefits of integrating V2G for a large-scale car-sharing fleet in Switzerland, considering the mobility demand of both current and future car-sharing users. In addition, we investigated the willingness of car-sharing users to trade in their time flexibility that can be utilized for the V2G integration, and estimated the value of financial incentives needed to motivate users to shift their booking times. These insights will offer essential guidance for the effective implementation of a V2G strategy within the car-sharing ecosystem.

Thematic Session

Mobility Behaviour

Thematic Session: Mobility Behaviour

Increasing Electrical Vehicle Adoption with personalized nudging

Ursa Bernardic[1*], Davide Cerruti[1], Massimo Filippini[1], Jonas Savelsberg[1], Giuseppe Ugazio[2]

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Replacing combustion engine vehicles with electric vehicles (EV) is an important component to realizing climate objectives and advancing sustainable transportation, aligning with the United Nations Development Goals and the Paris Agreement. In this project, we identify three perception biases that are linked to EV adoption and address them with personalized non-monetary information treatments to increase the adoption of EVs among owners of internal combustion engine vehicles.

To this end, we ran two surveys to first identify the main barriers to EV adoption, and second to test a series of treatments that are targeted at different behavioral or informational barriers/misperceptions preventing the adoption of electric vehicles. More precisely, we tested how information on range anxiety, charging anxiety, fuel cost savings, environmental impact (CO2 emissions), social norms, and physical characteristics of electric vehicles (addressing energy level and showing energy label, home-charging, number of charging stations) impact preferences for electric vehicles.

Subsequently, in a randomized controlled trial with online participants, we measured the extent of perception biases with regard to range anxiety, charging anxiety, and total cost of ownership. Then, we addressed these perception biases with treatments based on respondents' stated car usage behavior and assessed their effect on EV adoption in a stated choice task, the likelihood of switching to an EV, and the preferences for battery sizes. More specifically, in these treatments, we provide feedback on the actual compatibility of EVs based on respondents' driving and parking behaviour to provide empirical evidence on the effectiveness of tailored communication treatments (so-called personalized nudging based on participants' misperceptions) on EV adoption. Taken together, our results shed light on the extent of 1) misperceptions of EV compatibility, 2) the effectiveness of non-monetary treatments, and 3) personalized nudging for electrical vehicle adoption.

Impact of monetary incentives on the adoption of direct load control electricity tariffs by residential consumers

Davide Cerruti[1], Massimo Filippini[1 2], Flora Marchioro[2] and Jonas Savelsberg[1]

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To overcome the inherent clash between the ever-increasing push for electrification in the transportation and heating sectors, and the intermittent nature of renewable energy sources, demand response solutions are receiving growing attention from researchers and policymakers. Accordingly, programs such as direct load control (DLC) tariffs have been proposed as a possible solution. The present study aims to compute the willingness to accept (WTA) for an existing DLC tariff targeted at electric vehicle charging stations and heat pumps in Switzerland. To achieve this, we combined two randomized-controlled trials: (1) a stated-choice contingent valuation within a survey of 653 electric vehicle owners and (2) a revealed-preference field experiment on an existing DLC tariff proposed to 1500 clients of a local distribution system operator. In both settings, the treatment entailed a discount on the installation cost for the DLC remote control system, which for treated customers was entirely covered by the distribution system operator. Initial results suggest that both the annual discount level on the electricity bill and the coverage of installation costs can impact acceptance rates. We find also that presenting an explanatory video on the tariff has a positive results on DLC tariff adoption.

Making night train services a valuable alternative to air travel: insights from mobility patterns of night train users in Switzerland

Tiziano Gerosa[1], Francesca Cellina[1], Stefano Scagnolari[2]

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Addressing the air travel demand for leisure purposes is one of the key open challenges in transitioning to a low-carbon society. In Switzerland, where most of the flights are from/to nearby European countries, their replacement with night train (NT) services is a promising alternative. The empowerment of existing routes and the inclusion of additional destinations was recently announced, raising expectations for the relaunch of this previously neglected socio-technical innovation. However, there is still little research on the demand side, investigating how well-established NT are among this niche of long-distance travel innovators and whether the use of low-carbon transport solutions also extends to other areas of their life.

The present study aims to bridge this gap by answering the following research questions: 1) are long-distance travel choices of current NT users consolidated and environmentally consistent with their daily mobility practices? 2) what socio-demographic, contextual, and experiential factors mainly characterize their emergent mobility patterns? Answering these questions might provide new insights to increase the use of NT services by acting on factors influencing long-distance travel and the daily mobility.

We use a mixed-method approach that combines inductive statistical techniques to identify recurrent clusters of daily and long-distance mobility practices with qualitative investigations on the underlying experiential factors. A web-based survey was first developed and distributed through email and invitation flyers to the carriages of all NT departing from Switzerland between Sep 2022 and Jan 2023. A total of 389 travellers answered the questionnaire, reporting on their socio-demo and travel mode choices. Additional information on the local degree of urbanization, accessibility of public transport, and political orientation were linked through the residence address given by the respondents. A latent class analysis was then conducted to identify subgroups of participants based on their travel choices and evaluate relevant predictors of group membership at both the individual and the local community levels. Members of each emerging class were then randomly invited to participate in a semi-structured interview to investigate the personal experiences underlying their choices.

The latent class analysis resulted in three groups of travel practitioners distinguished by a predominant use of rail and public transport (Green = 40%), mixed long-distance travel mode choices and car-oriented daily mobility (Strategic = 41%), preference for plane combined with public transport and active daily mobility (Compensatory = 19%). Compared to G, on average, S have larger families and live in less densely populated and environmentally concerned areas, while C feel less responsible towards climate issues. A total of 15 qualitative interviews with members of each class of travel practitioners were carried out, and the first results will be available at the end of summer of 2023.

Mobile Charging Stations with Battery Energy Storage for EV Charging with Renewable Energy

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"In 2022, Switzerland saw the registration of nearly 110,800 all-electric vehicles (EV), constituting 2.3% of the total passenger car market. The rapid growth of EV adoption is undeniable, yet it faces a significant hurdle—the inadequacy of charging infrastructure to cater to all locations. Presently, the financial feasibility of deploying fixed charging stations (FCSs) at every potential site remains a challenge, given the relatively low ratio of EVs to internal combustion engine vehicles.

This shortage of FCSs increase range anxiety and prolongs overall charging times, both of which are key obstacles to widespread EV adoption. To address these issues, mobile charging stations with energy storage (MCSs) emerge as a pivotal solution, expediting the path toward greater EV adoption by offering charging services at the convenience of EV users in terms of timing and location.

My presentation aims to disseminate information regarding research papers, technical reports focused on MCSs and present latest development from Swiss based startup called Kolbev. We will discuss the benefits, analyze the associated challenges, and ultimately propose potential pilot and demonstration project topics centered on MCSs as a flexible adjunct to fixed charging stations. Leveraging MCS services presents a cost-effective technology for facility owners, enhancing the utilization rates of charging infrastructure. It also aids the power grid in mitigating the adverse impacts of growing EV penetration and utilization of renewable energy.

Kolbev introduces a pragmatic and transformative solution that has the potential to redefine our approach to EV charging and the integration of renewable energy sources. This presentation seeks to underscore the strategic importance of mobile large battery energy storage systems equipped with EV charging capabilities. It offers a compelling response to the pressing industry need for straightforward, secure, mobile, and cost-efficient charging solutions."

Policies for sustainable mobility leveraging bounded rationality: some results from the PROBOUND project

Valentino Piana[1*]

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The PROBOUND project (Promoting the energy transition by leveraging bounded rationality and appropriately redesigned policies) funded by the Swiss Federal Office of Energy (SFOE) within the Energy–Economy–Society (EES) research program (SI/502172) investigated the presence of bounded rationality (BR) in households taking energy-related decisions and the way in which a vast array of policy designs can draw upon it. The 21 policy designs are addressing mobility choices on resources (e.g. purchase of a vehicle) and uses (e.g. using public transport, bikes or a private car), since this is a field where individual decentralized decision-making can be easily affected by multi-stage knowledge processing, confirmation bias, habits and other aspect of bounded rationality.

The project has followed the sequence indicated in the following Figure 1:

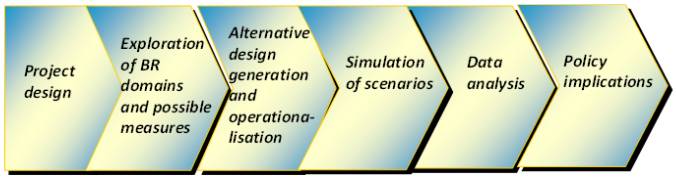

Figure 1: The PROBOUND phases

Achieving tight co-simulation, two models (STEM and BedDeM), addressing the overall energy system and SSH-inspired dynamics, have been alternating in producing a baseline trajectory of yearly values 2020-2050 for the evolution of the household vehicle fleet and its use.

The PROBOUND project, on a background of an even wider range of policies, has quantitatively evaluated the impacts of the several policies (and their multiple designs). These policies aim to address touchpoints of a bounded-rational process of car purchase which extends over time, is triggered by objective and subjective factors, and can lead not only to purchase a new vehicle but also a new mobility resource (such as the General Abonnement travel card to public transport). Some policies draw on nudging, others are independent from it.

Within the models and the assumptions of the project, these policies show different effectiveness: several of them are quite effective in the short term to boost sales of electric vehicles and to increase the use of public transport. Some of them anticipate to 2035 the year in which the fleet is composed by a majority of BEV, from the 2041 of the baseline.

These and further qualitative and quantitative results of simulating such policies in a co-simulation modeling framework and exercise will be shared with the community of the workshop. In particular, we shall discuss the overall approach, the way it has been implemented and how it could be extended to further fields of the energy transition, including through the SWEET program and future common projects.

Thematic Session

Transport System, multimodal mobility, digital solutions

Leveraging Carpooling to Enhance Multi-Modality: Learnings from Co-Design of a Mobility-as-a-Service Tool

Francesca Cellina [a], Marco Derboni [b], Vincenzo Giuffrida [b], Mirko Baruffini [c], Paolo Mastrobuono [c], Jan Trautmann [d], Uroš Tomic [e], Camille Vedel [f]

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Simulations have shown that integrating car-pooling into app-based Mobility-as-a-Service (MaaS) schemes is a promising option to favour multi-modal mobility in low-density, sub-urban contexts. However, evidence from real-life implementation is still limited: what practical enabling and impeding conditions affect the possibility to achieve such a potential and create tangible impact in real-life conditions?

We tackle this question from the perspective of potential MaaS users, within co-design activities aimed at developing MixMyRide, a Swiss-based inter-modal trip planning app combing public transport, shared micro-mobility, and carpooling. To collect insights on prospective users' needs and expectations, in Summer-Autumn 2022 we performed three co-design workshop sessions, which involved Southern-Switzerland selected stakeholders (transport operators, cantonal and municipal institutions, start-uppers, environmental NGOs) and interested citizens, self-selected through social media campaigns.

Five key elements of practical interest for multi-modal MaaS schemes emerged from the co-design workshops. How to ensure trust and a sufficiently large, critical mass of users, resonate with limitations identified in previous casual carpooling research. Additionally, pooled multi-modal mobility requires technology development (real-time, high granularity traffic data is needed to deal with risks of delays and missing inter-changes), new infrastructure equipment (pick-up and drop-off areas are needed in dense urban areas, close to public transport stops, to ensure safe and time-effective inter-changes), as well as novel leverages to incentivise car drivers to offer rides, as monetary or gamified leverages may not be sufficient to compensate for the loss in convenience and perception of individual flexibility).

Do multimodal travellers intend to increase the use of public transport and shared micro-mobility? Evidence from Switzerland

Uros Tomic*, Raphael Hörler, Mirjam Baumann, Jonas Giger, Andrea Del Duce

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Detrimental effects of car-based travel, such as environmental pollution and CO2 emissions, negative health effects, congestion-related problems, and the excessive use of public spaces that affects the quality of life, especially in urban areas, are increasingly motivating initiatives to reduce car dependency. A possible measure to accelerate the transition away from the current car-centric system could be to promote multimodal mobility [1]–[3]. Multimodal mobility offers the opportunity to experience transportation options other than car directly and, in the case of positive experiences, to develop intentions to increase the use of alternatives to private car. From that point of view, a lot can be learned from multimodal travellers, especially from the car users among them. Against this background, we explore in this study the research question whether multimodality might be associated with higher intention to increase the use of public transport and shared micro-mobility solutions in the future.

The study is part of a project financed by the Swiss Federal Office of Energy (SFOE), within which a travel planner app called MixMyRide is developed and launched. The app incorporates, in addition to traditional means of transport, such as private car, public transport, bike and foot, also shared micro-mobility solutions such as bike- and e-scooter-sharing and the possibility to offer and book carpooling service. Within the project, several surveys and workshops are planned with test persons from the agglomerations Zurich-Winterthur, Geneva and Lugano. In the course of a one year filed phase, the effect of the app on the travel behaviour of the participants will be analysed. This study focuses on the baseline survey of this project and investigates whether the intention to increase the use of public transport, bike-sharing and e-scooter-sharing (measured by the corresponding questions in the survey) varies with the level of multimodality (measured by the frequency of use of the different means of transport reported in the survey).

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Thematic Session: Transport System, multimodal mobility, digital solutions

~~Co-Design of Future Mobility Systems~~ (cancelled)

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When designing complex systems, we need to consider multiple trade-offs at various abstraction levels and scales, and choices of single components need to be studied jointly. For instance, the design of future mobility solutions (e.g., autonomous vehicles, micromobility) and the design of the mobility systems they enable are closely coupled. Indeed, knowledge about the intended service of novel mobility solutions would impact their design and deployment process, whilst insights about their technological development could significantly affect transportation management policies.

Optimally co-designing sociotechnical systems is a complex task for at least two reasons. On one hand, the co-design of interconnected systems (e.g., large networks of cyber-physical systems) involves the simultaneous choice of components arising from heterogeneous natures (e.g., hardware vs. software parts) and fields, while satisfying systemic constraints and accounting for multiple objectives. On the other hand, components are connected via collaborative and conflicting interactions between different stakeholders (e.g., within an intermodal mobility system).

In this talk, I will present a framework to co-design complex systems, leveraging a monotone theory of co-design and tools from game theory.

The framework will be instantiated in the task of designing future mobility systems, all the way from the policies that a city can design, to the autonomy of vehicles part of an autonomous mobility-on-demand service. Through various case studies, I will show how the proposed approaches allow one to efficiently answer heterogeneous questions, unifying different modeling techniques and promoting interdisciplinarity, modularity, and compositionality. I will then discuss open challenges for compositional systems design optimization, and present my agenda to tackle them.

Thematic Session: Transport System, multimodal mobility, digital solutions

Interactive Interface for Mobility Data Visual Analysis

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Translating mobility data into actionable decisions to achieve a sustainable future is a complex procedure that requires the contribution of experts and practitioners from different domains, such as energy systems, transport systems, infrastructure, and social science (Banister, 2008). With the ever-increasing volume of data generated by various instruments such as GPS devices, sensors, and mobile apps, the ability to harness this information effectively is paramount. Emerging visual environments connected to databases and analytical tools are designed and implemented to advance human decision-making and reasoning in complex scenarios (Chen et al., 2023).

Mobility data contains rich semantic information in space and time, encompassing multiple dimensions such as graphical data, infrastructure, human mobility, vehicles, and even more intricate spatial events, stories, human perception, and awareness. Many studies adopt cartographic methods to generalize, abstract, aggregate, and highlight the selected data, guiding stakeholders in deriving insights intuitively. Furthermore, geovisual analytical methods are increasingly employed to facilitate human reasoning in recognizing spatiotemporal patterns of metaigneous geodata (Zuo et al., 2022), urban traffic detection (Zeng et al., 2020), and human mobility analysis (Wu et al., 2017). Additionally, many new technologies are used to engage decision makers further. For example, augmented, mixed, and virtual reality devices are incorporated to enable immersive analysis (Strada et al., 2022). Moreover, interactive dashboards are adopted to present both an overview and detailed information on a single screen. These dashboards assist viewers in establishing an overview while empowering them to retrieve detailed information on demand.

With the ever-increasing amount of data, future challenges in visualizing mobility data involve protecting privacy regarding human mobility data and ensuring trustworthiness. To achieve this goal, we propose a framework for visualizing big mobility data, ensuring privacy by aggregating and abstracting data while enhancing data traceability and comparability. Additionally, the framework will be demonstrated through three solutions across the mobility data life cycle: pre-computation, computation, and post-computation.

In conclusion, visual analytics serves as a vital tool in the field of mobility by transforming complex data into actionable insights. Its ability to offer interactive visualizations, real-time dashboards, and predictive models empowers both urban planners and individual commuters to make better-informed decisions, ultimately contributing to more efficient and seamless transportation systems.

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Thematic Session

Heavy-duty and non-Road Transport

Thematic Session: Heavy-duty and non-Road Transport

From Urban Mobility to Global Freight: A Simulation Framework for Advancing Sustainability in Maritime Transportation

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We present a multi-agent simulation framework tailored to investigate the effect of novel system mechanisms and operational policies on economic and environmental factors for maritime transportation. The maritime transportation sector is a crucial pillar for global trade and economic growth, and a significant contributor to transportation related greenhouse gas emissions. For the example of oil transport, we simulate historical transportation requests and show how coordination of the global tanker fleet can reduce emissions and make operations less asset heavy. Future studies aim to further question the status-quo of the current maritime transportation system design and stakeholder incentives in favor of a sustainable and resilient future.

The role of HVO in SBB's decarbonisation strategy

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SBB's decarbonisation strategy includes various initiatives such as the procurement of battery-electric locomotives, measures to increase the overall energy efficiency as well as the use of Hydrotreated Vegetable Oil (HVO) as an alternative fuel. Overall, the strategy of SBB involves a two-step approach to decarbonisation:

1) utilizing alternative diesel fuels as a transitional solution (HVO-Blend & e-Fuels) and

2) gradually replacing the fleet with battery-electric locomotives.

HVO belongs to the paraffinic diesels (like SynFuels and e-Fuels) and is a pure hydrocarbon compound. It is a so-called drop-in fuel: it can be used as an admixture (blend) and pure.

- The blend with up to 30% admixture to conventional diesel meets the previous standards (EN 590) and can be used in all diesel engines.
- 100% HVO complies with the EN 15940 fuel standard, and many diesel engines - including those at SBB - have already been approved for it.

Diesel demand at SBB will decrease significantly over the next years due to the replacements of locomotives and efficiency measures. The remaining diesel demand will gradually be met with renewable, sustainable second-generation fuels (e.g. HVO, biodiesel). The presentation also includes an overview of the current diesel consumption in SBB's locomotives, highlighting the need for diesel alternatives. Furthermore, it outlines the transitional phase and the demand for diesel alternatives, providing a four-step introduction to alternative diesel fuels.

BIENE Battery Manager – a railway sector approach

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The BIENE project (**B**atter**IE**schwarm im Bahnstrom**NE**tz) was able to demonstrate the benefits of a central battery management for the upcoming electrification of diesel rail vehicles in Switzerland.

Based on the results of this study a BFE-funded project was started by SBB, Rhätische Bahn RhB and BFH to pilot the proposed solution on the first battery vehicles. The aim of the BIENE central battery management is to ensure sufficient battery capacity for the next operations, to enable age-optimised charging and to support asset management in optimising the life cycle costs of the batteries. In addition, grid-serving opportunities are to be exploited. The pilot project enables tested and well-founded requirements for future battery vehicles and supports an efficient technology shift from fossil energies to a climate-neutral vehicle fleet.

A joint railway sector solution is intended to exploit synergies for all parties involved so that vehicle users, owners and suppliers as well as energy providers can benefit together.

A multipronged approach to achieving sustainable heavy-duty transport

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The perils of climate change have underscored the urgent need for rapid decarbonization of every industrial sector as well as individual lifestyles. The transport sector accounting to 27% CO2 emission stands to be one of the largest emitters calling for drastic transformative measures. Out of this, 5.6% is contributed primarily by Heavy-Duty Vehicles (HDVs) such as long-haul trucks, coaches and buses. Unlike passenger cars, full electrification of HDVs presents some daunting challenges, due to their highly demanding missions that require ultra-high performance coupled with safety, durability, commercial fleet preferences (TCO, warranty, ease of operation) and availability of adequate charging infrastructure. Another important consideration that is particularly relevant for users of agricultural machinery is the aspect of 'self-sustenance' through the use of zero or low carbon renewable fuels (e-/synthetic/biofuels) derived from farm waste.

Hence, an agnostic approach constituting the development and implementation of a wide-range of propulsion technologies is necessary to bring immediate benefit in terms of the scale of reduction in carbon as well as other harmful emissions while fulfilling all the HD criteria for customer acceptance. Being a commercial vehicle OEM who are developing own powertrain solutions in-house, we are committed to pursue innovations and tailor technologies meeting all the above challenges. In this talk, a glimpse of our holistic strategy will be highlighted through our diverse product portfolio and innovative powertrain technologies in the pipeline, some of which are supported through EU/CH-funded R&D collaboration programs.