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E-Bike City

Designing Sustainable Streets

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Summary

The E-Bike City project explores how reallocating up to 50% of urban road space to micromobility (primarily conventional bicycles, e-bikes (up to 25kph) and speed pedelecs (up to 45kph)) affects accessibility in cities with more than 50,000 inhabitants. Using Zurich as a case study, the analysis shows that 54% of street space could be dedicated to micromobility (up from 12.2%), mainly by reorganizing motorized private transport and street parking. Existing public transport lanes and pedestrian infrastructure are preserved, and car access to buildings is maintained and some car parking is available within 200 meters of every building, along with a network of one-way streets. After determining the new street designs in Zurich, we then used agent-based transportation modeling (MATSim) and stated preference surveys to compare the effects it would have in 50 years with the expected rise in population.

Optimized planning and mode shifts
Optimized planning enables cycle path expansion with minimal impact on car travel times. Balanced solutions improve the cycle network by 35% while increasing car journey times by less than 20%. The introduction of safe, separated cycling infrastructure is crucial for making cycling attractive for bikes, e-bikes, and speed pedelecs, and for reducing private car dependency. Demand varies by trip length: conventional bikes are preferred for trips up to 1.6 km, e-bikes for trips up to 9 km, and speed pedelecs for longer distances. Travel time is a more significant factor in mode choice than cost, especially for car drivers.

The model estimates that car travel time becomes much more sensitive to changes in road space allocation in the E-Bike City scenario. This suggests that structural changes, such as reallocating road space, are more effective than price signals alone in reducing car dependency and can be used by city officials as a lever for change. If street space were reallocated to micromobility, up to 50% of car trips in the perimeter of the city and 80% of trips starting and ending in the city could be eliminated. Half of the passenger kilometers in motorized private transport would shift to public transport and bicycles. Car drivers with larger vehicles are more willing to switch to public transport and less likely to cycle, while small car owners were more likely to switch to e-bikes (both types of car drivers showed the least resistance to the 25kph e-bikes compared to other bike types). In percentage terms, bike modes saw the largest increases in demand, with conventional bikes and e-bikes nearly quadrupling their share of person-kilometers to 17.5%.

Public transport and environmental benefits
Our models showed that public transportation would need to cope with a doubling in demand as a result of E-Bike City. We proposed that by using a two-stage stochastic mixed-integer programming model, we could design a transit network that accommodates increases in public transportation demand. In bad weather conditions (some mode shifts from cycling to bus/tram) and during peak travel times, our model achieved a 6.5% reduction in operating costs and a 1.7–1.9% improvement in passenger travel times.

This massive mode shift away from private vehicles not only allows more space for more efficient modes, but it would reduce passenger transport emissions by about 45% (1.25 million tCO_2 over 50 years). The external costs of the transport system (including health, environment, accidents, and noise) shift from negative to positive over the 50-year modeling period. Cycling, walking, and public transport each have positive net externalities per kilometer, especially for trips up to 12 km. The project's implementation is estimated to cost between 300 and 650 million CHF, with annual social cost savings of 24–76 million CHF due to reduced accidents. The net social benefit over 50 years is projected at +38.10 billion CHF compared to a do-nothing scenario.

Public acceptance
A representative survey found 44.4% in favor of the E-Bike City, 43.3% opposed, and 12.3% unsure. Opposition is driven by perceived unfairness and fears of disruption, but visualizations highlighting greenery and improved urban quality help promote acceptance.

Zusammenfassung

Das E-Bike-City-Projekt untersucht, wie sich die Umwidmung von bis zu 50% des städtischen Strassenraums für Mikromobilität (hauptsächlich konventionelle Velos, E-Bikes (bis zu 25 km/h) und Speed-

Pedelecs (bis zu 45 km/h)) auf die Erreichbarkeit in Städten mit mehr als 50.000 Einwohnern auswirkt. Am Beispiel Zürich zeigt die Analyse, dass 54% des Strassenraums (gegenüber bisher 12.2%) für Mikromobilität reserviert werden könnten, vor allem durch die Umgestaltung des motorisierten Individualverkehrs und des Parkraums. Bestehende Öffentliche-Verkehrs-Spuren und Fussgängerinfrastruktur bleiben erhalten, und der Autozugang zu Gebäuden wird sichergestellt, wobei Autoparkplätze innerhalb von 200 Metern um jedes Gebäude sowie ein Netz von Einbahnstrassen vorgesehen sind. Nach der Festlegung der neuen Strassenkonzepte in Zürich wurden agentenbasierte Verkehrsmodelle (MATSim) und Stated-Preference-Befragungen verwendet, um die Auswirkungen im Vergleich zum erwarteten Bevölkerungswachstum über 50 Jahre zu simulieren.

Optimierte Planung und Modusverschiebungen

Durch optimierte Planung kann das Velowegnetz mit minimalen Auswirkungen auf die Autofahrzeiten ausgebaut werden. Ausgewogene Lösungen verbessern das Velonetz um 35%, während sich die Autofahrzeiten um weniger als 20% erhöhen. Die Einführung von sicheren, abgetrennten Veloinfrastrukturen ist entscheidend, um Velos, E-Bikes und Speed-Pedelecs attraktiv zu machen und die Abhängigkeit vom privaten Auto zu verringern. Die Nachfrage variiert je nach Streckenlänge: Konventionelle Velos werden für Strecken bis zu 1.6 km bevorzugt, E-Bikes für Strecken bis zu 9 km und Speed-Pedelecs für längere Distanzen. Die Reisezeit ist ein entscheidenderer Faktor bei der Verkehrsmittelwahl als die Kosten, insbesondere für Autofahrer.

Das Modell zeigt, dass die Autofahrzeit im E-Bike-City-Szenario viel empfindlicher auf Änderungen bei der Strassenraumverteilung reagiert. Dies deutet darauf hin, dass strukturelle Änderungen wie die Umverteilung des Strassenraums wirksamer sind als reine Preissignale, um die Abhängigkeit vom Auto zu verringern, und von Stadtverwaltungen als Hebel für Veränderungen genutzt werden können. Wenn Strassenraum für Mikromobilität umgewidmet würde, könnten bis zu 50% der Autofahrten im Stadtgebiet und 80% der Fahrten, die innerhalb der Stadt beginnen und enden, vermieden werden. Die Hälfte der Personenkilometer im motorisierten Individualverkehr würde auf den Öffentlichen Verkehr und Velos verlagert. Autofahrer mit grösseren Fahrzeugen sind eher bereit, auf den Öffentlichen Verkehr umzusteigen, und weniger bereit, mit dem Velo zu fahren, während Besitzer von Kleinwagen eher auf E-Bikes umsteigen (beide Gruppen zeigten im Vergleich zu anderen Velotypen den geringsten Widerstand gegen E-Bikes mit 25 km/h). Prozentual gesehen verzeichneten die Velotypen den grössten Nachfragezuwachs, wobei sich der Anteil der konventionellen Velos und E-Bikes an den Personenkilometern auf 17.5% fast vervierfachte.

Öffentlicher Verkehr und Umweltvorteile

Unsere Modelle zeigen, dass der Öffentliche Verkehr mit einer Verdoppelung der Nachfrage durch E-Bike-City rechnen muss. Wir schlagen vor, mit einem zweistufigen stochastischen gemischt-ganzzahligen Optimierungsmodell ein Nahverkehrsnetz zu entwerfen, das den Anstieg der Nachfrage bewältigt. Bei schlechtem Wetter (ein Teil der Velofahrten wechselt auf Bus/Tram) und zu Hauptverkehrszeiten erreichte unser Modell eine 6.5% Reduktion der Betriebskosten und eine Verbesserung der Fahrgastfahrzeiten um 1.7–1.9%. Diese massive Modusverschiebung weg vom privaten Auto schafft nicht nur mehr Platz für effizientere Verkehrsmittel, sondern reduziert auch die Emissionen des Personenverkehrs um ca. 45% (1.25 Mio. tCO_2 über 50 Jahre). Die externen Kosten des Verkehrssystems (einschliesslich Gesundheit, Umwelt, Unfälle und Lärm) wechseln über den 50-jährigen Modellierungszeitraum von negativ zu positiv. Velofahren, Zufussgehen und Öffentlicher Verkehr haben jeweils positive Netto-Externalitäten pro Kilometer, insbesondere bei Strecken bis zu 12 km. Die Umsetzung des Projekts wird auf 300 bis 650 Mio. CHF geschätzt, mit jährlichen sozialen Kosteneinsparungen von 24–76 Mio. CHF aufgrund reduzierter Unfälle. Der soziale Nettonutzen über 50 Jahre wird auf +38.10 Mrd. CHF im Vergleich zum Nichtstun-Szenario geschätzt.

Öffentliche Akzeptanz

Eine repräsentative Umfrage ergab, dass 44.4% für eine E-Bike-City sind, 43.3% dagegen und 12.3% unentschlossen. Die Ablehnung wird durch wahrgenommene Ungerechtigkeit und Befürchtungen vor Störungen motiviert, doch Visualisierungen, die Grünflächen und eine verbesserte urbane Qualität hervorheben, fördern die Akzeptanz.

Résumé

Le projet E-Bike City explore comment une réallocation allant jusqu'à 50% de l'espace routier urbain à la micromobilité (principalement vélos conventionnels, vélos électriques—jusqu'à 25km/h—et speed pedelecs—jusqu'à 45km/h) affecte l'accessibilité dans les villes de plus de 50 000 habitants. En utilisant Zurich comme étude de cas, l'analyse montre que 54% de l'espace des rues pourrait être dédié à la micromobilité (contre 12,2% actuellement), principalement grâce à la réorganisation du transport motorisé privé et du stationnement. Les voies de transport public existantes et l'infrastructure piétonne sont préservées, et l'accès des voitures aux bâtiments est maintenu, avec un certain nombre de places de stationnement disponibles dans un rayon de 200 mètres de chaque bâtiment, ainsi qu'un réseau de rues à sens unique. Après avoir défini la nouvelle configuration des rues à Zurich, nous avons utilisé la modélisation de transport basée sur les agents (MATSim) et des enquêtes de préférences déclarées pour comparer les effets attendus dans 50 ans compte tenu de l'augmentation anticipée de la population.

Planification optimisée et changement de mode
La planification optimisée permet d'étendre les pistes cyclables avec un impact minimal sur les temps de trajet en voiture. Des solutions équilibrées améliorent le réseau cyclable de 35% tout en augmentant les temps de trajet en voiture de moins de 20%. L'introduction d'infrastructures cyclables sécurisées et séparées est essentielle pour rendre le vélo attractif pour les vélos classiques, électriques et speed pedelecs, et pour réduire la dépendance à la voiture privée. La demande varie selon la longueur du trajet : les vélos classiques sont préférés pour les trajets jusqu'à 1,6 km, les vélos électriques pour les trajets jusqu'à 9 km, et les speed pedelecs pour les distances plus longues. Le temps de trajet est un facteur plus important dans le choix du mode que le coût, en particulier pour les automobilistes.

Le modèle estime que le temps de trajet en voiture devient beaucoup plus sensible aux changements d'allocation de l'espace routier dans le scénario E-Bike City. Cela suggère que les changements structurels, comme la réallocation de l'espace routier, sont plus efficaces que les signaux de prix seuls pour réduire la dépendance à la voiture et peuvent être utilisés par les responsables municipaux comme levier de changement. Si l'espace des rues était réalloué à la micromobilité, jusqu'à 50% des trajets en voiture dans le périmètre de la ville et 80% des trajets commençant et finissant en ville pourraient être supprimés. La moitié des kilomètres-passagers du transport motorisé privé se reporterait vers les transports publics et le vélo. Les automobilistes possédant de plus grands véhicules sont plus enclins à passer aux transports publics et moins susceptibles de passer au vélo, tandis que les propriétaires de petites voitures sont plus susceptibles de passer au vélo électrique (les deux types d'automobilistes ont montré ont montré une préférence aux vélos électriaues aux vélos électriques de 25km/h par rapport aux autres types de vélos). En termes de pourcentage, les modes cyclistes connaitraient la plus forte augmentation de la demande, avec les vélos classiques et électriques qui ont presque quadruplé leur part de kilomètres-passagers à 17,5%.

Transports publics et bénéfices environnementaux
Nos modèles montrent que les transports publics devraient faire face à un doublement de la demande en raison d'E-Bike City. Nous avons proposé qu'en utilisant un modèle de programmation stochastique mixte en deux étapes, nous puissions concevoir un réseau de transport capable de s'adapter à l'augmentation de la demande. En cas de mauvais temps (certains changements de mode du vélo vers le bus/tram) et pendant les heures de pointe, notre modèle conditionnel une réduction de 6,5% des coûts d'exploitation et une amélioration de 1,7 à 1,9% du temps de trajet des passagers.

Ce changement massif de mode au détriment des véhicules privés non seulement libère de l'espace pour des modes plus efficaces, mais réduirait également les émissions du transport de passagers d'environ 45% (1,25 million de tCO_2 sur 50 ans). Les coûts externes du système de transport (y compris la santé, l'environnement, les accidents et le bruit) passent du négatif au positif sur la période de modélisation de 50 ans. Le vélo, la marche et les transports publics ont chacun des externalités nettes positives par kilomètre, en particulier pour les trajets jusqu'à 12 km. La mise en œuvre du projet est estimée entre 300 et 650 millions de CHF, avec des économies annuelles de coûts sociaux de 24 à 76 millions de CHF grâce à la réduction des accidents. Le bénéfice social net sur 50 ans est projeté à +38,10 milliards de CHF par rapport à un scénario sans action.

Acceptation par le public
Une enquête représentative a révélé que 44,4% étaient favorables à E-Bike City, 43,3% opposés et 12,3% indécis. L'opposition est motivée par la perception d'injustice et la crainte de perturbations, mais les

visualisations mettant en avant la verdure et l'amélioration de la qualité urbaine aident à promouvoir l'acceptation.

Main findings («Take-Home Messages»)

- **1. Major road space reallocation for micromobility**

  Reallocating up to 54% of urban street space to micromobility while preserving public transport and pedestrian access is possible in Zurich, and it can significantly improve urban mobility and accessibility, supporting Swiss goals for sustainable, low-energy transport systems.

- **2. Strong reduction in car dependency and emissions**

  By shifting up to 50% of car trips in the perimeter of the city and 80% of trips starting and ending in the city to micromobility and public transport, passenger transport emissions are reduced by about 45% over 50 years, directly contributing to Switzerland's climate and energy targets.

- **3. High social and economic benefits**

  The project delivers net social benefits of +38.1 billion CHF over 50 years, thanks to reduced accidents, improved health, and lower environmental costs, aligning with Swiss priorities for cost-effective, people-cantered urban planning.

- **4. Public acceptance and improved urban quality**

  Despite initial concerns, visualizations of greener, higher-quality urban spaces help increase public acceptance of street space re-allocation, supporting a just and inclusive transition toward a more energy-efficient, liveable Switzerland.

DE

- **1. Umwidmung eines Grossteils des Strassenraums für Mikromobilität**

  Die Umwidmung von bis zu 54% des städtischen Strassenraums für Mikromobilität ist in Zürich möglich, ohne die Öffentlichen-Verkehrs-Spuren und Fussgängerinfrastruktur zu beeinträchtigen. Dies verbessert die urbane Mobilität und Erreichbarkeit massgeblich und unterstützt die Schweizer Ziele für nachhaltige und energieeffiziente Verkehrssysteme.

- **2. Deutliche Reduktion der Autoabhängigkeit und Emissionen**

  Durch die Verlagerung von bis zu 50% der Autofahrten im Stadtgebiet und 80% der Fahrten, die innerhalb der Stadt beginnen und enden, auf Mikromobilität und Öffentlichen Verkehr werden die Emissionen des Personenverkehrs über 50 Jahre um rund 45% reduziert. Dies leistet einen direkten Beitrag zu den Klima- und Energiezielen der Schweiz.

- **3. Hohe soziale und wirtschaftliche Vorteile**

  Das Projekt erbringt über 50 Jahre einen Nettonutzen von +38.1 Mrd. CHF, dank weniger Unfälle, besserer Gesundheit und tieferen Umweltkosten. Damit entspricht es den Schweizer Prioritäten für kosteneffiziente, menschenzentrierte Stadtentwicklung.

- **4. Öffentliche Akzeptanz und verbesserte urbane Qualität**

  Trotz anfänglicher Bedenken fördern Visualisierungen von grüneren, hochwertigeren urbanen Räumen die Akzeptanz der Strassenraumumwidmung und unterstützen einen gerechten, inklusiven Übergang zu einem energieeffizienteren, lebenswerteren Schweiz.

FR

- **1. Réallocation majeure de l’espace routier pour la micromobilité**

  La réallocation de jusqu’à 54% de l’espace urbain à la micromobilité, tout en préservant les voies de transport public et l’accès des piétons, est possible à Zurich. Cela permet d’améliorer de façon significative la mobilité et l’accessibilité urbaines, soutenant ainsi les objectifs suisses de systèmes de transport durables et à faible consommation d’énergie.

- **2. Réduction importante de la dépendance à la voiture et des émissions**

  En transférant jusqu’à 50% des trajets en voiture à l’intérieur du périmètre urbain et 80% des trajets commençant et finissant dans la ville vers la micromobilité et le transport public, les émissions du transport de passagers sont réduites d’environ 45% sur 50 ans, contribuant directement aux objectifs climatiques et énergétiques de la Suisse.

- **3. Avantages sociaux et économiques élevés**

  Le projet génère des bénéfices sociaux nets de +38,1 milliards de CHF sur 50 ans, grâce à la réduction des accidents, à l’amélioration de la santé et à la diminution des coûts environnementaux, en phase avec les priorités suisses d’une planification urbaine efficace et centrée sur les citoyens.

- **4. Acceptation publique et amélioration de la qualité urbaine**

  Malgré les préoccupations initiales, les visualisations d’espaces urbains plus verts et de meilleure qualité favorisent l’acceptation de la réallocation de l’espace routier, soutenant une transition juste et inclusive vers une Suisse plus économe en énergie et plus agréable à vivre.

Contents

List of abbreviations

D-BAUG: Department of Civil, Environmental and Geomatic Engineering

EBC: E-Bike City

EBIS: E-Bikes in Switzerland

EPFL: Swiss Federal Institute of Technology in Lausanne

ETHZ: Federal Institute of Technology Zurich

GPS: Global Positioning System

MATSim: Multi-Agent Transport Simulation

MOBIS: Mobility in Switzerland

OASIS: Optimization-based Activity Scheduling with Integrated Simultaneous choice dimensions

OECD: Organisation for Economic Co-operation and Development

SFOE: Swiss Federal Office of Energy

SNMan: Street Network Manipulator

SUMO: Simulation of Urban Mobility

1 Introduction

1.1. Context and motivation

The now obvious climate change and the damages caused by it are ever more frequently forcing policymakers and their supporting infrastructure—in think tanks, consultancies, and academic departments—to think the previously unthinkable. With the 1.5 degree increase already surpassed, the dilemma of transport policy is becoming even more acute (World Meteorological Organization, 2025). The dilemma of having to trade the positive effects of new capacity—accommodating population growth and increasing productivity—against their negative ones of increasing greenhouse gas emissions and sprawl. The climate is now the decisive factor in shaping transport policy. The longstanding argument that "no cars equals no economic prosperity" can no longer justify delaying the necessary transition in urban mobility. The window for prioritizing economic concerns over environmental imperatives has closed. Climate change impacts are forcing policymakers to consider transformative adaptation and mitigation policies, beyond incremental changes (European Environment Agency, 2024). Our E-Bike City (EBC) project offers a transformative adaptation to urban networks and transportation.

The existing set of policy ideas are well known and are known to have limitations and counterproductive effects. "Business as usual" of continuing to build new capacity is known to have only time-limited effects, as its induced demand will negate its impact in due course. In addition, in the Swiss context, voters were recently unwilling to pay for new motorway capacity projects, and the highest reported factor was concern for the climate. The people are aware of the impacts that their personal driving has on the climate, and they are ready to make the shift, but the policymakers continue to procrastinate. The shift to electric and later automated vehicles is slowing as the local authorities are dithering with the installation of charging points, especially in older, denser built-up areas. Relying solely on a transition from fossil fuels to electric cars is insufficient: while electric vehicles address fuel-related emissions, they do not solve the broader challenges of sustainable material supply, space allocation, congestion, and society's continued dependence on private car ownership. In addition, that shift will lower the variable costs/perceived generalized costs of vehicle use and with it will lead to unwanted induced demand effects. The shift to shared vehicles, from pooled taxis to buses to trains, is self-limited in its effect due to the system-inherent higher generalized costs. Its upfront capacity cost is high as well, which slows it down as an effective policy instrument. The fourth policy idea of pricing the negative externalities of traffic, from congestion and emissions to parking search, while known to be effective, is also known to be unpopular with the voting public, which in OECD countries is in its majority vehicle-owning.

In this situation, there is a clear need to develop new ideas, unusual ideas, dramatic ideas to explore the solution space for the policy discussion and the public. The arrival of market-ready, reasonably cheap, but fast electric bikes (pedelecs, s-pedelecs) makes the idea to reallocate road space to them an obvious one. Their urban speed is equal to the speed of urban traffic. So, the accessibility they could produce at scale should be comparable to the existing levels of accessibility. We know from many studies that the adoption of cycling is limited by its lack of space on the road, which produces a feeling of insecurity for many potential users. We are late for incremental or unproven solutions; what is needed are quick, easy-to-implement measures that can be deployed immediately. The EBC project explores such a realistic and scalable solution in an integrated and interdisciplinary approach, tested specifically in the Swiss context and widely applicable anywhere that bicycles can be ridden.

The EBC project is therefore assessing the impact of allocating 50% of road space to the active modes, while a) maintaining the existing public transport infrastructures, b) maintaining existing sidewalks for pedestrians, and c) maintaining motorized vehicle access to each street address for deliveries, emergency vehicles, craftsmen, etc. and to any private parking on the property. A further aspect of the project was to determine if it can maintain the levels of accessibility for the urban residents. EBC proposes a fundamental reallocation of urban space towards micromobility. By dedicating substantial road space to active modes such as bikes, e-bikes, cargo bikes, and scooters, the project introduces a modest but essential inconvenience for private car use (namely a reduction of on-street parking), which is an indirect intervention needed to drive meaningful change away from the conveniences offered by the car. Importantly, emergency vehicles and those with specific mobility needs will retain full access to all locations, ensuring that critical services are not compromised. According to our studies, the majority of mode shift expected from the EBC proposal is driven by two key factors: providing attractive, high-quality infrastructure for bikes and micromobility (the main "pull" factor) while moderately reducing the space allocated to moving and parked cars (the most significant "push" factor). This dual approach encourages a transition toward more sustainable transport modes.

The project's design is anchored in shifting away from private car use, particularly for daily commuting. It does so by ensuring access to shared vehicle hubs within 200 meters (in the case of this study) of every residence, promoting convenience and accessibility. EBC also inherently supports an intermodal transportation system, encouraging seamless integration between public transport and shared vehicles—both cars and micromobility options. Transitioning away from the convenience and perceived luxury of private automobiles presents financial challenges for the automotive industry and disrupts the routines of individuals accustomed to car ownership. In exchange, it gives rise to financial benefits for households and fully supports offers by public transportation providers. Next to this shift in industry supply and demand, we must critically assess the human and environmental costs we are willing to bear to maintain the status quo. Equally, all social costs in terms of infrastructure and accessibility need to be considered. "Business as usual" is simply no longer sustainable. Business as usual is damaging our climate and potentially making some environments unliveable. As extreme weather events intensify, driven by climate change, even the use of cars will become impractical or impossible in many cases. The results in this report highlight key components of our work that are especially policy relevant, but all elements are present.

1.2. Project objectives

The E-Bike City project is designed to fundamentally rethink urban mobility by shifting priorities away from private car use and toward sustainable, active modes such as cycling, e-bikes, and micromobility. Its primary objective is to reallocate approximately half of existing urban road space to cycling and micromobility infrastructure, while ensuring that essential access for motorized vehicles, emergency services, and public transport is maintained. This bold reconfiguration aims to make cycling and micromobility safe, attractive, and practical for a wide range of users, including those who currently rely on cars for daily travel.

A key technical objective is the development and demonstration of scalable, automated tools - such as the Street Network Manipulator (SNMan) - that enable cities to redesign their street networks efficiently within real-world constraints. These tools help ensure that all modes of transport remain connected and accessible, and that public transport operations are not disrupted. The project also provides comprehensive guidelines for street and intersection design, supporting municipal planners in implementing the E-Bike City vision across diverse urban contexts.

Beyond physical infrastructure, the project seeks to understand and maximize the broader benefits of this transformation. It aims to quantify reductions in CO_2 emissions and external costs, assess impacts on public health and safety, and evaluate the cost-effectiveness and feasibility of city-scale implementation through a Cost-Benefit Analysis. The project also investigates public acceptance and behavioral change, recognizing that successful adoption requires not only technical solutions but also fair, inclusive, and visually appealing street transformations that resonate with diverse urban populations.

Ultimately, the E-Bike City project strives to offer a practical blueprint for sustainable, equitable, and desirable urban mobility. By demonstrating that a large-scale shift toward active and shared modes is both possible and beneficial, the project aims to help cities achieve significant improvements in health, safety, environmental quality, and overall quality of life.

2 Approach, project management and methods

The E-Bike City project is founded on the urgent need to address the persistent challenges of urban mobility, particularly the outsized role of private automobiles in city life. While the approach is radical, it is also very pragmatic: rather than incremental changes or technological fixes taking years, the project proposes a city-scale reallocation of street space to prioritize cycling, e-bikes, and micromobility while maintaining essential access for motor vehicles, public transport, and emergency services. The vision is to offer practical solutions to rapidly and inexpensively create the possibility for a transportation system overhaul using simple principles and not relying on long-lasting, expensive infrastructure projects.

The project recognizes that technical progress in electric vehicles alone will not suffice to decarbonize transport or address broader issues like congestion, inefficient land use, and public health. Instead, it leverages the transformative potential of the recent surge in e-bike popularity (and e-scooters), which has expanded the accessibility and appeal of cycling to a much wider demographic. The core idea is to dedicate approximately half of existing urban road space to cycling infrastructure, while ensuring that all urban residents retain access to essential services and that public transport operations remain unimpeded.

The approach is designed to be scalable and adaptable and is purposefully interdisciplinary in nature, combining urban planning, transport engineering, behavioral science, and environmental assessment. Although the name points just to e-bikes, the project goes beyond bikes to consider equity, accessibility, and the integration of green and social spaces into street design. The project also acknowledges the importance of public acceptance and political feasibility, seeking to bridge ideological divides through clear communication, policy transparency, and the use of visualizations to make the benefits of transformation tangible.

A group of chairs at the Department of Civil, Environmental and Geomatic Engineering (ETH Zurich) coalesced around this idea in 2021, when the department was searching for lighthouse projects highlighting its abilities. Later, one chair at EPFL joined them. The chairs contributed their own resources, which were supplemented with departmental funds and contributions by the Federal Office of Energy and Energy Switzerland. The chairs are:

- Prof. Dr. Bryan Adey, Institute of Construction & Infrastructure Management
- Prof. Dr. Kay Axhausen, Institute for Transport Planning and Systems
- Prof. Dr. Michel Bierlaire, Transportation and Mobility Laboratory, EPFL
- Prof. Dr. Francesco Corman, Institute for Transport Planning and Systems
- Prof. Dr. David Kaufmann, Institute for Spatial and Landscape Development
- Dr. Anastasios Kouvelas, Institute for Transport Planning and Systems
- Prof. Dr. Stephan Pfister, Institute of Environmental Engineering
- Prof. Dr. Martin Raubal, Institute of Cartography and Geoinformation

The city of Zurich was our case study, as we had previous work on which we could build. Here, the simulation models implemented and calibrated in the MATSim and Sumo frameworks were important given the three-year timeframe of our project. Access to the existing Swiss Mobility Panel was also important for the work on the public acceptance of the idea. The earlier EBIS (E-Bikes in Switzerland) and MOBIS (Mobility in Switzerland) GPS tracking and survey studies provided further insights and data. Just over a year into the project, we realized the complexity involved in coordinating research among the 30 researchers on our team. We also recognized the importance of visually representing our scope of work to better communicate our science - both to the public and to decision-makers who could benefit from our results. To address these emerging needs, we brought in a project coordinator, Dr. Catherine Elliot. Catherine created a project milestones Gantt chart as a timeline to ensure that a functional MATSim product was delivered to all researchers who needed it for their modeling and data pipelines. In addition to organizing the research aspect of the project with meetings and regular updates, she planned and executed two phases of visualizations, first to create infographics of the 9 subprojects and an EBC logo, then to transform the four re-designed streets of Zurich into 32 before/after 3D rendered images and a virtual realistic video animating different street users and explaining the project vision and background. All of this was in addition to maintaining regular contact with media to disseminate research findings to the public and through LinkedIn to disseminate research to relevant professionals in urban planning, traffic engineering, etc. Finally, an "EBC results book" was created as a PDF and 500 were printed (including pull out visualizations and the EBC network map of Zurich). These were distributed at the EBC Results and Future Event on 4 June, 2025 as well as mailed and further distributed to ~250 researchers and professionals.

We are looking forward to the discussion of this promising idea. We are aware that our project was unable to explore all issues such a dramatic shift would raise. The lack of integration of suburbia is the most obvious one. The possible longer-term disinvestment in cars and suburban real estate is the other. Equally, the shifts in retail and other customer services need further attention. We also would need to study the resorting of workers and their households by their home and work locations. Inside the transport modelling frameworks, more attention is needed on the rescheduling of the days and weeks of the agents. Equally, the acquisition of cycles and the other mobility tools in the medium term and of their use over the course of the year will be important to understand the possible acceptance of the EBC.

3 Results

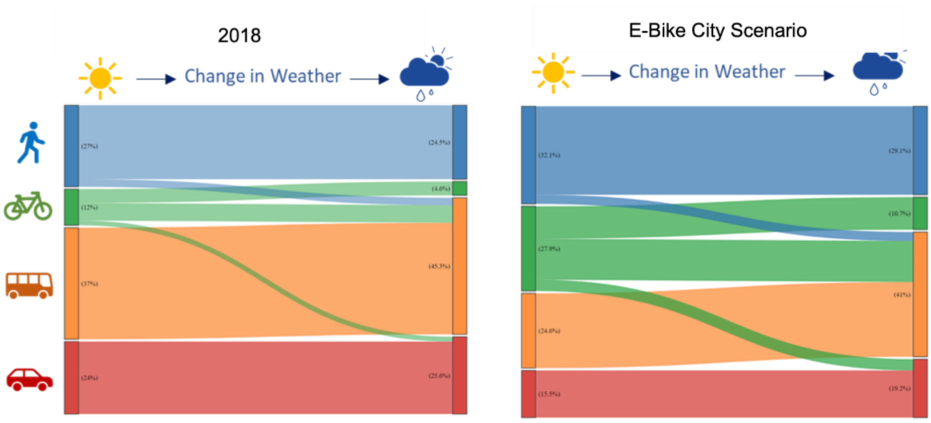
3.1. Multi-scale responsive public transport planning for bi-modal demand

Authors: William Andersson, Florian Fuchs, Zahra Ansarilari and Francesco Corman

Micromobility travel modes, such as e-bikes, are becoming increasingly popular. Travel demand is therefore more sensitive to people's bi-modal travel behavior, with changes in weather conditions causing variations in travel choices. This subproject aims to redesign the transit system to provide passengers with high-quality service and save operating expenses. For demand variations that may lead to high loads and surplus capacity, it is necessary to plan in advance, using minimal and easy-to-deploy actions. To address this issue, we developed a two-stage stochastic model using demand data from a MATSim simulation. Our model makes significant improvements to vehicle costs and passenger travel times.

In favorable weather, individuals with access to e-bikes may use them as their only mode of transport, or simply for access/egress to/from transit stops. In unfavorable weather, however, most such individuals will not use their e-bike at all, increasing the demand for public transport. Figure 1 shows the changes in mode share from favorable to unfavorable weather conditions in 2018 and the estimation of the change in mode share for the E-Bike City scenario.

Figure 1: Impact of weather on transport modes, measured in 2018 (left) and predicted for E-Bike City scenario (right).

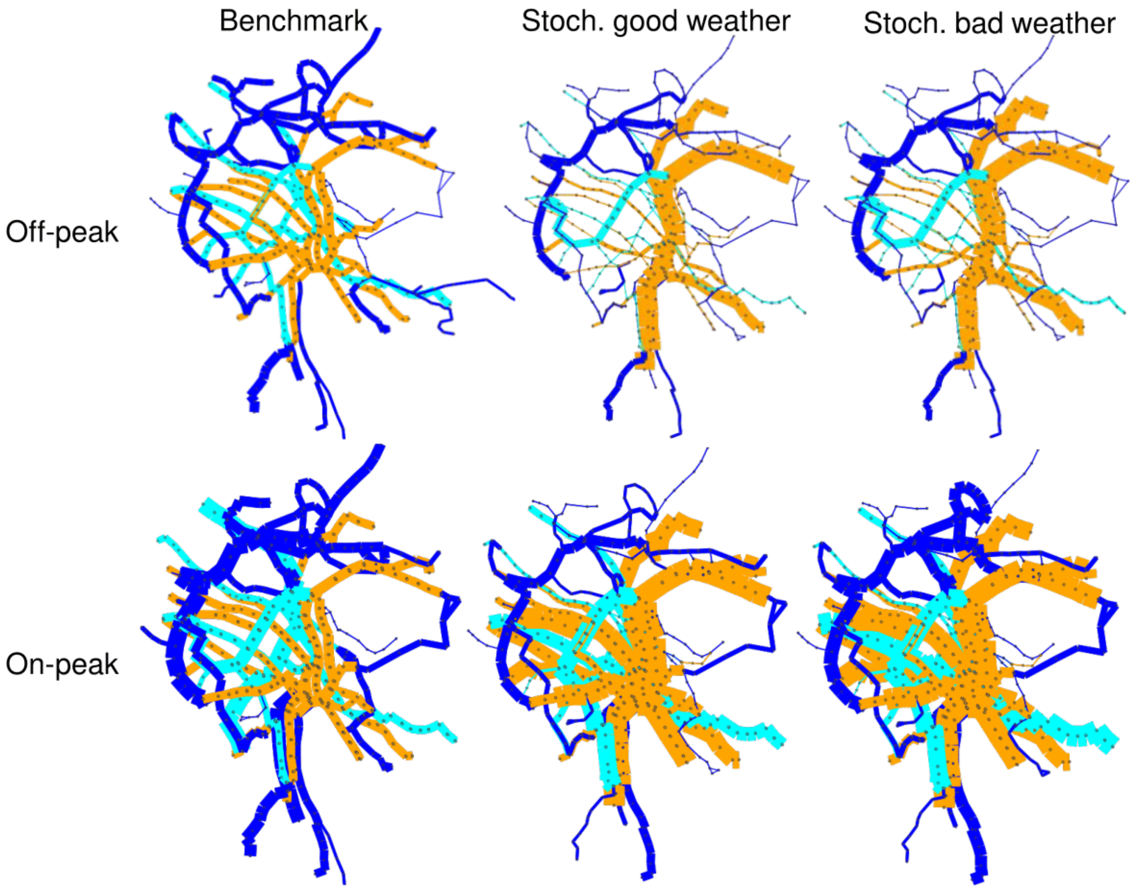


This research aims to create a deeper understanding of transit demand fluctuations' impact due to micromobility users on the design of a transit network. Conventional approaches plan for an average demand scenario, on the other hand, our approach is concerned with the case where the system might be oscillating between scenarios that are noticeably different. This provides us with either low or excessive demand, but not a "nice to have" average demand. Our model ensures the network accommodates the increased demand caused by adverse weather conditions, while also avoiding inefficiencies on lower-demand days. A proactive approach to manage demand fluctuations is essential when designing a bi-modal transit system where the modal split demand depends on external factors.

Our model output defines key transit network elements, including route layouts, stop sequences, connection points, and line frequencies. We propose a two-stage stochastic mixed-integer programming model to design a transit network that accounts for demand variability, such as due to weather conditions. The model uses a large pool of candidate lines, based on those that currently run in Zurich, and reasonable frequencies to choose from. The plan should minimize costs and recommend implementable actions while ensuring high-quality service for all users. To balance network simplicity with adaptability, the model keeps line configurations consistent across all demand variations during peak (and off-peak) periods, regardless of weather conditions, adjusting only line frequencies to accommodate demand fluctuations.

We focus on Zurich city. Our demand data comes from a MATSim simulation (Sonnak, 2024), generating 1000 demand relations. The model considers over 250 line configurations, with the MIP model containing 1.3M variables and 1.1M constraints. We use on-peak (07:00–09:00) and off-peak (14:00–16:00) demand data from the simulation for good weather scenarios and multiply the demand by 1.2 to create the bad weather scenarios. A visualization of the current (benchmark) transit networks as well as the optimized line networks for on-peak and off-peak demand both for good and bad weather scenarios are shown in figure 2.

Figure 2: Thickness corresponds to line frequency. Buses in blue, trolleybuses in cyan, trams in orange.



The changes are easy to see and are as expected: lines run at a higher frequency when there is more demand, especially comparing off-peak and on-peak demand. Similarly, in bad weather scenarios, we also see increased line frequencies due to the increased demand. For example, the stochastic model for the off-peak demand increases the frequency of line 11 (orange, running north to southeast) from 7 to 11 as the weather condition changes from good to bad. For on-peak demand, the stochastic model most notably changes the frequency for line 75 (blue loop in the north) from 2 to 7 during bad weather. Overall, the stochastic model removed 4 (of 41) lines from the off-peak benchmark and added 1; for the on-peak benchmark, the stochastic model removed 1 (of 36) and added 2. Furthermore, our model provides a 6.5% reduction in operating costs and a 1.7% improvement in passenger travel times during peak hours, while during off-peak hours it is 6.8% and 1.9%, respectively. We see this, for example, in how the frequencies for the same lines change between the benchmark and stochastic models. This demonstrates the benefit of planning in advance for fluctuations in demand.

3.2. Reorganizing the road network for an E-Bike City

Authors: Lukas Ballo, Martin Raubal and Kay W. Axhausen

We designed a new city-wide street network for Zurich using the SNMan tool, following the principles of the E-Bike City. The aim was to reallocate road space in a way that prioritizes cycling infrastructure while maintaining the high standard of public transport operations, access to buildings, and a minimum supply of on-street parking. Starting from OpenStreetMap data, we constructed a digital twin of Zurich's road network, enriched with local datasets on tram and bus routes, publicly accessible parking spaces, elevation, and population data. The simplified and processed network consisted of approximately 5,000 nodes and 7,000 edges within the municipal boundary. To guide the redesign, we divided the city into a network of main roads and 60 sub-networks in neighborhoods. Different logic was applied depending on the area type: On main roads, the goal was to channel car traffic efficiently, so the design guaranteed at least one motorized travel lane per street, ensuring continuous connectivity for through traffic. In contrast, within the neighborhoods, the focus shifted to minimizing car presence and reclaiming space for cycling. Here, only a minimal network of car lanes was retained—just enough to maintain access to the on-street parking spaces. This approach supports filtered permeability, discouraging through-traffic in residential areas while ensuring that essential motor vehicle access is preserved.

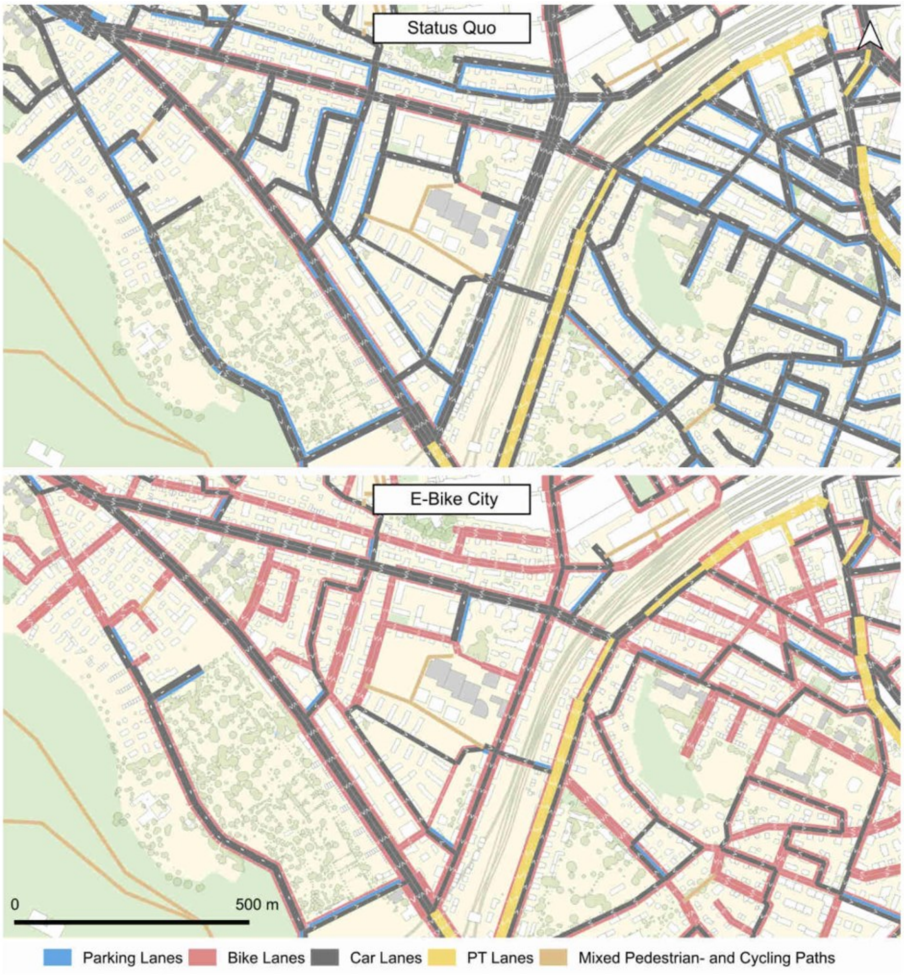
Throughout the process, key constraints were enforced: (1) All tram and bus routes had to remain fully operable. (2) Each residential location retains access to at least one on-street parking space within 200 meters. (3) The network must remain connected for all modes, with access and egress preserved. In our design, building access is guaranteed by a minimum provision of on-street parking—one space per 60 residents—reachable within a 200-meter walking distance from every building. These parking locations are embedded in a network of travel lanes that allows local motorized access. All remaining space is allocated to separated cycling infrastructure, with exceptions for emergency and utility vehicles, and for legally protected access to existing private garages.

Table 1: Network indicators.

Metric		Status Quo		E-Bike City		Change
avg shortest path for cars	km		5.463		7.412	+35.7%
avg shortest path for bicycles	km		5.391		5.334	-1.1%
avg shortest path for bicycles, comfort-adjusted	km		4.824		3.661	-24.1%
road space general travel lanes	km^2	(66.6%)	3.7564	(35.1%)	2.0257	-46.1%
road space parking	km^2	(14.3%)	0.8040	(3.8%)	0.2188	-72.8%
road space bus and tram lanes	km^2	(7.0%)	0.3962	(6.9%)	0.3962	+0.0%
road space cycling infrastructure	km^2	(12.1%)	0.6816	(54.3%)	3.1340	+359.8%

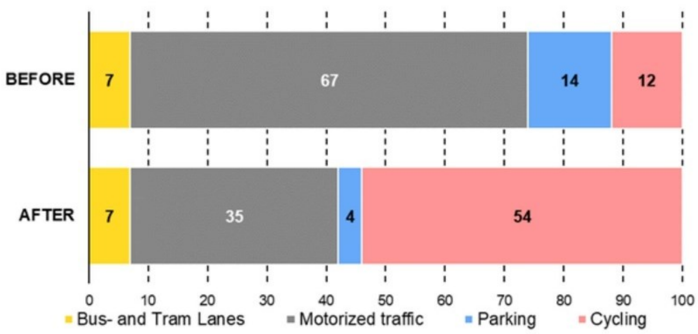
The results are summarized in table 1 and visualized in figures 3 and 4. Cycling infrastructure expanded from 12.1% to 54.3% of the total road space—an increase of 360%. At the same time, the area allocated to general car lanes dropped from 66.6% to 35.1%, and on-street parking was reduced by 73%. While essential car access was maintained, average car trip lengths increased by 35.7% due to many one-way streets. Cycling trips, by contrast, became substantially more attractive: the generalized cost adjusted for comfort and slopes decreased by 24.1%. All dedicated lanes for trams and buses were preserved, and every neighborhood remained accessible by car, with a reduced supply of parking.

Figure 3: Comparison of the status quo and the redesigned network



Figures 3 and 4 show a preview of the network before and after the redesign. See the linked map for the full network after further development (E-Bike City Zurich Overview plan). This design for Zurich demonstrates how SNMan enables an ambitious, yet realistic, constraint-aware transformation of existing urban street networks. It offers a tangible blueprint for city-scale shifts in mobility priorities grounded in data, responsive to access needs, and scalable for further simulation or planning refinement.

Figure 4: Comparison of road space allocation in Zurich, showing the rough percentage distribution under the Business-as-Usual scenario (before) versus the potential allocation after a full network-wide reallocation in the E-Bike City scenario (after).



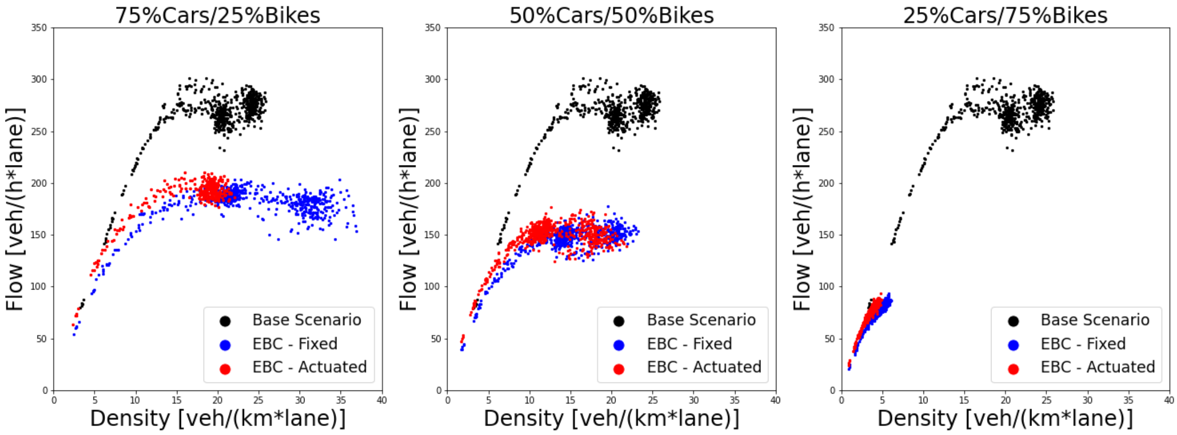
3.3. Congestion-informed road space allocation for cars and bicycles

Authors: Ying-Chuan Ni, Michail A. Makridis and Anastasios Kouvelas

Allocating dedicated road space to bicycles can improve the accessibility and safety for active mode road users, with a long-term goal of motivating travelers to opt for these transport modes instead of private cars, leading to reduced car demand. Among various transport policy measures, it has also been widely used due to its effectiveness in reducing delays caused by mixed-traffic interactions. However, space reserved for one mode is taken from another, which can potentially cause congestion due to local capacity reduction, e.g. in neighborhoods of infrequent usage or mode-inflexible demand, indicating that location selection plays an important role in the efficiency of space allocation strategy. A carefully designed road space allocation plan can balance the trade-off between eco-friendly mode enhancement and general traffic performance by maximizing the road space utilization efficiency.

In Fulton et al. (2025), we evaluated the network traffic performance for the E-Bike City road network design in the city center of Zurich through microscopic traffic simulation in scenarios with different car-bicycle modal splits. Compared to the base scenario, the outcomes show that most of the OD pairs would not encounter severe increment of average travel time when the modal shift from cars to bicycles reaches 50%. By analyzing the network fundamental diagrams, as shown in figure 5, it is found that oversaturated traffic states, namely the breakdown of network traffic flow, can be avoided with the help of actuated signal control even if the bicycle modal share is only 25%. Traffic congestion can be completely eliminated when the modal shift becomes 75%. The improved traffic condition is mainly brought by the sufficient road space reallocated and the relatively small occupancy of bicycles. Congestion would not occur on the bike lane network even when the bicycle modal share is high. Even though the general network-mean speed decreases due to the slow cycling desired speed, road users would not experience the negative impact resulted from traffic congestion, which is a major advantage of such a radical urban road space transformation.

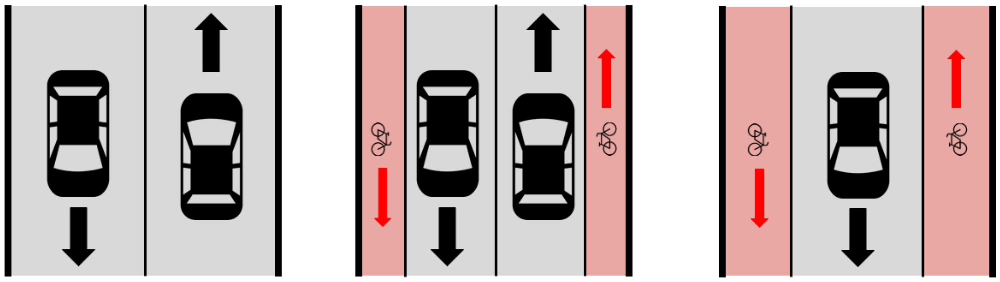
Figure 5: Car network fundamental diagrams in different scenarios



A road space allocation plan designed based on bi-modal traffic performance indicators can further prevent the degradation of network traffic performance even in a scenario with high car modal share. However, different from the allocation of dedicated bus lanes, such a decision-making problem is particularly challenging because of its multi-dimensionality. In the lane configurations considered, not only can the lane width for each mode vary on every road, but the direction of the car lane can also be changed. As illustrated in figure 6, after the reallocation, an 8-meter-wide road can either contain (1) narrow bike lanes and car lanes in both directions or (2) two wide bike lanes but only a one-way car street. For an urban network with limited road space, many one-way car streets are expected.

Besides car traffic flow, the unique non-lane-based traffic dynamics exhibited by bicycle traffic flow is also carefully considered based on the proposed simulation model and findings in Brunner et al. (2024) so that congestion on the bike lane network can also be avoided.

Figure 6: Possible lane configurations



two-way wide car street
with speed limit: 50 km/h
(base scenario)

two-way narrow car street
with speed limit: 30 km/h
1-meter-wide bike lanes

one-way narrow car street
with speed limit: 30 km/h
2.5-meter-wide bike lanes

A novel simulation-based optimization framework is proposed to search for the optimal road space allocation plan considering the bi-modal congestion dynamics in the network (Ni et al., 2025). The fitness of each solution is evaluated by analyzing the simulation output to obtain a weighted average route-mean speed over all OD pairs. By doing so, the congestion propagation due to queue spillback phenomena can be better mitigated for both modes compared to an allocation plan designed using a heuristic algorithm or an optimization approach only targeting at the accessibility aspect.

To prioritize a certain mode according to the transport policy, a larger weight can be assigned to either car or bicycle. Different modal splits can also lead to different allocation plans. A larger amount of road space would be allocated to bicycles when more travellers decide to use bicycles to commute. In addition, it can be expanded to account for the changing OD demand pattern at different times of day, e.g., morning and evening peaks, to facilitate a dynamic and adaptable allocation of the urban road space.

3.4. Network optimization and multi-target evaluation

Authors: Nina Wiedemann, Ayda Grisiute, Henry Martin and Martin Raubal

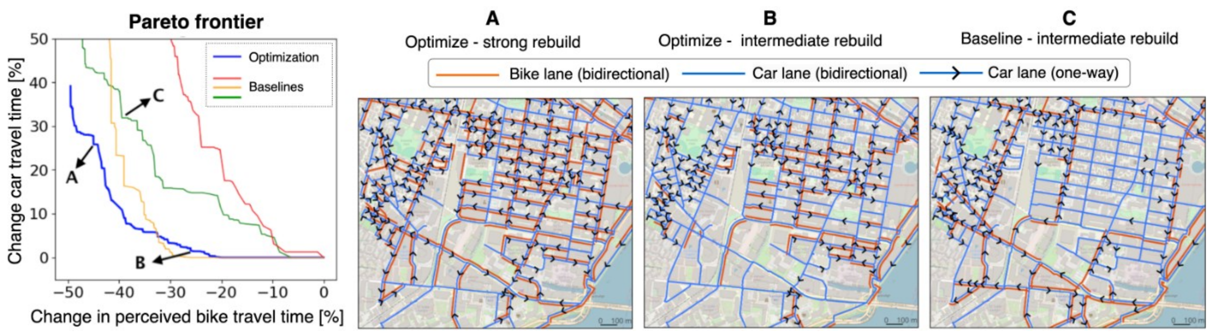
Developing an optimization algorithm for bike network planning

While cycling infrastructure promotes sustainability, health, and increased bike adoption, its implementation often sparks controversy due to the need to repurpose car lanes, parking spaces, or public transport routes. Thus, our approach aims to improve bikeability while minimizing negative impacts on other travel modes, in particular car accessibility. This trade-off is modeled through the concept of Pareto-optimality – solutions where no mode can be improved without worsening the other.

Unlike heuristic methods, which often lack transparency and neglect the broader implications of infrastructure changes, our approach systematically explores trade-offs between bike and car networks. To quantify bikeability, we use the concept of "perceived bike travel time", reflecting evidence that cyclists perceive dedicated bike lanes as faster. To optimize the network, we developed a linear programming approach that minimizes both (network-based) car travel times and perceived bike travel times (Wiedemann et al., 2025). Experiments on real and synthetic data testify the effectiveness and superiority of this optimization approach compared to heuristic methods. In a full-city case study of Zurich, the approach yielded a redesigned bike network with a 43% reduction in perceived bike travel time, while maintaining acceptable levels of car accessibility (see figure 7).

The output consists of a set of alternative lane reallocation scenarios, enabling planners to select network designs based on their preferred trade-offs. The framework is adaptable to different evaluation metrics, planning constraints, and urban contexts, making it a flexible decision-support tool for cities aiming to reallocate road space toward more sustainable mobility.

Figure 7: Comparison of network planning approaches via the Pareto frontier. Three examples generated with different algorithms and varying number of bike lanes are shown.



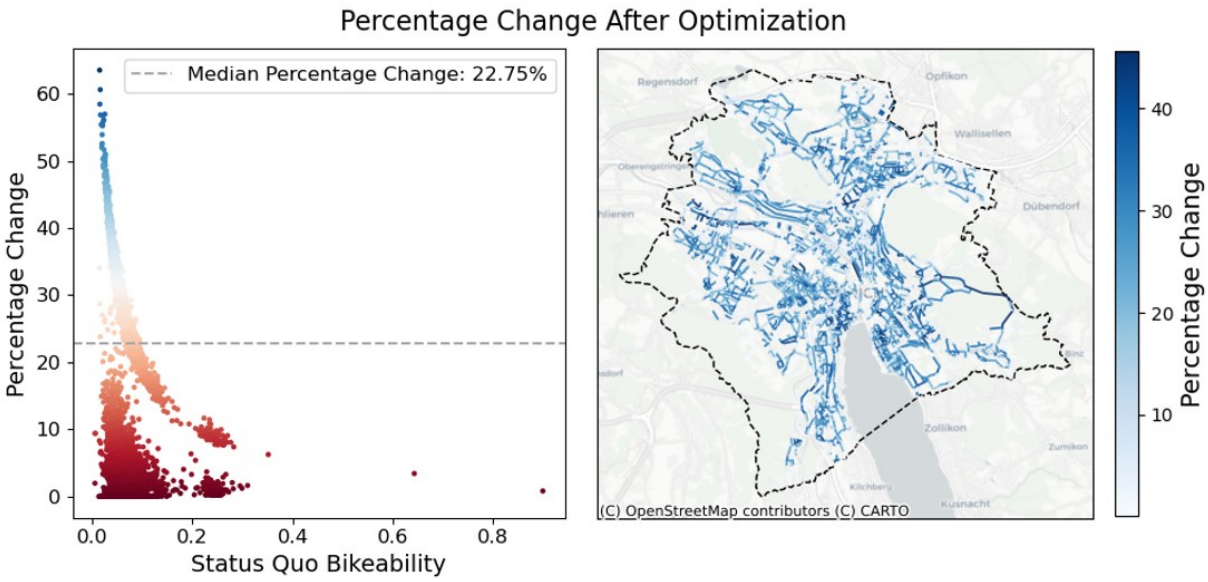
Developing a multi-factor evaluation for bike network designs

A robust evaluation of bike networks is essential to assess the effectiveness of envisioned bike network designs. Comprehensive evaluations typically involve complex decisions about evaluation methodology, which often requires systematically integrating diverse data sources and balancing multiple, sometimes conflicting, targets.

We developed a multi-target evaluation framework that combines a structured database of global bike network studies (Grisiute et al., 2024) with advanced decision-making techniques. Our database includes over 270 bike network evaluation metrics and 41 qualitative criteria, such as safety. We combined this knowledge base with Multi-Criteria Decision Analysis (MCDA), a method used to structure and solve complex decision problems by considering multiple criteria and transparently capturing evaluation design choices. This integration reflects a collective understanding of what constitutes an effective bike network, blending various targets into a cohesive framework systematically.

We applied our methodology to the proposed E-bike City network design, evaluating each street segment. A comparison of the results before and after road space optimization shows a notable improvement in overall bikeability, particularly in areas with previously poor overall cycling quality—resulting in an average increase in bikeability of 22.75% (see figure 8).

Figure 8: Percentage change of bikeability values between the status quo and the proposed road network design across Zurich.



Webapp

We have integrated both optimization and evaluation into a single web-based tool that enables users to replan and assess various design scenarios across Zurich. Publicly available, the tool lets users explore existing network designs and perform evaluations using our methods alongside established benchmarks. Tool: https://ebikecity.webapp.ethz.ch/

3.5. Sustainability assessment of battery supply chains and externalities in e-bike mobility

Authors: Vanessa Schenker, Marco Miotti and Stephan Pfister

Rethinking mobility also means rethinking materials. With the growing shift toward electrified transport, understanding the environmental impacts of the new technologies, such as Li-ion batteries, and materials involved is becoming increasingly important. This subproject explored the environmental impacts of Li-ion battery production, with a specific focus on the supply chains of key materials such as lithium, cobalt, nickel, and graphite. While all contribute to the battery's overall carbon footprint, lithium plays a particularly important role because of its soaring demand and the high variability in its environmental performance. These findings are then incorporated into mobility emission factors to allow assessing the benefits of an E-Bike City concerning environmental impacts.

Lithium mining and its environmental impacts

As the International Energy Agency (IEA 2024) reports, lithium is experiencing the fastest growth in demand among battery metals. Current production levels are not sufficient to meet future needs. New mines must open, and each one brings a different environmental profile due to the geology, environmental conditions and applied technology. One key source of lithium is brines, salty underground or surface water bodies, which are increasingly important for meeting global demand. Based on the uniqueness of the sites, different technologies were developed to extract lithium and the amount of energy, water, and chemicals required for lithium mining varies greatly. However, how these differences translate into environmental impacts had not been investigated so far.

To better understand this variability, we performed life cycle assessments of lithium carbonate production from salt lakes, based on five operational sites in Chile, Argentina, and China. We developed a transparent and modular framework to systematically collect data from patents, technical and sustainability reports and to assess environmental impacts at a high spatial resolution (Schenker et al. 2022). This approach allowed us to trace how local conditions, such as climate, energy source, reagent use, and brine composition, shape environmental performance. In a second step, we expanded this approach and investigated 90% of current production and key future projects across 25 sites worldwide (Schenker et al. 2024, Schenker and Pfister 2025). We revealed a substantial variability in environmental impacts driven by site-specific factors (mainly brine chemistry, energy sources, and processing technology). In particular, emerging extraction sites and technologies can lead to up to 7 times higher climate impacts and significantly greater water use compared to conventional methods, due to the need to process much larger volumes of low-grade or impure brines (figure 9). Importantly, this research highlights that future lithium projects are likely to be more resource- and energy-intensive than current operations because the quality of accessible brine resources is expected to decline over time, while resource prices probably increase and make its production economically viable. Therefore, environmental burden per unit of lithium carbonate produced may increase if no counteractions are employed.

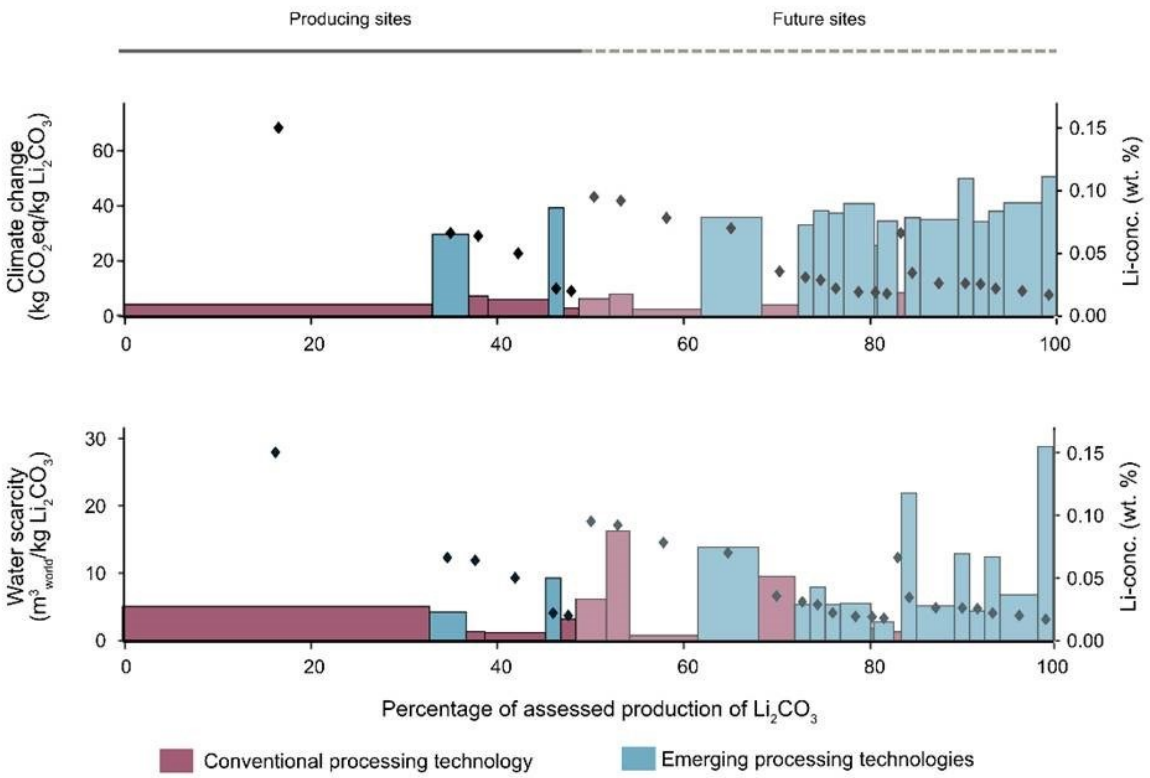
Battery production and its materials

In parallel, we analyzed market data to estimate the carbon footprints of currently producing mines for lithium, cobalt, nickel, and graphite. These materials are core inputs for the two dominant battery chemistries used in e-mobility: NMC (nickel-manganese-cobalt) and LFP (lithium iron phosphate). A central finding of our research is that the carbon footprint per energy storage capacity of batteries varies substantially (NMC batteries: 59 – 115 kg CO_2 eq/kWh, LFP batteries: 54 – 69 kg CO_2 eq/kWh), and was misestimated in previous literature. One of the most important reasons is the source and production process of these materials (Peiseler et al. 2024).

Incorporating battery production emissions into mobility emission factors

We incorporated the updated inventories for lithium mining into existing assessments of lifecycle greenhouse gas emissions per transport service (measured as passenger-km) of different land-based modes of transport. Baseline GHG emissions (before the inventory updates) are based on mobitool and ecoinvent (Sacchi and Bauer 2023; mobitool association 2023; ecoinvent 2022).

Figure 9: Climate change and water scarcity impacts of lithium carbonate production from brines. The right y axis indicates the Li concentration of the brines (represented by black diamonds)



In addition, we report overall externalities based on GHG emissions, air quality impact, ecology, biodiversity and landscape impact, and accidents for different land-based modes of transport. These externalities serve the assessment of the overall societal impact of the e-bike city and are based on a report produced for the Swiss federal government (Ecoplan & INFRAS 2024). Aspects of this assessment also rely on mobitool lifecycle inventories, meaning that externalities are generally expected to be consistent with GHG emissions.

Results from the revised GHG emission inventories show that bicycles have substantially lower emissions and external costs per km as cars (table 2). This is also true for e-bikes if they are used regularly despite their batteries (assuming a lifetime of 2,000 km per year over 10 years for regular e-bikes, and 3,000 km per year over 10 years for s-pedelecs; Sacchi and Bauer 2023). Emissions of bicycles are also substantially lower than those of public transit if the latter predominantly consists of regular buses with diesel engines.

Total external costs for all active modes (walking, regular bicycles, and e-bikes) are negative, meaning that there is a net benefit from using these modes (table 2). This is due to the positive impact of active mobility on personal health, compared to baseline physical activity levels that are typical for the Swiss population but without walking and cycling to get to specific destinations (Ecoplan & INFRAS 2024). Accidents do substantially impact the external costs of bicycle-based modes, but not enough to compensate for their health benefits. Note that the accident rates underlying this assessment are based on the present infrastructure and behavior (i.e., not the E-Bike City).

Table 2: Greenhouse gas (GHG) emissions and externalities per passenger-km of different land-based modes of transport. Emissions have been updated based on our refined lithium mining inventories.

Mode	Submode	**GHG emissions** [g CO_2 eq/person-km]	**All externalities** [CHF cents/person-km]			
			Total	Costs		Benefits
				Without accidents	Accidents only	Health
Walking		0	-95	0.5	2.5	-98
Bicycle	Regular	12	-36	1	24	-61
	E-bike (any)	20	-28	3	21	-52
Public transit	Bus (regular)	112	20	18	2	0
	Bus (trolley)	25	8	6	2	0
	Tram	16	3	1.5	1.5	0
	Rail (regional)	9	1	1	0	0
Car	Typical (gasoline)	226	17	9	3	0
	Typical (electric)	108	13	10	3	0

3.6. Pedaling towards acceptance: Public preferences and cleavages in street transformation policies

Authors: Michael Wicki, Claudia Sinatra, Jake Stephan, Aura Huang, Alessio Guidon and David Kaufmann

Cities today face two interlinked challenges: the negative externalities of car-dominated transport systems (including emissions, noise, and accidents) and the inefficient use of urban space, as private cars occupy a disproportionate share of it. In response, cities are increasingly seeking to reallocate street space to active mobility, public transport, and public life. Our subproject investigates public opinion on this transformation through the lens of the "E-Bike City" vision. This scenario entails a comprehensive reallocation of 50% of current street space to cycling, walking, and public transport, aiming to reduce car dependence and improve urban quality of life. Yet the successful implementation of such a far-reaching policy depends crucially on public support. To better understand public preferences, we conducted two large-scale survey experiments embedded in a nationally representative mobility panel of Swiss residents. Both experiments combine randomized design features with realistic framing to examine what drives acceptance and what inhibits it.

Experiment 1: Cleavages in acceptance - Transport habits, ideology and perceptions

The first experiment explored support for an E-Bike City policy proposal. Overall public opinion was split: 44.4% of respondents expressed support, while 43.4% were opposed. While the proposal was widely expected to be effective in fostering cycling, it was also perceived as restrictive individually and judged as unfair for society as a whole. Sociodemographic patterns emerged in expected ways, with urban residents, women, younger generations, and those with higher education showing more support. However, the most decisive cleavages were not demographic, but behavioral and ideological. Frequent cyclists and left-leaning respondents were substantially more supportive, while frequent drivers and right-leaning individuals tended to oppose the policy. These divides reflect deeper differences in values and mobility preferences, and they underscore the politicization of street space transformation. Importantly, the perception of effectiveness (e.g., improving cycling conditions or reducing emissions) is high across groups (see figure 10). However, perceived effectiveness alone does not predict support. Instead, resistance is strongly associated with perceived unfairness and intrusiveness—suggesting that justice considerations are central to the public's evaluation. We also tested whether so-called ancillary measures, such as expanding public transport or creating park-and-ride infrastructure, increase acceptance. While such measures overall improve support slightly, their effect is most pronounced among those already inclined to support the policy, and they do little to bridge divides.

Experiment 2: Street redesigns - Visualized implementation and public preferences

In the second experiment, we moved from abstract policy evaluation to concrete street reallocation scenarios. Participants evaluated pairs of redesigned streets based on visual representations (static or 360° images), varying across infrastructure, greenery, social space, cost, and financing. Here too, acceptance differed across transport lifestyles and ideological lines, but the cleavages were less pronounced. The visual nature of the designs shifted attention from political identity to spatial qualities. Greenery emerged as the most influential design feature across all outcomes (see figure 11). It increased acceptance, made streets more attractive as residential environments, and enhanced willingness to cycle. Differences between main and side roads were also evident. Infrastructure improvements—such as protected cycle lanes—played a larger role on main roads. Side streets were generally more acceptable for residential use, even with minimal interventions. Visual format mattered as well. 360° images enhanced the salience of social spaces and generated higher acceptance levels than static images.

Figure 10: Marginal means of perceived acceptance, fairness, effectiveness, and intrusiveness for different levels of ancillary measures, financing models, and subsidy allocation in the E-Bike City policy vignette experiment. Values are based on pooled model estimates with 95% confidence intervals (N = 6495).

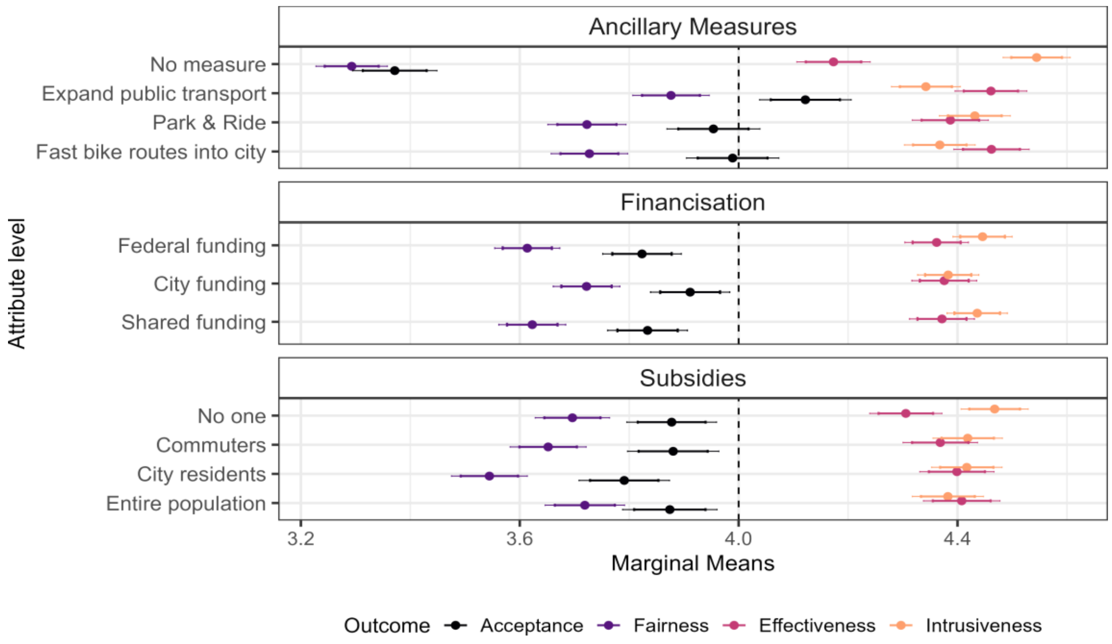
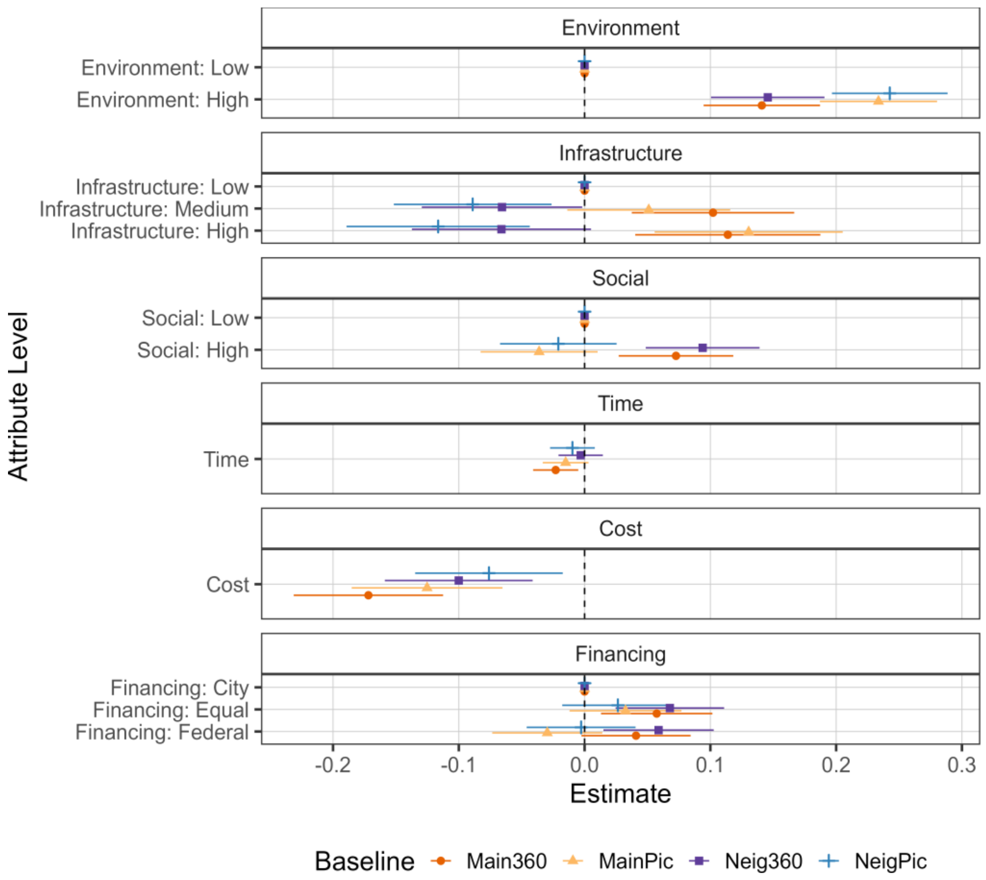


Figure 11: Estimated effects of built environment attributes on public acceptance of street redesigns across different street types and visual presentation formats. Values based on multilevel models of forced-choice responses between redesign scenarios (N = 5753).



Conclusion

Our results underline that public support for urban street reallocation is not merely a question of infrastructure provision. Rather, it is shaped by political and lifestyle cleavages, and depends on how people perceive the fairness, effectiveness, and everyday intrusiveness of the proposed changes. Abstract support remains polarized, but design and visualization can help bridge divides. Street transformations must therefore be more than technically sound; they must be just, legible, and meaningfully embedded in people's lived experience. Our findings show that integrating environmental and social qualities into street design – and making these qualities visible and tangible – can broaden support for ambitious urban mobility policies.

3.7. Mode-choice and the role of e-bikes in a sustainable mobility transition

Author: Lucas Meyer de Freitas

A future mobility system that prioritizes cycling and public transport over car travel could dramatically shift how people move—especially if high-quality infrastructure supports modern bicycle types like e-bikes and s-pedelecs. We conducted a survey with 1'200 respondents in the Canton of Zurich as well as neighboring Cantons to find out the potentials as well as the reasons for choosing bikes, e-bikes and s-pedelecs. The key finding is that e-bikes and s-pedelecs can play an important role in replacing car trips, even for longer distances, while infrastructure quality and personal attitudes—especially car ownership—remain central in shaping travel choices.

To quantify the potential of this transformation, we implemented a two-step data collection approach. First, over 3,200 residents of Zurich and surrounding municipalities recorded a full day of travel in an interactive diary. Then, a subset of these respondents participated in a stated- preference survey based on a future scenario in which car lanes are replaced by wide, cohesive cycling infrastructure. The respondents were shown specific trips they had taken and were asked to choose between updated travel options, including e-bikes (up to 25 km/h) and s-pedelecs (up to 45 km/h), for those same journeys.

To provide realistic travel times, we used simulation tools that incorporate terrain, fitness level, and bicycle type. Car travel times were increased to reflect the removal of car lanes, based on a MATSim transport simulation. For example, morning peak car travel times increased by 80% due to reduced road capacity. These increased travel times were found to be a much stronger driver of behavioral change than pricing policies alone. The strongest proportional gains in mode share came from e-bikes and s-pedelecs, which together show a substantial increase in demand, as shown in subchapter 3.10. Interestingly, while public transport captured the largest absolute number of former car trips, the faster cycling modes showed the greatest growth in popularity—especially among car owners.

Elasticity results indicate that travel time has a much higher impact on people's choices than travel cost—especially for car drivers. The model estimates a car travel time elasticity of -0.71 in our E-Bike City scenario, compared to a baseline of just -0.17 in the Swiss national mobility survey (Gayda et al., 2024). These results suggest that substantial reductions in car dependency require structural, supply-side changes—such as reallocating road space—rather than price signals alone.

Another interesting result of the mode choice model is that different bicycle types appear to have trip distances for which demand for them is the highest: for trips up to 1.6 km, conventional bikes have the highest demand across different bike types, followed by e-bikes (25 km/h) for trips up to 9 km and s-pedelecs (45 km/h) for all trips with distances greater than that. The increased speed of s-pedelecs, which comes at a higher purchase cost, only seems to pay off for longer distance trips.

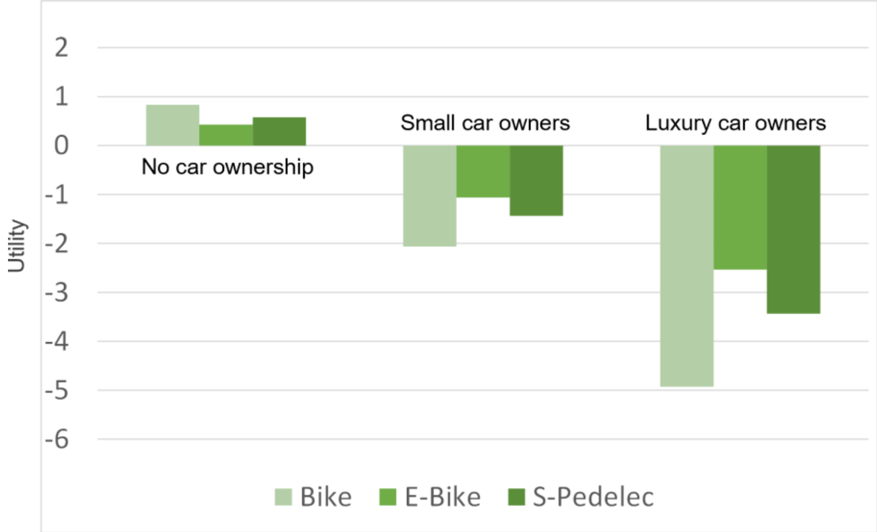
In the mode-choice models, we also introduced a novel variable: a route-specific cycling infrastructure interaction term, which measures the share of the route that is safe and protected for cyclists. Our results show that this infrastructure quality strongly affects people's willingness to choose cycling, especially conventional bikes. For e-bikes and s-pedelecs, the influence of infrastructure is still present but somewhat less critical, possibly due to the higher speeds, which reduce conflicts with cars for riders of these modes.

Attitudes also play a key role. We used an Integrated Choice and Latent Variable (ICLV) model that links policy preferences (e.g., support for reducing parking or implementing 30 km/h zones) to deeper latent attitudes, which are in turn influenced by sociodemographic factors, especially car ownership. Owners of SUVs or luxury cars were much less supportive of cycling policies and much less willing to switch away from driving. Conversely, people without cars, or those who own small vehicles, were far more receptive to cycling and supportive of policy changes.

Interestingly, among car drivers, the negative perception of e-bikes and s-pedelecs was lower than for conventional bicycles. This suggests that faster and more comfortable alternatives have a greater potential to trigger behavior change in a car-centric society. Figure 12 shows how the (dis-)utility of traveling by differing bicycle modes differs for those who do not own a car versus small or luxury car owners.

For further reading, see: Mode-choice modelling of a sustainable mobility transition considering different bicycle types (Meyer de Freitas *et al.*, 2025).

Figure 12: Utility of riding different bike types for different groups



3.8. The cost of transforming into an E-Bike City and the resulting change in safety

Authors: David Zani and Bryan T. Adey

Costs

Implementing the E-Bike City (EBC) will require financial investments in cycling infrastructure: new bike lanes, physical barriers between lanes, updated traffic signals, etc. These infrastructures are relatively cheap compared to building new roads or separated bike paths, but the costs can vary widely depending on the specific design that is implemented and the available road space. To make an estimate for the cost of implementing the EBC, three things are needed: a plan for how each type of road and intersection will be transformed; an overview of how many of each type of road and intersection currently exists in Zurich; and the costs for transforming each type of infrastructure into its new EBC version.

Other subprojects within EBC have provided the plans for how different road types and intersections will be transformed (Ballo and Cardoso, 2025). To create an overview of how much of each type of road exists in Zurich, we used a machine learning model (Zani and Adey, 2024). This model looks at aerial images of roads and is able to show with good accuracy where in the image the road is located (see figure 13.)

With this approach, road space can be estimated for virtually any city that has existing aerial imagery. This method is therefore easy to apply in other cities and is also more accurate than conventional methods, including expert opinion and average lane width-based estimations. Lastly, for the transformation costs, we collected data on past cycling infrastructure projects from Swiss communes and cantons. This allowed us to estimate how much it would cost to transition each road type and intersection in Zurich into an EBC design, and then to summarise the costs for all road infrastructure in the city.

Safety

The safety of cyclists in the EBC can be expressed as the expected cyclist crash risk (the likelihood of being involved in a crash multiplied by the financial impact of such a crash). Crash likelihood is based on the number of crashes that occur on a road or at an intersection and the number of cyclists using that infrastructure. These data are provided by official crash statistics in Switzerland and cycling traffic models in Zurich (Amt für Mobilität, 2024), allowing us to calculate crash risk for Zurich's current roads and intersections, and for their transformed EBC versions. We can also think about safety in the EBC as being generally more similar to existing cycling cities, such as Amsterdam in The Netherlands or Bern in Switzerland. This comparison would capture other ways in which the EBC would be safer for cyclists, including a different culture and age of traffic participants and cyclists' feeling of safety that is difficult to quantify (Zani *et al.*, 2024).

Figure 13: The aerial image (left) used as input to the machine learning model and the resulting road space estimation (right).

Results

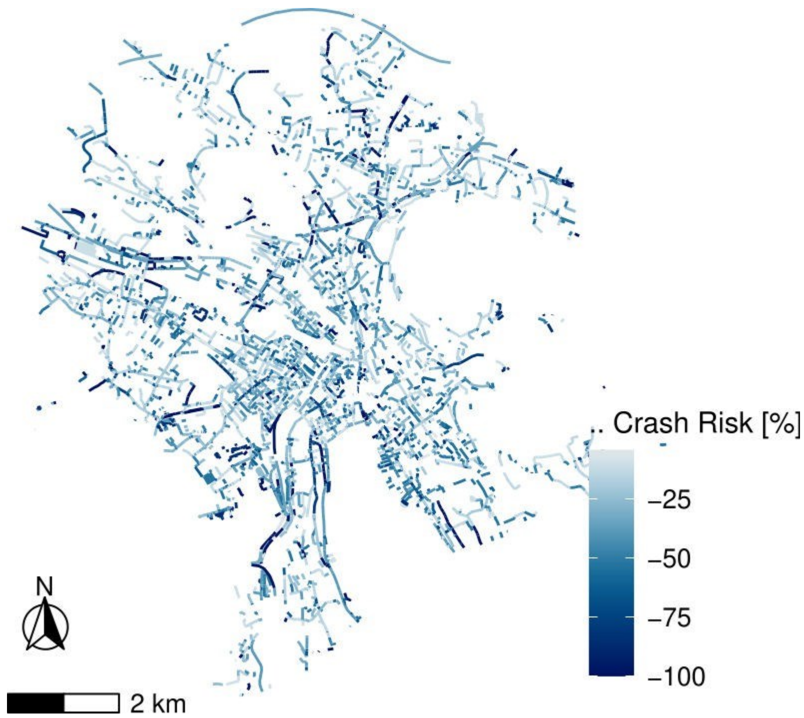
Based on these methods, we find that transitioning each type of road into an EBC road could cost as little as 41 million Swiss Francs (CHF), if the most cost-effective designs are chosen. The average cost of 58,300 CHF per kilometer shows how the EBC's focus on cost-efficient infrastructure transformations could result in relatively cheap implementation. More expensive designs are possible that could cost up to 320 million CHF, but the additional safety provided by these designs is small. Intersections are more expensive to transform, as these require the construction of physical barriers between lanes and traffic light reprogramming in many cases. The costs for transforming intersections are therefore around 256–315 million CHF, without a significantly cheaper option available.

The expected safety improvement can be quantified through a reduced cyclist crash risk, relative to the current crash rates, severities, and cycling volumes in Zurich. This reduction is likely to be around 22 million CHF per year, as safer infrastructure reduces both the likelihood (40% lower crash rate) and severity of bicycle crashes (71% fewer serious or fatal crashes) (see figure 14 for a map showing where the safety benefits in Zurich are expected). When comparing Zurich to cities with more developed cycling infrastructure (Amsterdam, Utrecht, Bern), a reduction of cycling crash rates by about 50% seems realistic. Considering the costs and safety improvements together, we can estimate that each CHF invested in cycling infrastructure could reduce the cycling crash risk by about 1.4 CHF over 25 years (Zani and Adey, 2025).

Conclusion

This subproject showed how an EBC could be implemented with relatively little financial investment in Zuich, and provide a significant benefit through improved cyclist safety. Together with other benefits through improved air quality, health, and public spaces, and reduced pollution and noise emissions, the financial investment required to create an EBC will most likely be worth the cost.

Figure 14: A map of Zurich's road network and the expected reduction in crash risk after implementing the E-Bike City designs.



3.9. Estimating choice models for daily schedules

Authors: Janody Pougala and Michel Bierlaire

OASIS framework and parameter estimation

A drastic change in urban configuration is bound to affect activity and travel behavior in observable (differences in the choice of mode and location, distance traveled) and unobservable (changes in habits and preferences) ways. Quantifying the individual modifications induced by the e-bike city is necessary to develop reliable indicators to assess the project's feasibility. In addition, understanding existing behavior and how individuals occupy and interact with their environment in time and space is necessary to develop the e-bike city appropriately. This collaboration applies the OASIS framework (Pougala et al., 2023b) to produce behaviorally realistic simulations of the e-bike city scenarios (see figure 15).

OASIS is an activity-based simulation framework that outputs distributions of likely activity schedules for given individuals. It answers two main research gaps in the activity-based literature: (i) accurately modeling the behavior-activity-travel interactions, which explain the scheduling process while maintaining a high level of theoretical soundness and practical flexibility, (ii) dealing with the uncertainty due to the lack of data and knowledge on these interactions to estimate and calibrate scheduling models.

Each schedule is associated with a utility function, indicating the satisfaction an individual derives from an activity plan. The parameters of this function are notoriously difficult to estimate, given the infinite possible combinations of schedules, and the fact that most of these combinations are unknown even to the decision-maker. We propose a two-step strategy to estimate the utility function parameters:

1) We generate a choice set of feasible alternatives using the Metropolis-Hastings algorithm. This choice set contains a given number of schedules; each associated with a probability of being chosen. The set must contain the chosen schedule and both high and low probability alternatives to ensure the consistency of our estimates.
2) Based on this set of alternatives, we apply a discrete choice approach to derive the maximum likelihood estimators of the parameters.

Estimation of MATSim parameters

The primary tool used to simulate different scenarios is MATSim. Each agent in the microsimulation is characterised by a schedule of daily activities, scored by a utility function that is, among others, dependent on activity duration and network conditions (Charypar & Nagel, 2005). The scoring function parameters are typical values from Vickrey's model for departure time choice, and are not estimated.

In this project, we estimate the scoring function parameters using the 2-step methodology presented above. We also compare the performance of the scoring function with two other utility specifications, the OASIS linear specification (Pougala et al., 2022), and the PlanomatX function (Feil, 2010), to understand the importance and contribution of dimensions such as activity start time and duration on the utility function.

For all three specifications, we have estimated parameters for a small sample of the Swiss Mobility and Transport Microcensus (BFS ARE, 2017) and choice sets of 10 alternatives per person. An example output is shown in figure 16. Regarding the utility specifications, initial comparisons of the impact of activity duration on utility (figure 17) show that all specifications behave similarly for constraining activities (education and work), but differences can be observed for flexible activities (leisure and shopping). Comparing schedule simulation outputs between the OASIS and the PlanomatX function shows that the inclusion of start time in the utility function improves the realism of the results (Pougala et al., 2023a).

Figure 15: OASIS framework

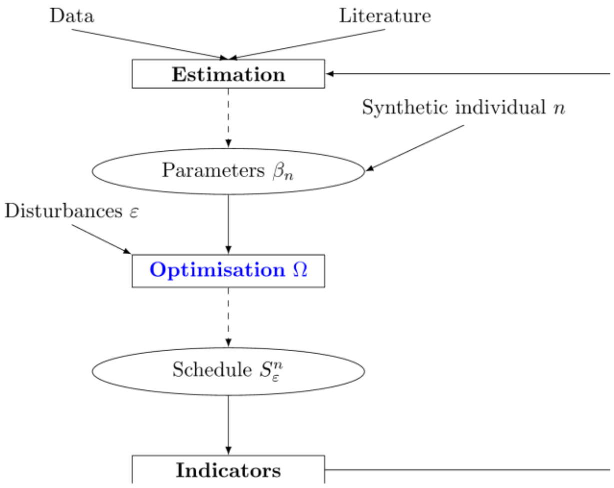


Figure 16: Example of output

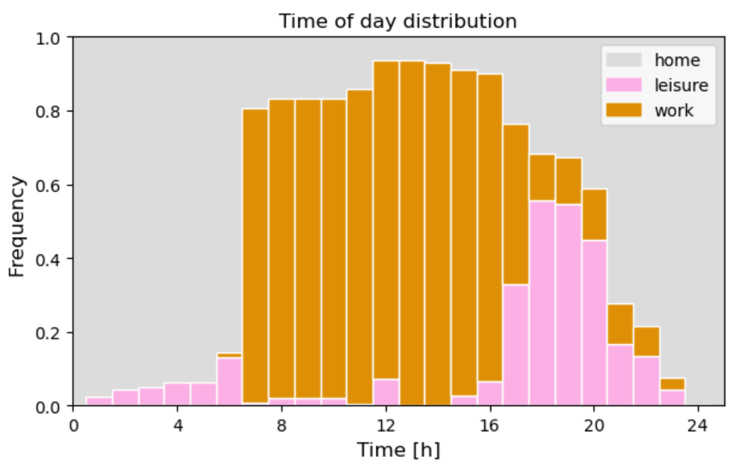
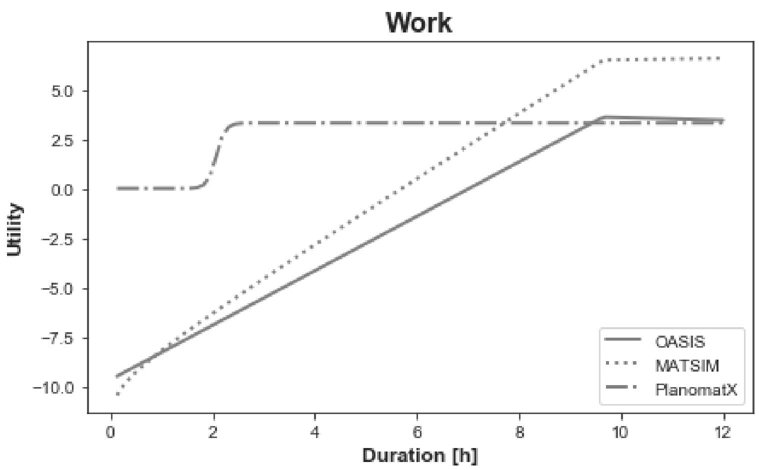


Figure 17: Comparison of work duration utility specifications.



3.10. Effects of an E-Bike City

Authors: Lucas Meyer de Freitas, Marco Miotti and David Zani

To understand the effects of an E-Bike City, a two-stage survey was carried out to understand the mode-choices of individuals in such a scenario. This survey was the basis for the calculation of the mode-shifts expected in an E-Bike city and the evaluation of its effects for the environment and society. More details about this survey and the mode-shift potentials of different groups are presented in subchapter 3.7. The survey results were then implemented in an agent-based transport simulation of a study area consisting of the city of Zurich as well as all municipalities where at least 10% of its population commutes to Zurich (figure 18). This large study area ensures that most trips and the full effects of an E-Bike city implementation in the city of Zurich are considered. For the evaluation we assumed that the E-Bike city would be implemented today and considered a 50-year evaluation period.

The reduction in road space for cars resulted in a substantial increase in travel times for car trips with origin or destination in the city of Zurich. During the morning and evening peak hours, car travel times increased by 80%. This increase in travel times by car is a main factor pushing drivers away from their cars towards other modes. Figure 19 shows the changes in mode-choice that result from a potential implementation of the E-bike city proposal. Most of the reduced car trips shift towards public transport. At the same time, in percentual terms, bike modes are the ones that increase their shares the most, with conventional Bikes and slow E-Bikes (25 km/h) roughly quadrupling their demand. It is therefore assumed that e-bikes and s-pedelec ownership would increase accordingly. The overall cycling demand of 17.5% is almost double of the share of cycling person-kilometers (pkm) in The Netherlands of 9% (Statistics Netherlands, 2016).

Figure 18: Study area: All trips within the perimeter are considered. E-Bike City implementation only within the city of Zurich.

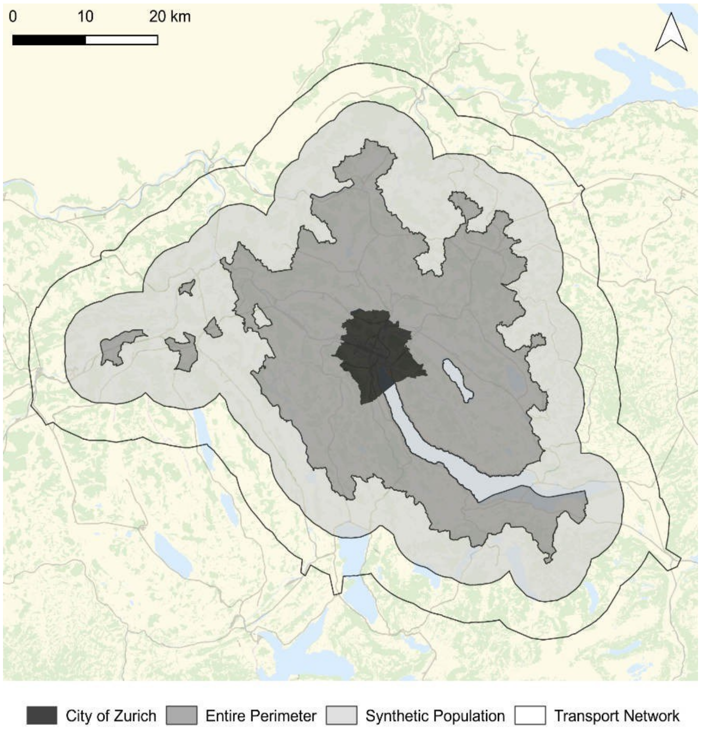
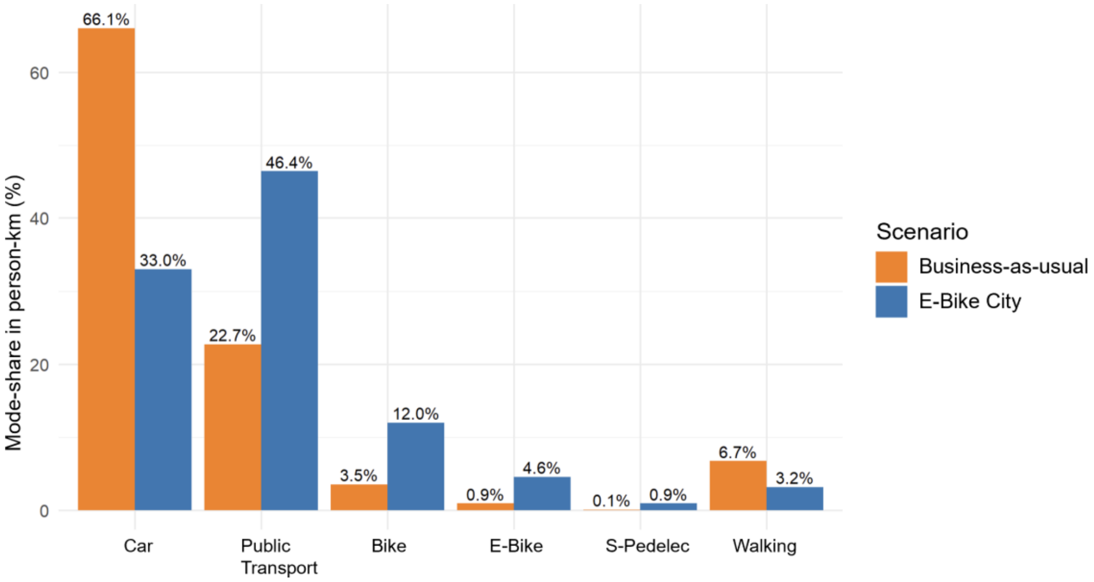


Figure 19: Mode-choice in an E-Bike City: Results for all trips within the study area.



This massive mode-shift has two main effects: A reduction in the emissions of the transport system in the study area of ca. 1'250'000 t CO_2 over 50 years (figure 20), amounting to an emissions reduction of ca. 45% for the passenger transport system. At the same time, the external cost of the transport system, that is, its effects on health, the environment, accidents and noise, shows a major turn: from external costs of ca. -0.5 bn CHF over the 50 years' study period, up to +1.0 bn CHF (figure 20). Effectively, this means that our mobility would end up having positive instead of negative external effects for society. The positive upturn arises mostly due the increased cycling rates and public transport usage. At a trip level, cycling and e-bikes have positive external costs of 36 and 28 CHF-cents/km, respectively. At the same time walking has a positive effect of 95 CHF-cents/km while public trans- port's external cost varies greatly, from -20 CHF-cents/pkm for buses to -3 for trams and -1 CHF-cents/pkm for rail. These low externalities of electric rail based public transport associated with the high positive externalities of walking result in the fact that trips with distances of up to ca. 12km end up having positive net externalities (figure 21). The externality values are all based on the official Swiss external costs of transport (Ecoplan and INFRAS, 2024).

This turn in the sign of the external costs of transport shows that, based on today's monetary values associated to the externalities of the transport system, the health benefits of cycling and walking would outweigh the negative effects of the emissions and externalities caused in the transport system. More details on the externalities are presented in subchapter 3.7.

Besides the external costs of the trans- port system, the full cost-benefit analysis (CBA), also requires information on the costs of implementing the E-Bike City as well as the consumer surplus, that is, the individual next to the societal (dis-) benefits of transport. While externalities evaluate the costs of travel carried by society as a whole, the consumer surplus shows the cost of travel carried by travelers. We calculated the cost-benefit effects based on two different methodologies: The current Swiss cost-benefit analysis norm (Ecoplan and Metron, 2005) as well as on the Log- sum method (de Jong et al., 2007).

The reason for doing so is the fact that the Swiss cost-benefit analysis, as well as the majority of transport cost-benefit norms and practices around the world, bases the consumer surplus solely in terms of travel time savings and direct monetary costs of travel while, most importantly, it only considers benefits resulting from the use of individual motorized modes (car, motorcycles) and public transport. That such a norm is not well suited to evaluate a project with a cycling focus is evident. Nonetheless, we compare its results to the more integrated and complete method for computing consumer surplus: the Logsum method. The advantage of this method is that it accounts for all transport modes in the one hand, while it also for the full (dis-)benefits associated with each mode.

Figure 20: Yearly CO_2 emissions and externalities of the (passenger) transport system before and after an E-Bike City.

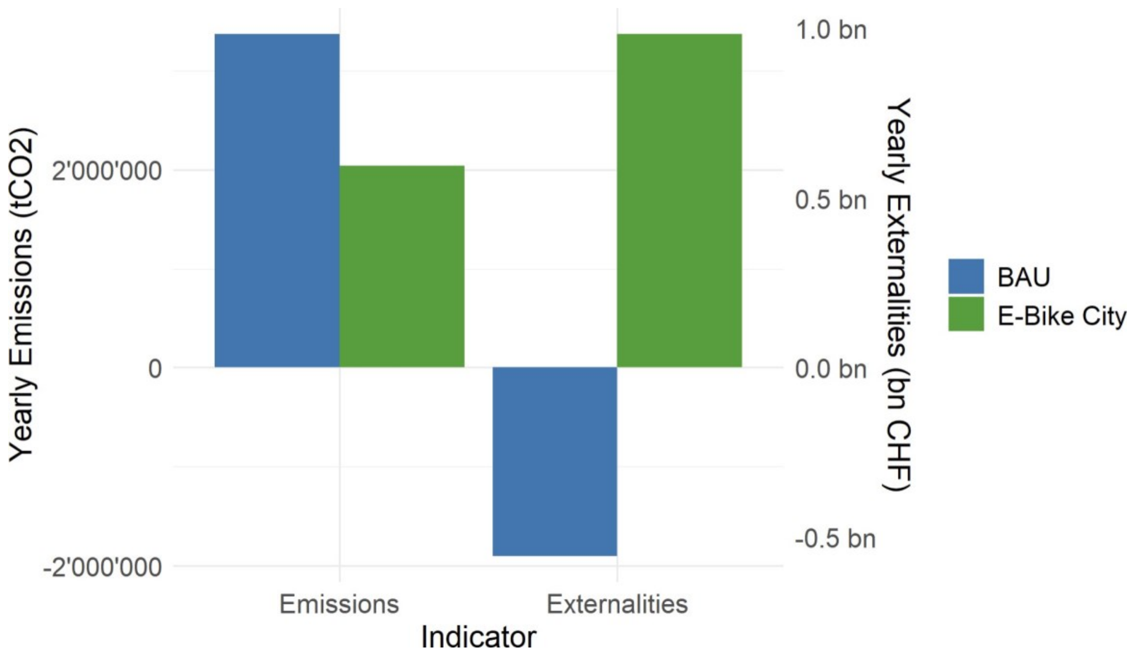


Figure 21: Public-transport average trip externalities in the study area by distance.

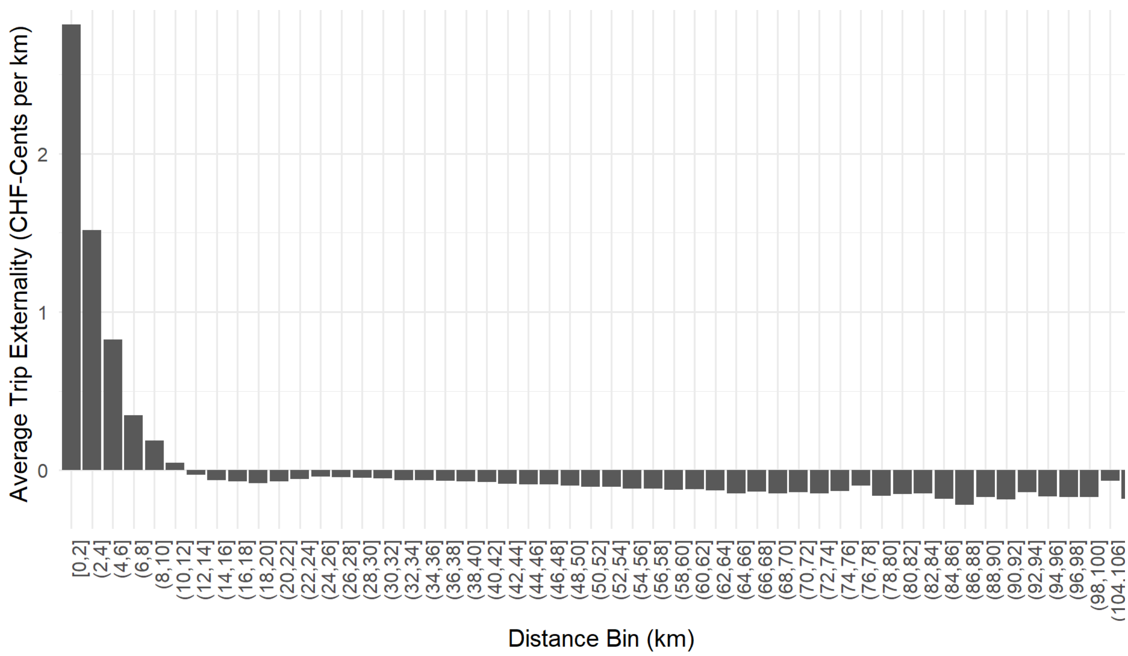


Table 3: Cost-benefit analysis results in net present values (NPV). The values shown are differences to the do-nothing scenario.

	VSS Norm	Logsum
Costs (CHF)	-0.36 bn	-0.36 bn
Consumer surplus (CHF)	-75.19 bn	-10.22 bn
Externalities (CHF)	-10.22 bn	-10.22 bn
Total NPV (CHF)	**-26.87 bn**	**+38.10 bn**

Table 3 shows the results of the CBA for both methods. If the project were to be evaluated using the current VSS norm, the consumer surplus would be ca. 7.5 times lower than when using the Logsum method. This massive difference arises mostly because when applying this norm, the effect of so many car trips switching to other modes has a negative outcome. At the same time, the benefits of travel by public transport have a lower monetary value and cycling is not even accounted for.

When all modes are considered (Logsum), the effect is still negative, and the outcome of car travel times increases considerably. Still, the consumer surplus and externality values are substantially higher than the cost of implementing an E-bike City. The CBA calculation considers the forecasted population increase and demo- graphic change up to 2050 and a discount rate of 2% as in the VSS CBA norm.

The results show the massive socioeconomic benefits that can arise from a transport policy aimed at shifting transport demand away from cars in favor of cycling and public transport. While the demand for cycling could increase substantially to levels above those observed in The Netherlands, they also show that public transport would need to cope with a doubling of demand. How public transport can deal with this increased demand is discussed in subchapter 3.1. Nonetheless, the benefits that can potentially arise are nothing less than transformative for society. Less noise, pollution, and healthier lives are the direct results for inhabitants in and around Zurich, while the near halving of CO_2 emissions would be a substantial contribution to respond to the climate crisis. The true benefits are expected to be even larger, as the evaluation methods used solely focus on the transport system itself. More space for greenery and gained urban space for different activities, increasing livability are further positive outcomes of an E-Bike City which provides even further benefits for society.

4 Discussion

The findings of the E-Bike City project illuminate a path toward urban mobility that is not only sustainable but also transformative for energy use and city life. By reallocating road space to micromobility, the project demonstrates how cities can reduce car dependency and its associated energy consumption, while simultaneously addressing the urgent need for climate action and improved urban quality.

A central outcome of the E-Bike City vision is the substantial reduction in passenger transport emissions—projected at up to 45% over 50 years. This shift is largely attributable to the mode change from private cars to cycling, e-bikes, and public transport, which collectively require far less energy per passenger-kilometer. The move away from fossil-fueled vehicles also reduces the city's reliance on imported energy and vulnerability to price fluctuations in global oil markets. Importantly, the project's simulations show that even with increased cycling and e-bike use—which rely on batteries and electricity—the net energy demand and environmental impact remain dramatically lower than in a car-dominated scenario. This is supported by lifecycle assessments that account for battery production, highlighting that the positive externalities of micromobility outweigh the emissions and resource use associated with battery supply chains, especially when compared to the energy and emissions of private car travel.

The project also underscores the importance of not simply replacing car trips with electric vehicle trips. While electrification is necessary, it is insufficient on its own to achieve the deep decarbonization and space efficiency required for sustainable cities. Instead, the E-Bike City approach leverages the energy efficiency of active and micromobility modes, which are inherently less resource-intensive and more space-efficient than most electric cars on the market. This is crucial for cities aiming to meet ambitious climate and energy targets, as it addresses both the supply and demand sides of urban energy use.

The reallocation of road space to micromobility not only reduces emissions but also fundamentally alters the urban landscape. By prioritizing cycling and walking, cities can reclaim vast amounts of space previously dedicated to car lanes and parking. This transformation enables the integration of greenery, social spaces, and public life into the urban fabric, which in turn enhances the attractiveness and liability of neighborhoods. The project's visualizations and public surveys highlight that such changes, when well-designed and communicated, can shift public opinion and foster greater acceptance of sustainable mobility policies, particularly when the benefits to urban quality—such as increased greenery and reduced noise—are made tangible.

The project's approach to infrastructure redesign is both pragmatic and scalable. By using automated tools like the Street Network Manipulator, cities can efficiently adapt their street networks to prioritize micromobility while maintaining essential access for deliveries, emergency services, and public transport. This ensures that the benefits of reduced car use are not offset by negative impacts on urban functionality or accessibility.

The E-Bike City findings challenge traditional urban policy approaches that prioritize car mobility and incremental change. The project demonstrates that structural interventions—such as reallocating road space—are more effective than price signals or technological fixes alone in driving mode shift and reducing car dependency. This has important implications for urban governance, suggesting that bold, visible changes can catalyze behavioral change and unlock the potential of sustainable mobility.

Equity considerations are also central to the discussion. The benefits of increased cycling and improved public transport are greatest for those who are currently disadvantaged by car-centric cities, including lower-income residents, women, and younger people. However, the project also acknowledges the need for careful attention to distributive justice, as the transition could have unintended consequences for suburban residents or those with limited access to alternative modes. Ongoing public engagement and transparent communication are essential to ensure that the transformation is inclusive and that the gains are widely shared.

The E-Bike City vision goes beyond emissions and energy savings. By promoting active mobility, the project contributes to improved public health, reduced noise, and a more vibrant urban environment. The health benefits of increased physical activity and reduced air pollution are significant, turning the external costs of the transport system from negative to positive over the long term. This is a rare outcome in urban policy, where interventions often struggle to achieve net positive impacts across multiple domains.

Looking ahead, the E-Bike City approach offers a scalable and adaptable blueprint for cities worldwide. The results from Zurich suggest that similar transformations are possible in other urban contexts, provided that the interventions are tailored to local conditions and supported by robust public engagement. The project's interdisciplinary methodology, combining transport planning, behavioral science, and environmental assessment, provides a model for how cities can navigate the complex trade-offs involved in urban mobility transitions.

In summary, the E-Bike City project demonstrates that reallocating urban road space to micromobility is not only feasible but also transformative. It offers a pathway to dramatically reduce energy use and emissions, improve urban quality, and create healthier, more liveable cities for all residents. The challenge now is to translate these findings into practice, ensuring that the benefits of sustainable mobility are realized across diverse urban communities.

5 Conclusions and outlook

The E-Bike City project demonstrates that a transformative reallocation of urban road space (prioritizing cycling, e-bikes, and micromobility while maintaining essential access for motorized vehicles, public transport, and emergency services) can deliver substantial benefits for cities and their residents. By shifting the mobility paradigm away from car dependency toward active and sustainable modes, the project achieves significant reductions in CO_2 emissions and a positive reversal of the transport system's external costs. Over a 50-year horizon, the envisioned transformation could reduce passenger transport emissions by up to 45%, while the health benefits of increased physical activity and reduced pollution turn the external costs of mobility from negative to positive for society as a whole.

Key to this vision are innovative tools such as the Street Network Manipulator, which enables automated, scalable, and constraint-aware redesigns of urban street networks. This ensures that essential connectivity, public transport operations, and minimum parking access are preserved. The project also provides municipalities with practical, standards-aligned guidelines for street and intersection design, emphasizing cost-effective, incremental changes that can be deployed quickly and scaled as needed.

Public acceptance remains a critical factor for the success of such transformations. While policy support is divided along political and lifestyle lines—with cyclists and left-leaning individuals more supportive, and car drivers and right-leaning respondents more sceptical—visualizations and design features such as greenery and social spaces can bridge divides and increase overall acceptance. The project highlights the importance of distributive justice and equity, showing that the benefits of improved accessibility and safety are greatest for those currently disadvantaged by car-centric transport systems, though careful attention is needed to avoid exacerbating existing inequalities.

From a practical standpoint, the costs of implementing the E-Bike City vision are relatively modest compared to the societal benefits, with significant improvements in cyclist safety and reductions in crash rates. Comprehensive cost-benefit analyses confirm that the positive effects of the transformation outweigh the costs, especially when accounting for the full range of health, environmental, and urban liveability benefits.

Looking ahead, the E-Bike City project offers a compelling vision for sustainable urban mobility that is both ambitious and achievable. The results from Zurich provide a blueprint that is adaptable to other Swiss cities and urban contexts worldwide, offering a pathway to meet national climate and energy targets. The project's interdisciplinary approach—combining transport planning, behavioral science, environmental assessment, and public policy—ensures that the proposed solutions are robust, evidence-based, and responsive to the needs of diverse urban populations.

Future work should focus on expanding the scope of the E-Bike City concept to include suburban and peri-urban areas, where the challenges of car dependency and limited public transport are often most acute. Further research is needed to understand the long-term impacts on urban form, real estate values, and the distribution of economic opportunities, as well as the potential for intercommunal cycling networks and seamless integration with regional transit systems.

The project also highlights the importance of ongoing public engagement and transparent communication to build broad-based support for transformative mobility policies. Visualizations, pilot projects, and participatory planning processes can help make the benefits of the E-Bike City tangible and address concerns about fairness and intrusiveness. As cities continue to grapple with the urgent need to reduce emissions and improve quality of life, the E-Bike City approach offers a promising, scalable, and equitable solution for the future of urban mobility.

By supporting the E-Bike City project, the Swiss Federal Office of Energy is contributing to the development of innovative, sustainable, and people-cantered mobility strategies that align with Switzerland's climate and energy objectives. The project's findings and tools provide a solid foundation for advancing the transition toward zero-emission transport and creating healthier, more liveable cities for all residents.

6 National and international cooperation

The project, anchored in a three-year lighthouse initiative at ETH Zurich, brought together a cross-departmental team of over 30 researchers and principal investigators within Switzerland, spanning disciplines from transport planning and civil engineering to behavioral science and environmental assessment. This collaborative effort was further enriched by the inclusion of researchers from EPFL, ensuring a diversity of expertise and perspectives.

The project's international scope was underscored by the involvement of a 12-member advisory committee, whose members hail from across Europe and Switzerland. This committee provided critical feedback and guidance throughout the project, helping to align the research with both Swiss and broader European policy priorities. Close working relationships were established with the City and Canton of Zurich, as well as local and city councillors, ensuring that the project's findings and recommendations were grounded in real-world urban governance and planning needs.

Upon publication of the visualizations and international research presentations, the EBC project gained attention beyond Switzerland. In particular, interest has been shown by German speaking media, particularly in Germany, as well as across Europe. In September 2023, a collaboration was forged with the Urban Cycling Institute and in 2023, the Cycling Research Board Annual meeting was hosted by the EBC Management Team at ETH in Zurich drawing 150 attendees from over 20 different countries. Moreover, the final EBC Results and Future Event was livestreamed to an international audience.

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Feil, M. (2010) Choosing the daily schedule: Expanding activity-based travel demand modelling, Doctoral Thesis, ETH Zurich, Zurich.

Fulton, E. J., Y.-C. Ni and A. Kouvelas (2025) Impact of radical bike lane allocation on bi-modal urban network traffic performance: A simulation case study, *SVT Working Paper*, IVT, ETH Zurich, Zurich.

Gayda, S., A. Fedosseev, M. Ruyssen, M. Kouwenhoven, R. Tapia and M. Bierlaire (2024) Analysis of the stated preference survey 2021 on mode, route and departure time choices, *Final report*, Federal Office for Spatial Development (ARE), Berne.

Grisiute, A., N. Wiedemann, P. Herthogs and M. Raubal (2024) An ontology-based approach for harmonizing metrics in bike network evaluations, *Computers, Environment and Urban Systems*, **113**, 102178.

IEA (2024) Global critical minerals outlook 2024, *Technical Report*, International Energy Agency, Paris.

Meyer de Freitas, L., S. Bekhor and K. W. Axhausen (2025) Mode-choice modelling of a sustainable mobility transition considering different bicycle types, *Arbeitsberichte Verkehrs- und Raumplanung*, **1906**, IVT, ETH Zurich and Technion, Zurich and Tel Aviv.

Mobitool Association (2023) mobitool-Faktoren v3.0, https://www.mobitool.ch.

Ni, Y.-C., A. Mohapatra, M. Makridis and A. Kouvelas (2025) Congestion-aware optimization of urban road space allocation for cars and bicycle, paper presented at the *25th Swiss Transport Research Conference (STRC 2025)*, Ascona, May 2025.

Pougala, J., T. Hillel and M. Bierlaire (2022) Capturing trade-offs between daily scheduling choices, *Journal of Choice Modelling*, **43**, 100354.

Pougala, J., T. Hillel and M. Bierlaire (2023a) Modelling the impact of activity duration on utility-based scheduling decisions: A comparative analysis, paper presented at the *11th Symposium of the European Research in Transportation*, Zurich, September 2023.

Pougala, J., T. Hillel and M. Bierlaire (2023b) OASIS: Optimisation-based activity scheduling with integrated simultaneous choice dimensions, *Transportation Research Part C: Emerging Technologies*, **155**, 104291.

Sacchi, R. and C. Bauer (2023) Life cycle inventories for on-road vehicles, *Datasets*, Paul Scherrer Institute, Villigen.

Schenker, V., P. Bayer, C. Oberschelp and S. Pfister (2024) Is lithium from geothermal brines the sustainable solution for Li-ion batteries?, *Renewable and Sustainable Energy Reviews*, **199**, 114456.

Schenker, V., C. Oberschelp and S. Pfister (2022) Regionalized life cycle assessment of present and future lithium production for Li-ion batteries, *Resources, Conservation and Recycling*, **187**, 106611.

Schenker, V. and S. Pfister (2025) Current and Future Impacts of Lithium Carbonate from Brines: A Global Regionalized Life Cycle Assessment Model, *Environmental Science & Technology*, **59** (13) 6543–6555.

Sonnak, M. (2024) Evaluation of E-Bike-City road networks, *Master Thesis*, IVT, ETH Zurich, Zurich, January 2024.

Statistics Netherlands (2016) Transport and Mobility 2016, *Report*, Statistics Netherlands, The Hague.

Wiedemann, N., C. Nöbel, L. Ballo, H. Martin and M. Raubal (2025) Bike network planning in limited urban space, *Transportation Research Part B: Methodological*, **192**, 103135.

World Meteorological Organization (2025) State of the global climate 2024, *Annual Global Report*, **1368**, WMO, Geneva.

Zani, D. and B. T. Adey (2024) Modelling road infrastructure potential for the appraisal of sustainable bicycling networks, paper presented at the *International Scientific Conference on Mobility and Transport (mobil.TUM 2024)*, Berlin, April 2024.

Zani, D. and B. T. Adey (2025) Creating network-wide overviews of road infrastructure costs and crash risk in early planning stages, paper presented at the *25th Swiss Transport Research Conference (STRC 2025)*, Ascona, May 2025.

Zani, D., G. Kapousizis, B. T. Adey and K. Geurs (2024) Comparison of bicycle crashes between the Netherlands and Switzerland: Linking crashes with infrastructure, paper presented at the *8th Annual Meeting of the Cycling Research Board (CRBAM 2024)*, Zurich, September 2024.

8 Visualizations

- E-Bike City: Results and Future Event 4 June, 2025 (Website with recordings of event)
- E-Bike City Final Results Brochure PDF (500 physical copies distributed to the public)
- E-Bike City Zurich: Overview plan (Network Map after EBC redesign)
- E-Bike City 3D Street Visualizations
- E-Bike City: Liveable, accessible, convenient and affordable urban transportation: Explainer videos from phase 1 visualizations

Albisriederplatz Zurich

- Overview
- From a bicycle
- With pedestrians
- From within a car

Baslerstrasse Zurich

- Overview
- From a bicycle
- With pedestrians
- From within a car

Langmauerstrasse Zurich

- Overview
- From a bicycle
- With pedestrians
- From within a car

Winterthurerstrasse Zurich

- Overview
- From a bicycle
- With pedestrians
- From within a car

9 E-Bike City publications

9.1. Reviewed journal contributions

Ballo, L., K. W. Axhausen and M. Raubal (2024) Designing an E-Bike City: An automated process for network-wide multimodal road space reallocation, *Journal of Cycling and Micromobility Research*, **2**, 100048.

Ballo, L., L. Meyer de Freitas, A. Meister and K. W. Axhausen (2023) The E-Bike City as a radical shift toward zero-emission transport: Sustainable? Equitable? Desirable?, *Journal of Transport Geography*, **111**, 103663.

Brunner, J., Y.-C. Ni, A. Kouvelas and M. Makridis (2024) Microscopic simulation of bicycle traffic flow incorporating cyclists' heterogeneous dynamics and non-lane-based movement strategies, *Simulation Modelling Practice and Theory*, **135**, 102986.

Gallo, F., N. Sacco and F. Corman (2023) Network-wide public transport occupancy prediction framework with multiple line interactions, *IEEE Open Journal of Intelligent Transportation Systems*, **4**, 815–832.

Grisiute, A., N. Wiedemann, P. Herthogs and M. Raubal (2024) An ontology-based approach for harmonizing metrics in bike network evaluations, *Computers, Environment and Urban Systems*, **113**, 102178.

Manser, P., T. Haering, T. Hillel, J. Pougala, R. Krueger and M. Bierlaire (2024) Estimating flexibility preferences to resolve temporal scheduling conflicts in activity-based modelling, *Transportation*, **51** (2) 501–528.

Meister, A., M. Felder, B. Schmid and K. W. Axhausen (2023) Route choice modelling for cyclists on urban networks, *Transportation Research Part A: Policy and Practice*, **173**, 103723.

Meister, A., Z. Liang, M. Felder and K. W. Axhausen (2024) Comparative study on route choice models for cyclists, *Journal of Cycling and Micromobility Research*, **2**, 100018.

Ni, Y.-C., M. Makridis and A. Kouvelas (2024) Bicycle as a traffic mode: From microscopic cycling behavior to macroscopic bicycle flow, *Journal of Cycling and Micromobility Research*, **2**, 100022.

Peiseler, L., V. Schenker, K. Schatzmann, S. Pfister, V. Wood and T. Schmidt (2024) Carbon footprint distributions of lithium-ion batteries and their materials, *Nature Communications*, **15** (1) 10301.

Pougala, J., T. Hillel and M. Bierlaire (2022) Capturing trade-offs between daily scheduling choices, *Journal of Choice Modelling*, **43**, 100354.

Pougala, J., T. Hillel and M. Bierlaire (2023) OASIS: Optimisation-based Activity Scheduling with Integrated Simultaneous choice dimensions, *Transportation Research Part C: Emerging Technologies*, **155**, 104291.

Schenker, V., P. Bayer, C. Oberschelp and S. Pfister (2024) Is lithium from geothermal brines the sustainable solution for Li-ion batteries?, *Renewable and Sustainable Energy Reviews*, **199**, 114456.

Schenker, V., C. Oberschelp and S. Pfister (2022) Regionalized life cycle assessment of present and future lithium production for Li-ion batteries, *Resources, Conservation and Recycling*, **187**, 106611.

Schenker, V. and S. Pfister (2025) Current and future impacts of lithium carbonate from brines: A global regionalized life cycle assessment model, *Environmental Science & Technology*, **59** (13) 6543–6555.

Wiedemann, N., C. Nöbel, L. Ballo, H. Martin and M. Raubal (2025) Bike network planning in limited urban space, *Transportation Research Part B: Methodological*, **192**, 103135.

9.2. Reviewed papers in books and conference proceedings

Allemann, D. and M. Raubal (2015) Usage differences between bikes and e-bikes, paper presented at the *18th International Conference on Geographic Information Science as an Enabler of Smarter Cities and Communities (AGILE 2015)*, Lisbon. June 2015.

Axhausen, K. W. (2022) The dilemma of transport policy making and the Covid-19 accelerator, in M. Attard and C. Mulley (eds.) *Transport and Pandemic Experiences*, vol. 17, 39–51, Emerald, Leeds.

Ballo, L., A. Sallard, L. Meyer de Freitas and K. W. Axhausen (2025) Is "small" infrastructure the next factory for accessibility? Evaluating the regional accessibility effects of a cycling-centric transport policy in Zurich, paper presented at the *104th Annual Meeting of the Transportation Research Board (TRB 2025)*, Washington, D.C., January 2025.

Gallo, F., T. Spanninger and F. Corman (2023) Weather effects on the public transport ridership of the City of Zurich at a stop-to-stop level, paper presented at the *8th International Conference on Models and Technologies for Intelligent Transportation Systems (MT-ITS 2023)*, Nice, June 2023.

Gan, G., A. Meister and M. Balac (2024) Cycling mode choice: A revealed performance study in Switzerland, paper presented at the *103rd Annual Meeting of the Transportation Research Board (TRB 2024)*, Washington, D.C., January 2024.

Kaufmann, D., M. Wicki, C. Sinatra and A. Huang (2025) Creating urban space: A visualization-based survey experiment for urban street redesign, paper presented at the *Conference Villes, Ecological Transition and Local Politics: A Comparative Perspective*, Paris, March 2025.

Martin-Iradi, B., F. Corman and N. Geroliminis (2024) Dynamic capacity planning for demand-responsive multimodal transit, paper presented at the *Conference in Emerging Technologies in Transportation Systems (TRC-30)*, Heraklion, September 2024.

Maurer, L., A. Meister and K. W. Axhausen (2025) GPS-based speed profiles for cyclists in Zurich, Switzerland, paper presented at the *104th Annual Meeting of the Transportation Research Board (TRB 2025)*, Washington, D.C., January 2025.

Meister, A., L. Zheng and M. Balac (2025) Probabilistic routing for agent-based simulations, paper presented at the *104th Annual Meeting of the Transportation Research Board (TRB 2025)*, Washington, D.C., January 2025.

Ni, Y.-C., M. Makridis and A. Kouvelas (2023) Investigating link- and network-level bicycle traffic flow characteristics using a microsimulation approach, paper presented at the *11th Symposium of the European Association for Research in Transportation (hEART 2023)*, Zurich, September 2023.

Raubal, M., D. Bucher and H. Martin (2021) Geosmartness for personalized and sustainable future urban mobility, in W. Shi, M. F. Goodchild, M. Batty, M.-P. Kwan and A. Zhang (eds.) *Urban Informatics*, 59–83, Springer, New York.

Ringel, L., C. Kielhauser and B. T. Adey (2022) Wider view over bicycle accidents: Complementing and extending bicycle accident statistics in urban areas using surveys, paper presented at the *10th Annual International Cycling Safety Conference (ICSC 2022)*, Dresden, November 2022.

Wicki, M. (2025) Public support for sustainable urban mobility: A survey experiment on the E-Bike City concept in Switzerland, paper presented at the *1st ETH Domain Conference on Social Sciences on Environment, Technology and Sustainability*, Dübendorf, January 2025.

Wicki, M., C. Sinatra, A. Huang and D. Kaufmann (2025) Exploring public preferences for urban street redesign: A visualization-based stated choice experiment in Switzerland, paper presented at the *Conference Creating Healthy and Successful Cities (EURA 2025)*, Bristol, June 2025.

Wicki, M., C. Sinatra and D. Kaufmann (2024) Assessing public preferences for urban street re-design: A stated choice experiment, paper presented at the *8th Annual Meeting of the Cycling Research Board (CRBAM 2024)*, Zurich, September 2024.

9.3. Books, published research reports, norms and official guidelines

Gayda, S., A. Fedosseev, M. Ruyssen, M. Kouwenhoven, R. Tapia and M. Bierlaire (2024) Analysis of the stated preference survey 2021 on mode, route and departure time choices, *Final report*, Federal Office for Spatial Development (ARE), Berne.

Meyer de Freitas, L., M. Miotti and D. Zani (2024) Effects of an E-Bike City, *Cost-benefit analysis*, ETH Zurich, Zurich, April 2024.

9.4. Dissertations

Ballo, L. (2025) Addressing large challenges with small infrastructure: Envisioning the E-Bike City, Doctoral Thesis, ETH Zurich, Zurich.

Meister, A. (2024) Measuring, modelling and simulation of cyclist route choice behavior, Doctoral Thesis, ETH Zurich, Zurich.

Schenker, V. (2024) Regionalized life cycle assessment of lithium carbonate production from brines, Doctoral Thesis, ETH Zurich, Zurich.

9.5. Working and conference papers

Andersson, W., F. Fuchs, Z. Ansarilari and F. Corman (2025) Stochastic transit network design considering weather conditions, *Working Paper*, IVT, ETH Zurich, Zurich.

Ballo, L. and K. W. Axhausen (2023) Modeling sustainable mobility futures using an automated process of road space reallocation in urban street networks: A case study in Zurich, *Arbeitsberichte Verkehrs- und Raumplanung*, **1835**, IVT, ETH Zurich, Zurich.

Ballo, L., L. Meyer de Freitas, A. Meister and K. W. Axhausen (2022) Introducing the E-Bike City: Sustainable mobility through urban design?, *Arbeitsberichte Verkehrs- und Raumplanung*, **1770**, IVT, ETH Zurich, Zurich.

Ballo, L., A. Sallard, L. Meyer de Freitas and K. W. Axhausen (2024) Accessibility in an E-Bike City, paper presented at the *24th Swiss Transport Research Conference (STRC 2024)*, Ascona, May 2024.

Elliot, C., R. Egan, M. Wicki and K. W. Axhausen (2025) Inclusive street re-design for bicycles and micromobility: A thematic analysis of the public sentiment in zurich's E-Bike City project, *Arbeitsberichte Verkehrs- und Raumplanung*, **1908**, IVT, ETH Zurich, Zurich.

Elliot, C., M. Wicki and K. W. Axhausen (2024) Unveiling public sentiment: Analyzing commenter feedback on the Zurich E-Bike City research project, paper presented at the *24th Swiss Transport Research Conference (STRC 2024)*, Ascona, May 2024.

Fulton, E. J., Y.-C. Ni and A. Kouvelas (2025) Impact of radical bike lane allocation on bi-modal urban network traffic performance: A simulation case study, *Working Paper*, IVT, ETH Zurich, Zurich.

Klasovitá, V. and F. Corman (2024) Including uncertainties in line planning and timetabling, paper presented at the *24th Swiss Transport Research Conference (STRC 2024)*, Ascona, May 2024.

Meister, A. (2022) Modelling route choice of cyclists in Zurich, paper presented at the *22nd Swiss Transport Research Conference (STRC 2022)*, Ascona, May 2022.

Meyer de Freitas, L. and K. W. Axhausen (2022a) Cycling potentials in Switzerland: An assessment of its determinants using health survey data and first results, paper presented at the *22nd Swiss Transport Research Conference (STRC 2022)*, Ascona, May 2022.

Meyer de Freitas, L. and K. W. Axhausen (2022b) Evaluating mode-shift potentials to cycling based on individual capabilities, *Arbeitsberichte Verkehrs- und Raumplanung*, **1763**, IVT, ETH Zurich, Zurich.

Meyer de Freitas, L., S. Bekhor and K. W. Axhausen (2025) Mode-choice modelling of a sustainable mobility transition considering different bicycle types, *Arbeitsberichte Verkehrs- und Raumplanung*, **1906**, IVT, ETH Zurich, Zurich.

Ni, Y.-C., M. Makridis and A. Kouvelas (2023) Three-dimensional macroscopic fundamental diagrams for dedicated bicycle and car traffic in an actuated signal control network, paper presented at the *23rd Swiss Transport Research Conference (STRC 2023)*, Ascona, April 2023.

Ni, Y.-C., A. Mohapatra, M. Makridis and A. Kouvelas (2025) Congestion-aware optimization of urban road space allocation for cars and bicycles, paper presented at the *25th Swiss Transport Research Conference (STRC 2025)*, Ascona, May 2025.

Pougala, J., T. Hillel and M. Bierlaire (2023) From one-day to multiday activity scheduling: Extending the OASIS Framework, paper presented at the *23rd Swiss Transport Research Conference (STRC 2023)*, Ascona, May 2023.

Salvadé, N., T. Hillel, J. Pougala, T. Haering and M. Bierlaire (2022) Representing location choice within activity-based models, paper presented at the *22nd Swiss Transport Research Conference (STRC 2022)*, Ascona, May 2022.

Wang, M., J. Pougala and M. Bierlaire (2023) Initial comparisons between Multiple Discrete-Continuous Extreme Value (MDCEV) model and Optimization-based Activity Scheduling Integrating Simultaneous choice dimensions (OASIS) framework, paper presented at the *23rd Swiss Transport Research Conference (STRC 2023)*, Ascona, May 2023.

Wicki, M. and D. Kaufmann (2025) Exploring public acceptance of urban road space reallocation: A vignette-based survey experiment, *Working Paper*, IRL, ETH Zurich, Zurich.

Wicki, M., C. Sinatra, A. Huang and D. Kaufmann (2025) Designing streets for people, not cars: A visual choice experiment on urban street transformation, *Working Paper*, IRL, ETH Zurich, Zurich.

Zani, D. (2025a) Cycle infrastructure implementation costs, paper presented at the *25th Swiss Transport Research Conference (STRC 2025)*, Ascona, May 2025.

Zani, D. (2025b) Cycling infrastructure evolution in Swiss cities, paper presented at the *25th Swiss Transport Research Conference (STRC 2025)*, Ascona, May 2025.

Zani, D., C. Kielhauser and B. T. Adey (2023) Overcoming challenges in cost-benefit analysis of urban cycling infrastructure, paper presented at the *23rd Swiss Transport Research Conference (STRC 2023)*, April 2023.

9.6. Public presentations and other invited talks

Axhausen, K. W. (2022) E-Bike City: Welcome, presentation at the E-Bike City: Designing sustainable streets - Kick-off Event, Zurich, November 2022.

Axhausen, K. W. (2023a) Could an E-Bike (+ walking, transit, scooter) City work?, presentation at the 5th Bridging Transportation Researchers Conference (BTR5), online, August 2023.

Axhausen, K. W. (2023b) E-Bike City: An answer to our transport dead-end?, presentation at the SUMO User Conference 2023, Berlin, May 2023.

Axhausen, K. W. (2023c) E-Bike City: Verifying a vison, presentation at the Guest Lecture at the Department of Civil Engineering, University of Sydney, online, October 2023.

Axhausen, K. W. (2023d) How to model the E-Bike City?, presentation at the Seminar "From Traffic Modeling to Smart Cities and Digital Democracies", ETH Zurich, October 2023.

Axhausen, K. W. (2023e) Projekt E-Bike-City, presentation at the DAV- Personalversammlung, Zurich, April 2023.

Axhausen, K. W. (2024a) Assessing major changes in the transport systems: The case of the E-Bike City, presentation at the TMI Wise Seminar, Takashima, September 2024.

Axhausen, K. W. (2024b) E-Bike City: Plan B for sustainable transport?, presentation at the ITLS Seminar 2024, University of Sydney, April 2024.

Axhausen, K. W. (2024c) How to assess a mayor network change? The case of the E-Bike City, presentation at the MSc Class, Kyoto University, Kyoto, October 2024.

Axhausen, K. W. (2024d) What next when BAU doesn't work anymore?, presentation at the MIT Mobility Forum, online, December 2024.

Axhausen, K. W., D. Kaufmann and C. Elliot (2023) E-Bike City, presentation for the Tiefbauamt, Zurich, November 2023.

Ballo, L. (2022a) E-Bike City: An urban transformation for a sustainable future?, pre- sentation at the Center for Sustainable Future Mobility: Kick-off Symposium, May 2022.

Ballo, L. (2022b) E-Bike City: Nachhaltig? Gerecht? Wünschenswert?, presentation at the Universitätstagung Verkehrswesen 2022, Weimar, September 2022.

Ballo, L. (2023a) E-Bike City: Masterplan for Zurich, presentation at the Elcykelkom- munen – en vej til klimavenlig og sund mobilitet? Gate 21 Webinar, online, December 2023.

Ballo, L. (2023b) Modeling transport networks resulting from alternative allocations of road space, poster presentation at the Center for Sustainable Future Mobility Symposium 2023 (CSFM 2023), Zurich, June 2023.

Ballo, L. (2023c) Modelling road space allocation on street networks for radical sustainable mobility transitions, presentation at the 23rd Swiss Transport Research Conference (STRC 2023), Ascona, May 2023.

Ballo, L. (2024a) E-Bike City, presentation at the US Mayors in Switzerland, Zurich, April 2024.

Ballo, L. (2024b) E-Bike City masterplan: Designing a car-reduced urban mobility future for Zurich, abstract presented at the International Scientific Conference on Mobility and Transport (mobil.TUM 2024), Munich, April 2024.

Ballo, L. and L. Meyer de Freitas (2022) E-Bike City: Konzept und Verlagerungspotentiale auf das Velo, presentation at the Alumni Verkehrsingenieurtag 2022, Zurich, April 2022.

Ballo, L., L. Meyer de Freitas, A. Meister and K. W. Axhausen (2022) Rebuilding streets for sustainable transport: The E-Bike City?, presentation at the 6th Annual Meeting of the Cycling Research Board (CRB 2022), Amsterdam, October 2022.

Ballo, L., A. Sallard, L. Meyer de Freitas and K. W. Axhausen (2024) How will an E-Bike City change our accessibility?, presentation at the 8th Annual Meeting of the Cycling Research Board (CRBAM 2024), Zurich, September 2024.

Brunner, J., M. Makridis and Y.-C. Ni (2023) An integrated microscopic bicycle simulation model considering non-lane-based traffic characteristics, presentation at the 23rd Swiss Transport Research Conference (STRC 2023), Ascona, May 2023.

Elliot, C. (2024a) E-Bike City, presentation at the Niederländisch-Schweizerische Netzwerk-Veranstaltung, Zurich, March 2024.

Elliot, C. (2024b) E-Bike City, presentation at the grand opening of M-Way E-Bike Store, Berne, March 2024.

Elliot, C. (2024c) E-Bike-City Zürich: Vision eines nachhaltigen Verkehrs, presentation for the Verein Kli- magrosseltern Schweiz, Zurich, August 2024.

Elliot, C. (2024d) The future of sustainable commuting, presentaton at Deloitte, Zurich, June 2024.

Elliot, C. (2024e) Shifting cities towards micromobility: Understanding the citizen's perspective in an E-Bike City, presentation at the Future Cities Laboratory Seminar, online, February 2024.

Elliot, C. (2024f) Traffic evaporation through redesigning streets: The vision of E-Bike City and how to change the narrative, presentation at the public symposium Bike Sharing and Co: How to do it well, Wies- baden, September 2024.

Elliot, C. (2024g) Weshalb eine E-Bike-City?, presentation at the E-Motion Jubiläumsver- anstaltung, Di- etikon, March 2024.

Elliot, C. (2025a) E-Bike City, presentation at the ETH Zurich Sustainability Day, Zurich, April 2025.

Elliot, C. (2025b) How an E-Bike City leads to safer cycling in cities: How can we use technology to address the increase in (e)bike accidents and encourage safer cycling in cities? presentation at the Cycling Hack, Geneva, May 2025.

Elliot, C., K. W. Axhausen, A. D. Marra, F. Fuchs, F. Corman, L. Ballo, C. Livingston, M. Balac, Y.-C. Ni, M. Makridis, A. Kouvelas, N. Wiedemann, A. Grisiute, M. Raubal, V. Schenker, M. Miotti, S. Pfister, S. Hellweg, M. Wicki, C. Sinatra, D. Kaufmann, L. Meyer de Freitas, A. H. G. Meister, D. Zani, B. T. Adey, J. Pougala and M. Bierlaire (2024a) What we learned so far with the E-Bike City research D-BAUG lighthouse project, presentation at the IVT Seminar, Zurich, July 2024.

Elliot, C., D. Freitag, T. Hug and F. Perret (2024b) Strasse als Lebensraum, presentation at the Veloforum Schweiz, Zurich, May 2024.

Elliot, C., M. Wicki, R. Egan and K. W. Axhausen (2024c) Exploring the narrative behind Zurich's E-Bike City research project: A thematic analysis of self-identifying transport user types, presentation at the 8th Annual Meeting of the Cycling Research Board (CRBAM 2024), Zurich, September 2024.

Elvarsson, A. B., D. Zani and B. T. Adey (2024) Fast lane for planning cycling infrastructure, presentation at the 8th Annual Meeting of the Cycling Research Board (CRBAM 2024), Zurich, September 2024.

Felder, M., A. Meister and K. W. Axhausen (2022) Choice set generation for large-scale cycling networks, presentation at the 22nd Swiss Transport Research Conference (STRC 2022), Ascona, May 2022.

Fuchs, F. and F. Corman (2022) Multi-scale responsive public transport for bi-modal demand, poster presentation at the E-Bike City: Designing Sustainable Streets - Kick-off Event, Zurich, November 2022.

Fulton, E., Y.-C. Ni and A. Kouvelas (2024) Assessing the influence of bike lane allocation on network traffic performance using microsimulation, presentation at the 8th Annual Meeting of the Cycling Research Board (CRBAM 2024), Zurich, September 2024.

Grisiute, A., N. Wiedemann, H. Martin and M. Raubal (2023) Ontology-based approach for harmonizing metrics in bike network evaluations, presentation at the 7th Annual Meeting of the Cycling Research Board (CRBAM 2023), Wuppertal, October 2023.

Grisiute, A., N. Wiedemann and M. Raubal (2024) Network design and evaluation for the E-bike City vision, poster presentation at the Center for Sustainable Future Mobility Symposium 2024 (CSFM 2024), Zurich, May 2024.

Hintermann, B., J. Roth, L. Schwab, K. W. Axhausen, A. Meister, L. Meyer de Freitas and T. Götschi (2023) Mobility pricing to promote e-biking and reduce transportation externalities: A GPS-tracked experiment, presentation at the 23rd Swiss Transport Research Conference (STRC 2023), Ascona, May 2023.

Klasovitá, V. and F. Corman (2023) Line planning for time-varying passenger demand in railways, poster presentation at the 10th International Conference on Railway Operations Modelling and Analysis (RailBelgrade 2023), Belgrade, April 2023.

Livingston, C. (2022) E-Bike City: Designing sustainable streets, presentation at the E-Bike City: Designing sustainable streets - Kick-off Event, Zurich, November 2022.

Livingston, C. (2023a) E-Bike City: A vision of sustainable transport, presentation at the GreenBuzz Thematic Event: Driving Towards Zero Emissions - The Future of Sustainable Mobility, Zurich, October 2023.

Livingston, C. (2023b) Weshalb eine E-Bike-City? presentation at Switzerland's Congress for Light Electric Mobility (SLEM), Berne, September 2023.

Livingston, C. and K. W. Axhausen (2023) Cycling norms for the E-Bike City: An interplay of policy, engineering, and culture, presentation at the 7th Annual Meeting of the Cycling Research Board (CRBAM 2023), Wuppertal, October 2023.

Marra, A. D., F. Gallo, T. Spanninger and F. Corman (2022) The impact of weather on transit demand, poster presentation at the E-Bike City: Designing Sustainable Streets, Kick-off Event, Zurich, November 2022.

Meister, A. (2022) Modelling of cyclists in agent-based simulation, presentation at the Center for Sustainable Future Mobility: Kick-off Symposium, Zurich, May 2022.

Meister, A., M. Balac, L. Zheng and K. W. Axhausen (2024) Route choice model integration into MATSim, presentation at the 8th Annual Meeting of the Cycling Research Board (CRBAM 2024), Zurich, September 2024.

Meister, A., M. Felder, B. Schmid and K. W. Axhausen (2023) Route choice modelling for cyclists on dense urban networks, presentation at the 102nd Annual Meeting of the Transportation Research Board (TRB 2023), Washington D.C., January 2023.

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ETH News / D-BAUG News

Over the three-year duration of «E-Bike City», regular updates were shared through the official channels of ETH Zurich and the Department of Civil, Environmental and Geomatic Engineering as part of a strategically planned communications effort. The following entries present a selection of the most relevant announcements – they helped shape public debate and, alongside numerous outreach events, often served as a basis for media coverage.

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