sccer mobility

Swiss Competence Center for Energy Research
Efficient Technologies and Systems for Mobility

In Zusammenarbeit mit der KTI

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CA B1.: Integration, Operation and Optimization of Mobility Systems

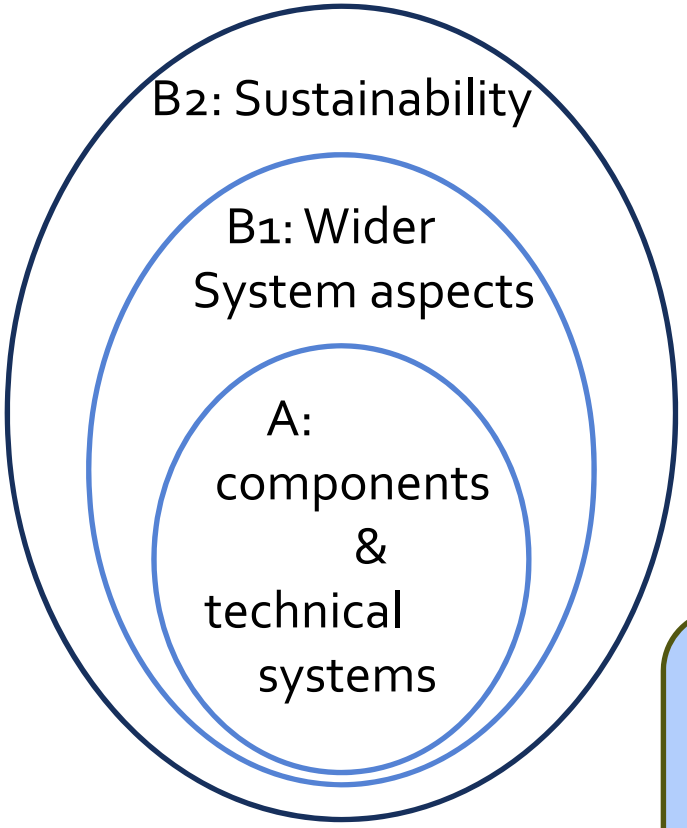
Co-Coordinators Prof. Martin Raubal (ETH), Prof. Vinzenz V. Härri (FHZ)

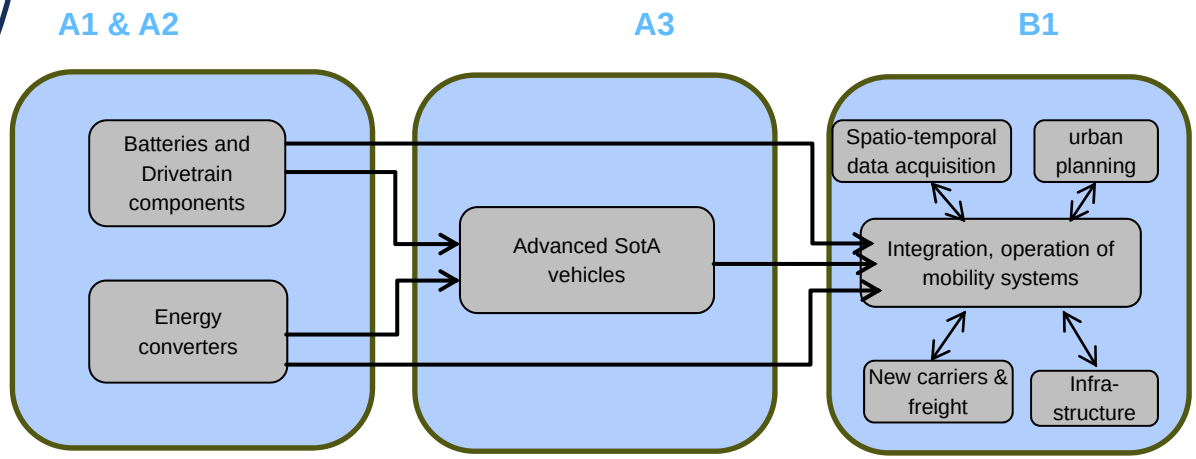
SCCER Mobility: 1st. Annual Conference

September 11th 2014 – ETH Zürich, ML Halle – E12

Scope: Wider System Aspects of Mobility

The system shells





Overall Context

B1: Measures for optimization of efficiency by system approach

Supply:	Technologies and infrastructure integration
Demand:	Users, Linking mobility, environmental data, urban planning

Abstract B1

B1 deals with

- increasing the energy efficiency in transportation from a systems point of view.
- To this end users, technology and the infrastructure are interfaced with each other by linking mobility patterns with urban planning and environmental data.
- This includes simulating and monitoring people's spatio-temporal behavior in near real-time with the goal of calculating and communicating energy saving options.
- Such approach will result in an optimization of mobility systems and therefore a reduction of the future energy demand.

Subtasks

- B1.1: Integration, Infrastructure & New Urban Transport
- B1.2: Spatio-temporal Data Acquisition & Analysis,

  Monitoring Devices and User Communication
- B1.3: Urban Planning & Environmental Impact

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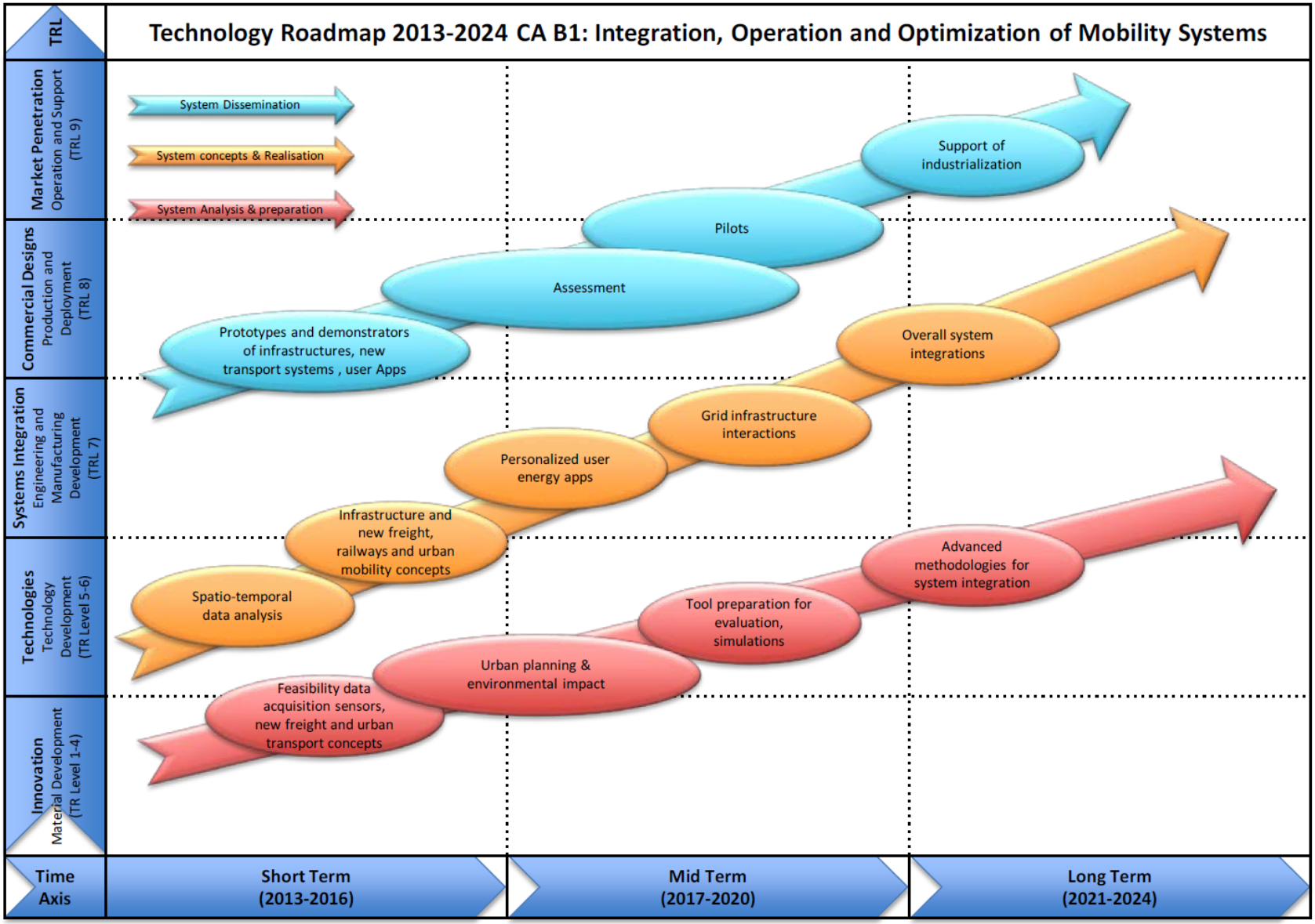
Road Map B1



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CA B1.1:
Infrastructure & New Urban Transport

Context B1.1

- Integrating technical subsystems: drive-chains, overhead-lines and pantographs, inductive or other power transfer devices, static storages, substations and decentralized renewable power supply hubs
- Overall benefits by reducing energy losses in the supply chain: planning of distributed and intelligent grid infrastructures, which satisfy the demand of dynamic control for handling the high power peaks by breaking and acceleration
- overall evaluation and optimization of the most promising transport carriers and their optimal multimodal combination from an energy efficiency point-of-view
- including advanced and new carriers: trains, LRT, elevators, escalators, people movers, cable cars….
- Taking into account operation profiles and applied in pilot transportation projects

Vision for 2030

- New Light Tram with Batteries (Charging with IPT / Contact Rail)
- Other new transport carrier

Ref. HESS Carosserie AG

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Vision for 2030

Monorail

Arial tram: Caracas (Venezuela),
Town Cable Car Algeria (Doppelmayr)

Solar Elevators

People Mover:
Airport transport Birmingham (GB)

Escalators

Urban Transport and Infrastructure in 2014

- Urban Transport as a Mobility System

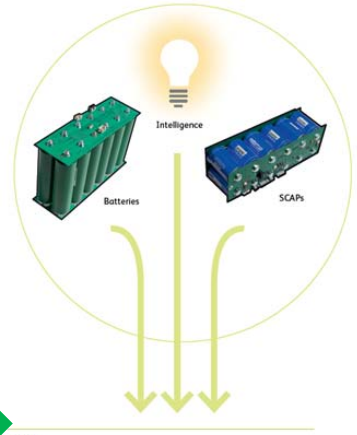
PV-Module or Grid ⇔ Batteries ⇔ E-Vehicles (V2x technologies)

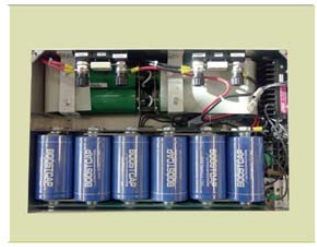
Urban Transport and Infrastructure (IVT & IIEE)

- Support of E-buses market introduction
- New Midi Bus for Zürich (2015-2017), VBZ

Grid & Charging Infrastructure

E-Vehicle (Midi Bus)

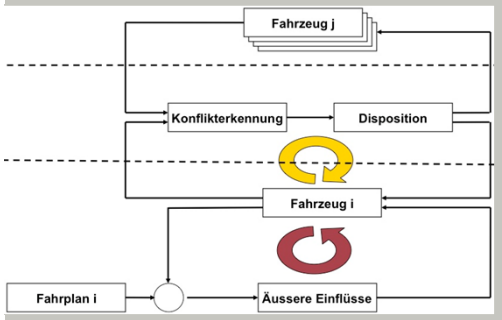




Components

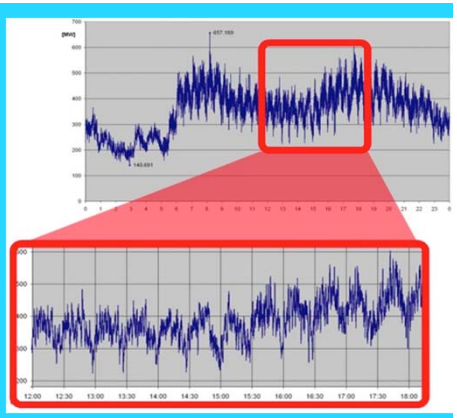
- → Specification of today's and future busses?

Other Related Topics



Automatic train operation joint with centralized train management system
Holistic optimization of energy consumption and network capacity in rail systems

Reduction of the peak loads of energy consumption in integrated timetable systems
Energy storage on locomotives and/or new timetables with smoothed connection systems

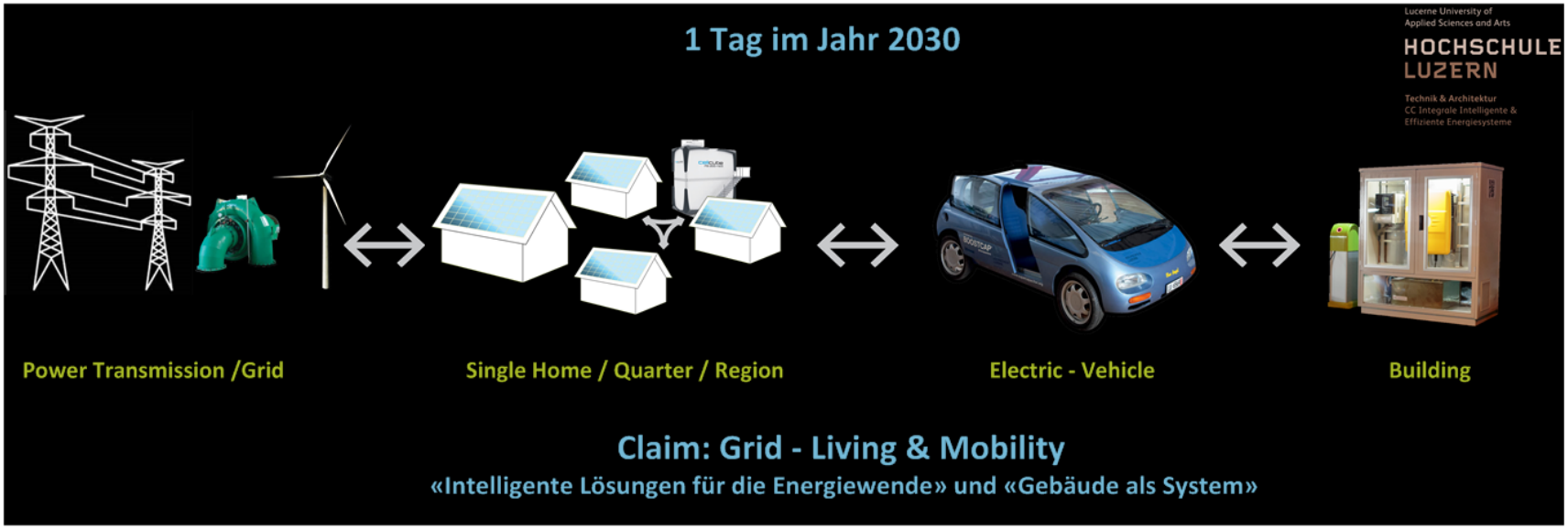


Electromobility in urban public transport systems
Decision method for the evaluation of road-bound electric public transport systems

Enhanced flexibility and productivity in the single waggonload system
New opportunities given by hybrid diesel-electric locomotives for multipurpose operation

Urban Transport and Infrastructure

- Interaction with SCCER (Grids)



Grid & Power Transmission

Quarter / Building & Energy Storage

E-Vehicle & Charging Infrastructure

CA B1.2: Spatio-temporal Data Acquisition & Analysis, Monitoring Devices and User Communication

Context B1.2

- Novel data sources, sensors, and monitoring devices will allow us in the future to tackle the challenges of reducing CO2 emissions and energy consumption from a new perspective.
- Development of an integrative framework for utilizing ICT (Information and Communication Technologies) to acquire massive data from people regarding their daily movement patterns and energy consumption.
- Goal of calculating and communicating energy saving options, e.g., the most energy efficient route to take, through a mobile service to the individual.
- Forecasting and predicting urban traffic and corresponding energy consumption.
- Developed personalized energy mobility service/app will be tested and evaluated for a large study in the cantons of Zürich and Luzern.

Heyko Stöber

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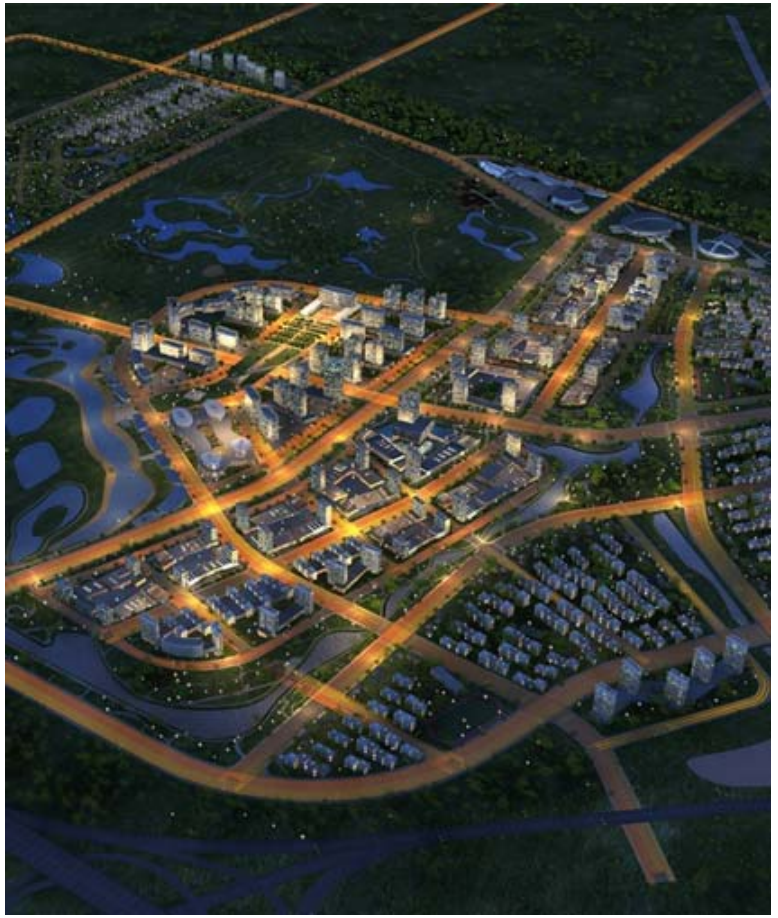

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Mobility & Energy – the Challenges

- Mobile Information Society
  - Human mobility patterns (mass events)
  - Location-based decision support
- Complex mobility systems
  - Transport infrastructure
- Complex mobile decision-making
- Increased energy consumption
  - Integration of renewable energy sources
  - Reducing environmental impact

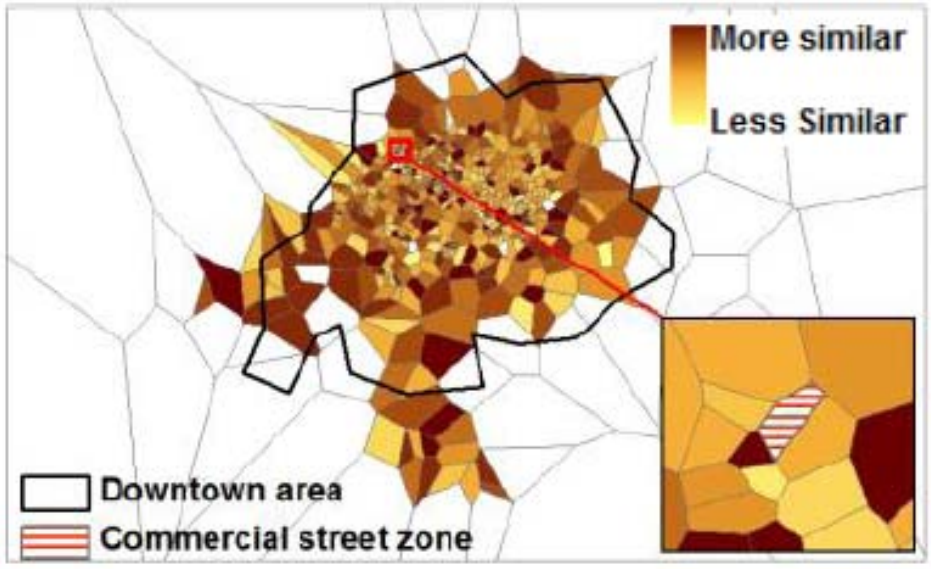
Human Mobility Analysis

- Where are people's activity spaces?
- How similar are people's trajectories?
- Where are the hotspots of an urban system?

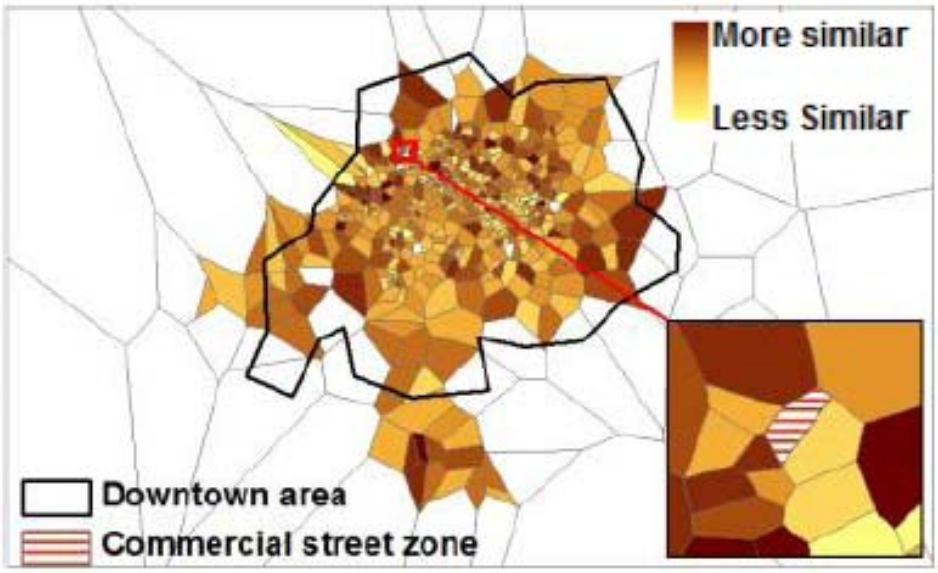
Can we extract human mobility patterns & activity behavior from mobile phone data?

- Georeferenced mobile phone data
  - Large spatio-temporal scale
  - Low spatio-temporal resolution
  - Few individual attributes

Dynamic Mobility Patterns



Weekdays



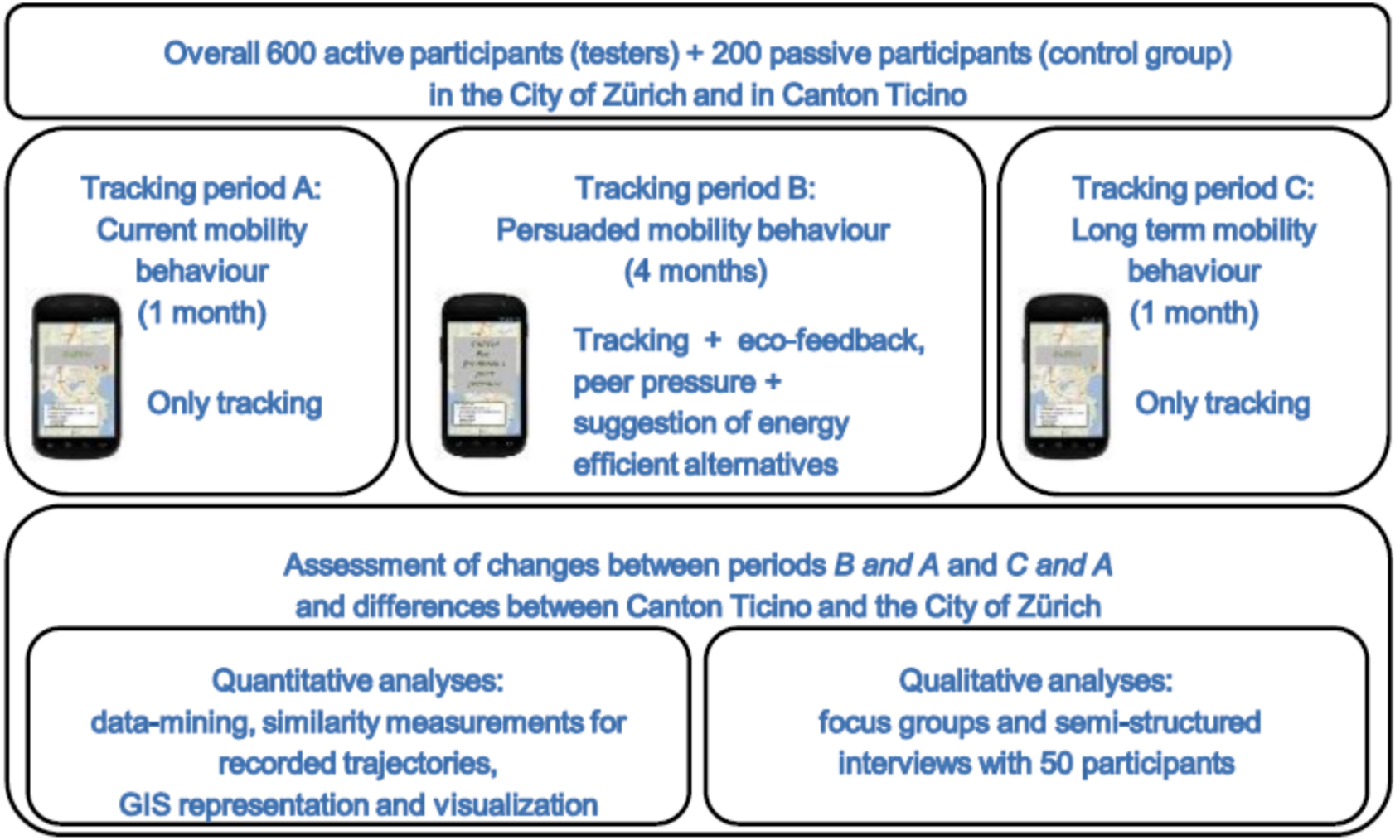
Weekends

- Mobility patterns more similar on weekdays.
- Surrounding polygons more similar on weekends.

[Yuan & Raubal 2012]

GoEco!

- A Community based eco-feedback approach to promote sustainable personal mobility styles.
- Project proposal by University of Applied Sciences and Arts of Southern Switzerland & ETH Zürich.
- Can eco-feedback, social comparison and peer pressure be effectively used to promote a sustainable lifestyle?
- Can they help in reducing private motorized transport and bringing about a transition to different mobility options, such as vehicle sharing, intermodal use of means of transport, public transportation and slow mobility?

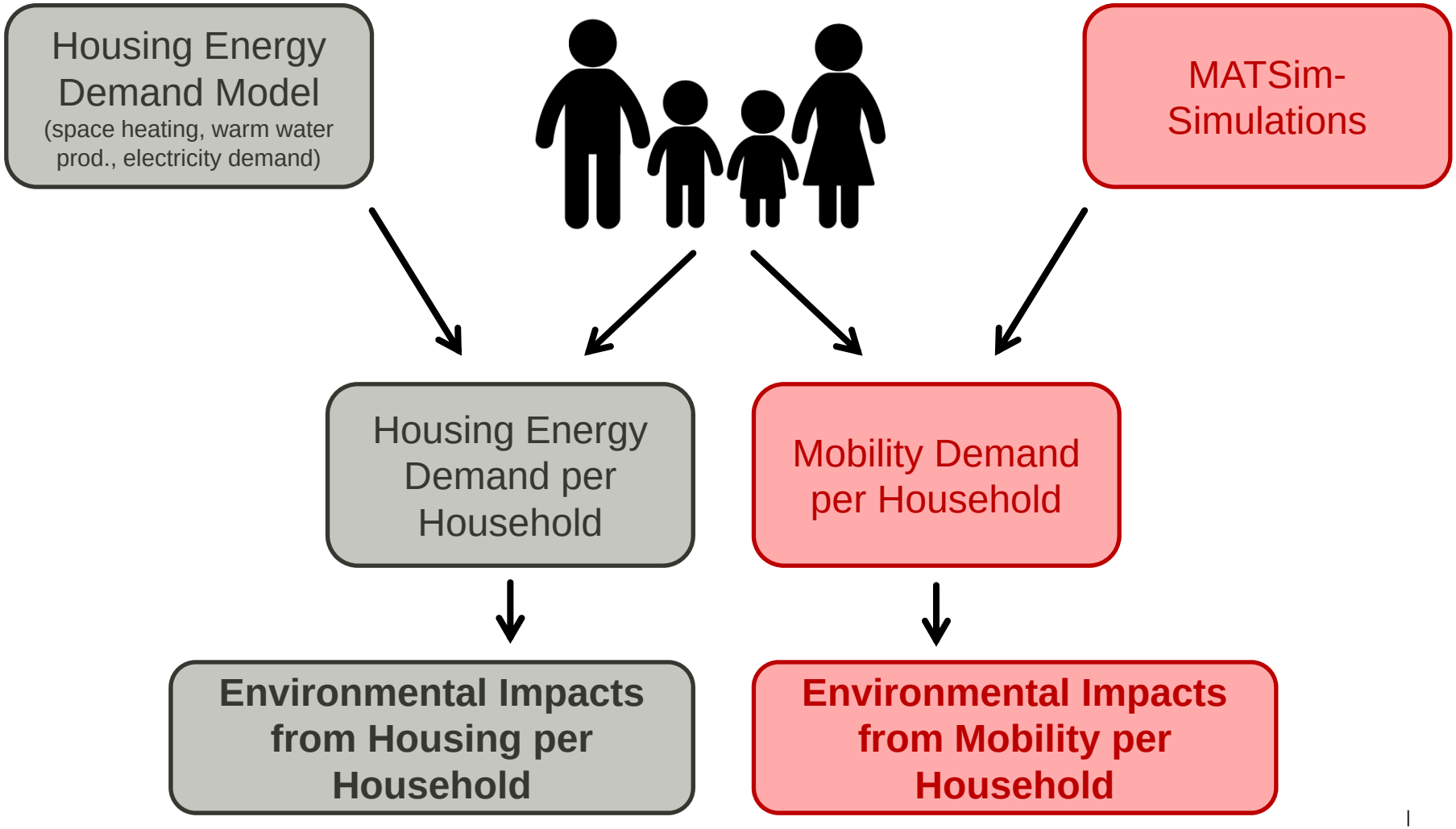

Overall 600 active participants (testers) + 200 passive participants (control group)
in the City of Zürich and in Canton Ticino
Tracking period A:
Current mobility
behaviour
(1 month)
Only tracking
Tracking period B:
Persuaded mobility behaviour
(4 months)
Tracking + eco-feedback,
peer pressure +
suggestion of energy
efficient alternatives
Tracking period C:
Long term mobility
behaviour
(1 month)
Only tracking
Assessment of changes between periods B and A and C and A
and differences between Canton Ticino and the City of Zürich
Quantitative analyses:
data-mining, similarity measurements for
recorded trajectories,
GIS representation and visualization
Qualitative analyses:
focus groups and semi-structured
interviews with 50 participants

CA B1.3:
Urban Planning & Environmental Impact

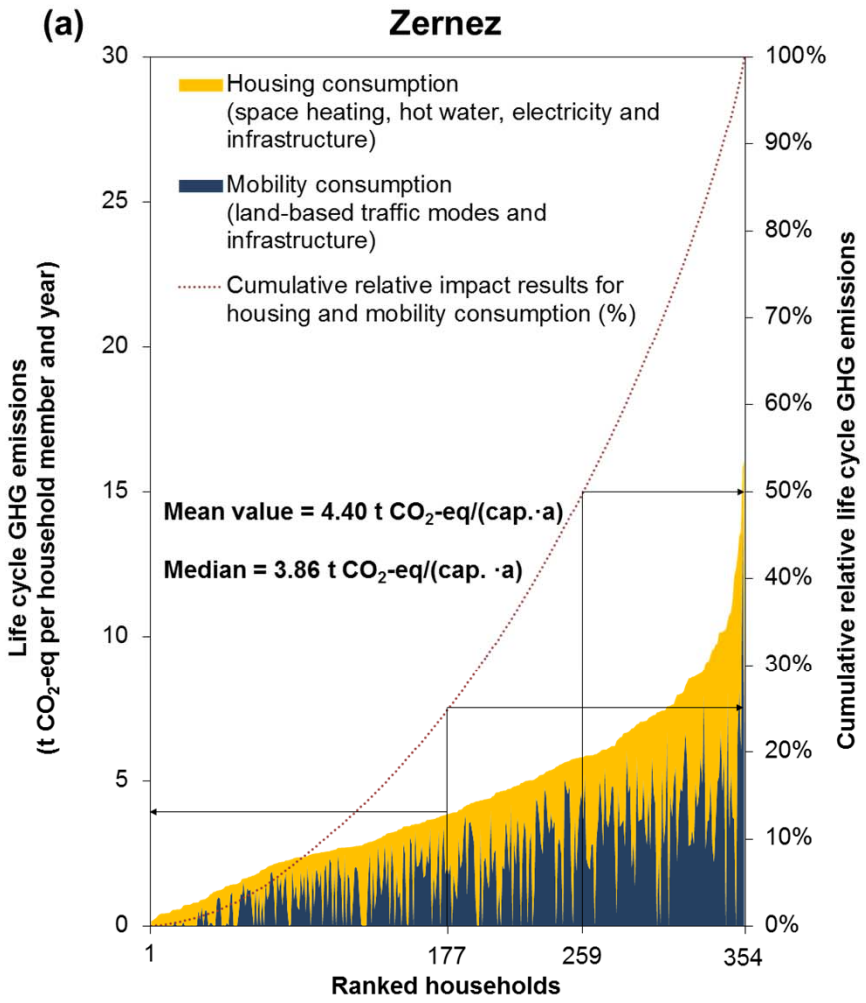
Context B1.3

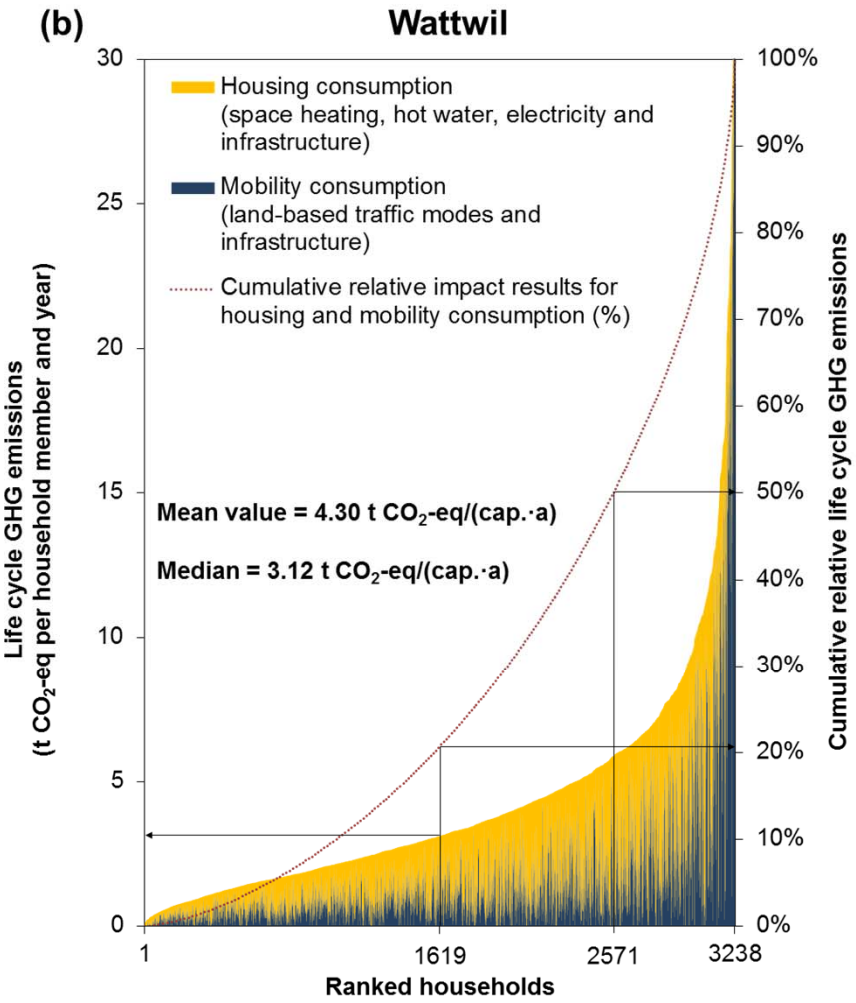
- The aim is to show consequences of the interaction of future (growing) mobility (public and private) on housing, settlement and community infrastructure: on life quality. The results will help communities and related organisations (public and private) to optimize urban planning and infrastructure, i.e. to optimize related opportunity costs.
- Modelling the energy demand and impacts of housing and land-based mobility for all households in Switzerland
- Cluster analysis of urban settlements: Interaction of settlements typologies and mobility behaviour in Switzerland.
- Integration of future scenarios and optimization approaches
- Economic analysis, consequences and products
- Implementation into practice

Model for the LCA of Housing and Land-Based Mobility Demand of Individual Households

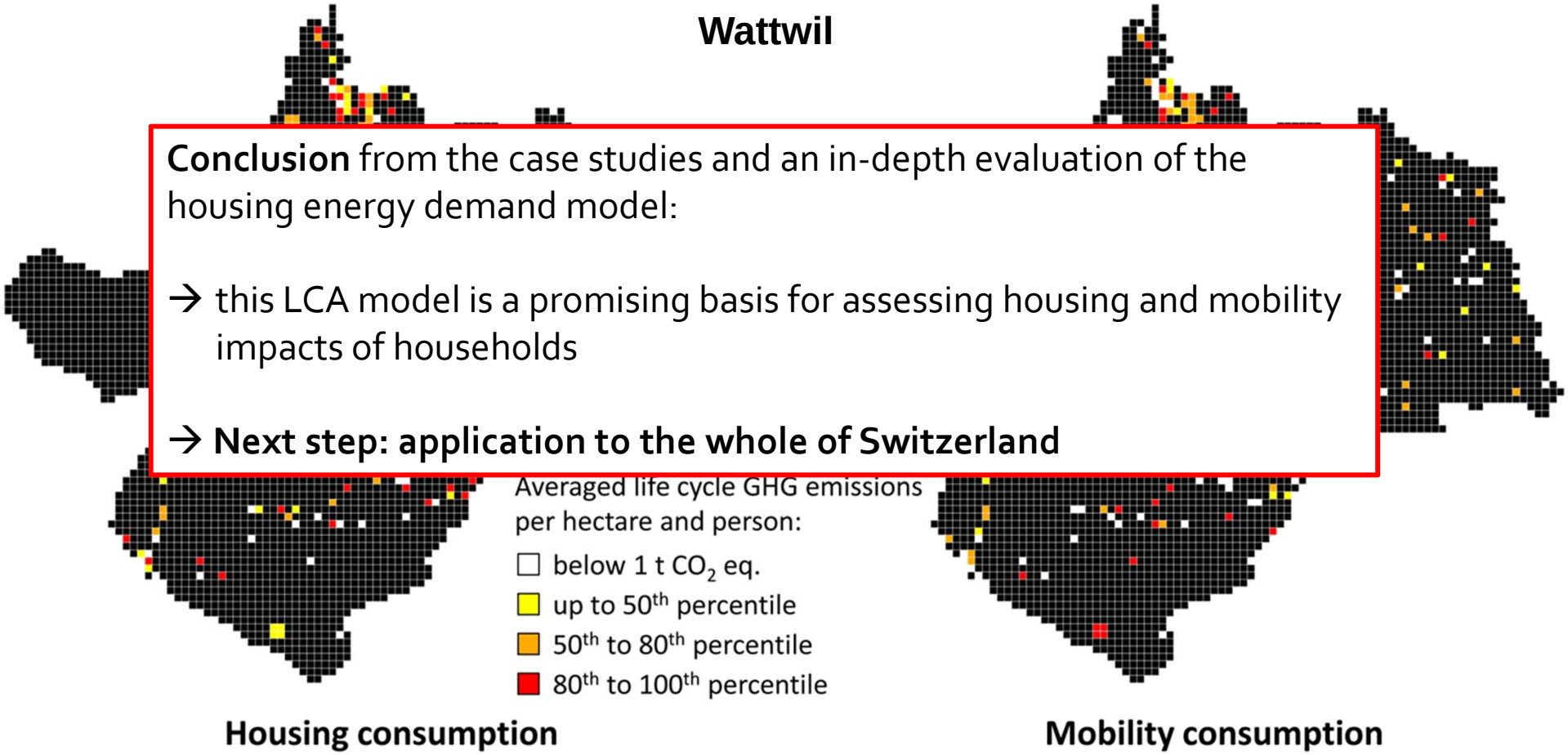


Examples of Case Studies





Examples of Case Studies

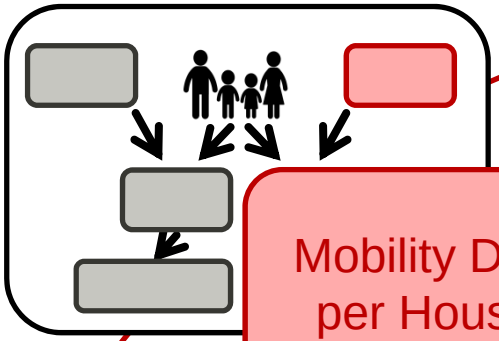


Conclusion from the case studies and an in-depth evaluation of the housing energy demand model:

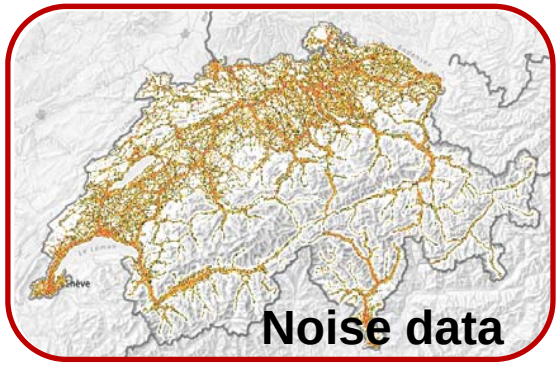
→ this LCA model is a promising basis for assessing housing and mobility impacts of households

→ **Next step: application to the whole of Switzerland**

Examples of Case Studies: noise impacts from mobility



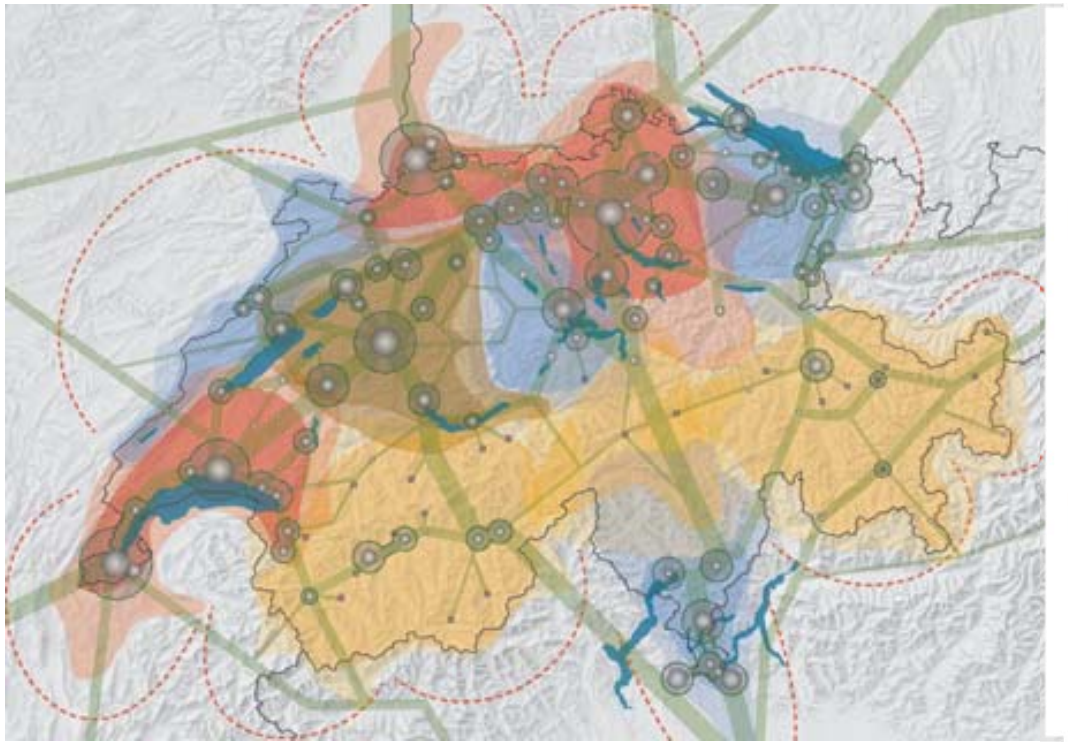
Mobility Demand per Household



***Noise* Impacts from Mobility per Household**

Raumkonzept Schweiz (ARE), Life Quality and Multi Modal Mobility: Settlements, Households, Mobility

Raumkonzept Schweiz (ARE) and Local Multi Modal Mobility: Settlement Types, Households, Mobility



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