

**NRP 73 Proposal 407340\_172402**

# **Constraint Aware Pathways to the Post-Fossil Swiss City (CAPATHITY)**

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# Outline

- Introduction
- Main research questions and milestones
- Significance and contribution to NRP 73
- Conditions formulated in letter from December 20, 2016
- Project management and organisation

## Introduction Context



[http://vincent.callebaut.org/object/150105\\_\\_parissmartcity2050/parissmartcity2050/projects](http://vincent.callebaut.org/object/150105__parissmartcity2050/parissmartcity2050/projects)

### Sustainable Cities

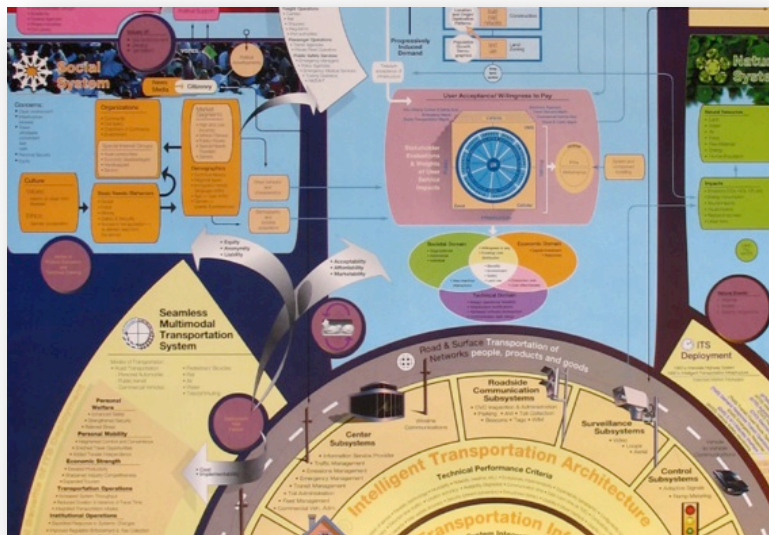


<http://old.wbcsd.org/work-program/sustainable-cities/sustainablecities.aspx>

- The 21<sup>st</sup> century could become the century of cities, with urban spaces being the central organisational form of society (WBGU, 2016);
- In May 2017, Switzerland voted for a new energy strategy promoting efficient renewable energies and phasing out nuclear and fossil energy in the near future.
- The necessary transition is expected to go along with
  - a **transformation of the anthropogenic metabolism**, resulting in shifts in material use (metallisation), environmental impacts, and labour;
  - **new infrastructures** to provide services for material -, energy - and information harvesting, conditioning, distribution and valorisation;
  - an increased need for **multi-stakeholder learning** to address complex and connected problems effectively.

# Introduction

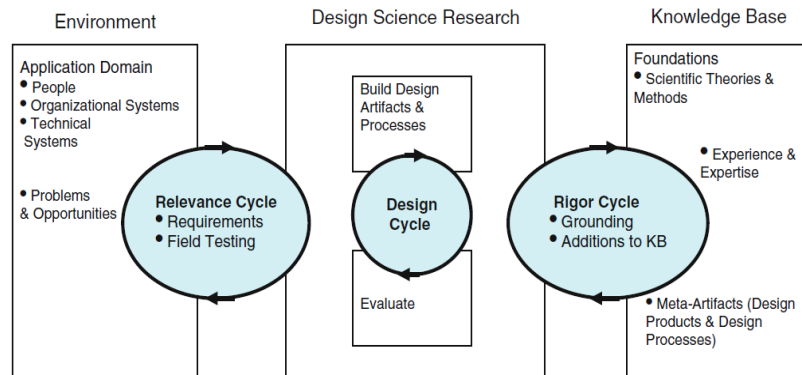
## Goal and scope



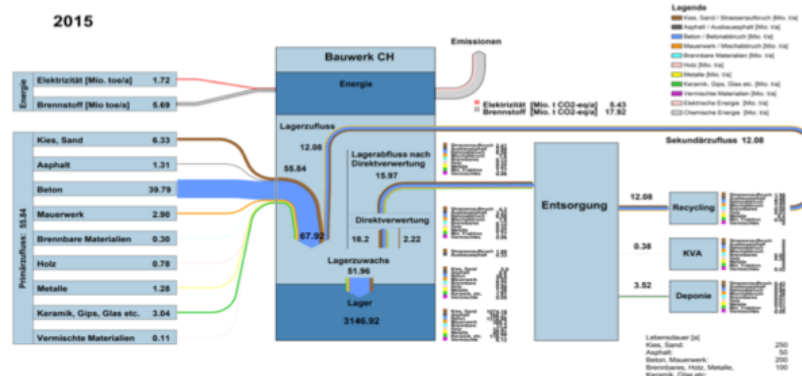
Example for a graphical representation of the system under study

- Develop a generic simulation game that allows finding and evaluating pathways towards possible future cities
  - by showing, through simulation, whether and how certain goals could be reached from a physical (metabolic) perspective (physical constraints);
  - by revealing, through playing of the game, trade-offs between different stakeholders (social constraints).
- Apply the simulation game to explore pathways to the post-fossil "Swiss City 2050"
  - a fictional built environment covering all Switzerland, sheltering 10 million people with structures and services;
  - being both fossil carbon free in 2050 and a substantial atmospheric carbon sink by 2100.

# Introduction Approach



- Iterative simulation game development according to
  - the Design Science Research (DSR) approach (Hevner, 2007);
  - game design sequence encompassing 5 phases and 21 steps (Duke & Geurts, 2004).



- Starting point: Bauwerk CH (Gauch et al., 2016)
  - addresses 10 dominant material & energy stocks and flows related to above and below ground constructions in Switzerland 2015.

Duke & Geurts (2004) Policy Games for Strategic Management – Pathways into the Unknown. Dutch University Press, Amsterdam.  
Gauch, M. Matasci, C., Hincapié, I., Hörler, R. and Böni H. (2016): Material- und Energieressourcen sowie Umweltauswirkungen der baulichen Infrastruktur der Schweiz. Technical Report. Empa, St. Gallen.  
Hevner (2007) A three-cycle view of design science research. Scand. J. Inform. Syst. 19, 87-92.

# Main research questions and milestones

## Research questions



### Implementation and application



### Research & development

#### Dynamic stock & flow model development

PhD student 1

- What are the functional requirements to adequately represent the metabolism of the evolving Swiss City?
- How to make the model responsive to the requirements of the simulation game?
- How to integrate expert knowledge in view of an autonomous simulation during the application of the game?

#### Simulation game development

Postdoc

- Design simulation game;
- Organise and co-moderate multiple simulation game workshops;
- Coordinate the two PhD students and integrate their numerical simulation models into the simulation game.

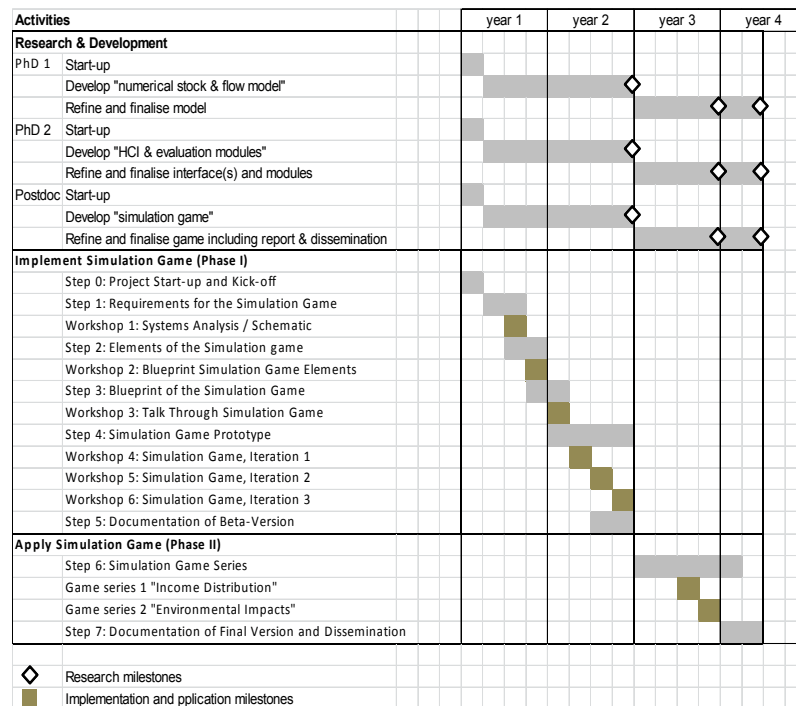
#### HCI and evaluation modules development

PhD student 2

- What are the functional requirements to the simulation engine and its interface?
- How to couple physical stocks and flows in all scenarios with environmental impacts based on LCIA methods?
- How to couple physical stocks and flows in all scenarios with labour demand and income distribution?

# Main research questions and milestones

## Milestones



### ■ Research milestones

- submission of the expected publications in Q8, Q12, and Q14.

### ■ Implementation and application milestones

- completion of the workshops in Q3, Q4, Q5, Q6, Q7, Q8, Q11, and Q12.

### ■ Products & dissemination

- simulation game prototype (beta-version) in Q8;
- refined and finalised simulation game in Q14 presented on the occasion of a public dissemination workshop.



## Significance and contribution to NRP 73

### Scientific and practical significance



<https://www.cadeautje-kopen.nl/populair/virtual-reality-headset-smartphone-detail>

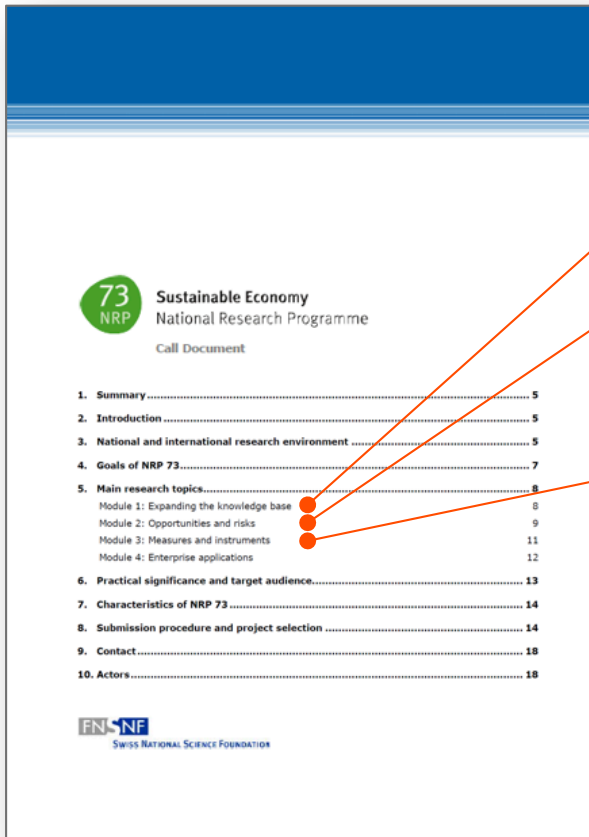


- Integrates existing methodologies in an innovative way;
  - Improves understanding of the implications of transforming the built environment;
  - Identifies relevant co-benefits and trade-offs of possible transitions to the post-fossil Swiss City.
- 
- Delivers a generic simulation game to identify visionary and realistic transitions for challenging societal endeavours;
  - Supports stakeholders in experiencing the impacts of decisions and identifying proactive roles for the transition;
  - Promotes the alignment of interests of government, industry, and scientific research.




# Significance and contribution to NRP 73

## Contribution to NRP 73



The image shows the cover of the '73 NRP Sustainable Economy National Research Programme Call Document'. It features a blue header and a table of contents. Three orange lines point from specific sections of the table of contents to the bulleted text on the right: one from 'Main research topics' to the first bullet, one from 'Module 1: Expanding the knowledge base' to the second bullet, and one from 'Module 3: Measures and instruments' to the third bullet.

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National Research Programme	
Call Document	
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 **FNSF**  
SWISS NATIONAL SCIENCE FOUNDATION

- Expands the knowledge on possible future use and dependence of Switzerland on resources;
- Allows identifying challenges for the Swiss economy when transitioning towards a more sustainable economy and assessing how changes will affect the ecological, economic and social framework conditions;
- Functions as a testbed to investigate the possibilities and limitations of strategies (voluntary cooperation, positive incentives, federal policies, ...).

# Conditions formulated in letter from December 20, 2017

## Income distribution effects

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Bern, 20. Dezember 2016

### Verfügung

Nationales Forschungsprogramm „Nachhaltige Wirtschaft“ (NFP 73)

Skizze Nr. 407340\_172402 „Constraint Aware Pathways to the Post-Fossil Swiss City (CAPATHITY)“

Die praktische Anwendung und die Umsetzung der Ergebnisse sind wichtige Aspekte des NFP 73. Deshalb lädt die Leitungsgruppe dazu ein, im Forschungsgesuch eine gut durchdachte Strategie für die Anwendung und Umsetzung zu präsentieren (siehe dazu Kapitel 2 „Implementation“ der Wordvorlage für den wissenschaftlichen Teil des Forschungsgesuchs).

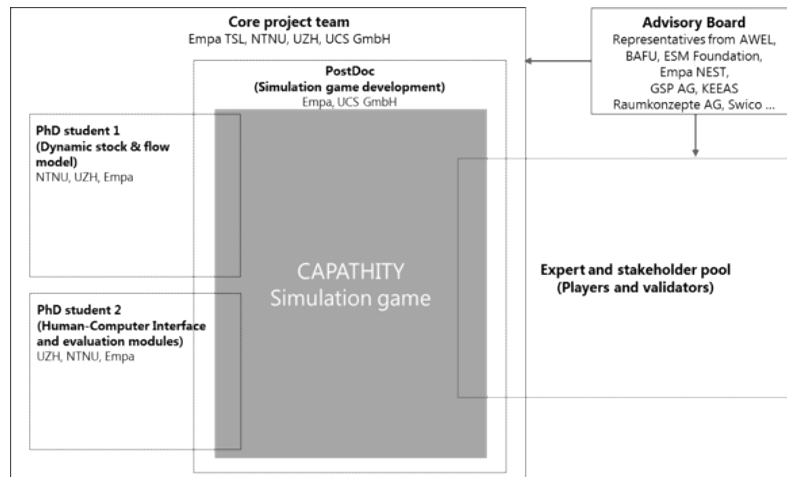
### Projektspezifische Bedingungen:

Vor dem Hintergrund der geforderten systemischen Sichtweise, lädt die Leitungsgruppe Sie dazu ein, Einkommensverteilungseffekte von post-fossilen Schweizer Städten sowie deren Auswirkungen auf die soziale Wohlfahrt zu berücksichtigen.

- Development of a separate evaluation module addressing effects on income distribution and social welfare;
- Introduction of a simulation game application phase, in which income distribution effects and implications for social welfare can be explored in a dedicated game series;
- Inclusion of economic analyses - and urban planning experts (Dr. A. Naef, GSP AG; Dr. S. Friedrich, KEEAS Raumkonzepte) in the advisory board and in the expert and stakeholder pool.

# Project management and organisation

## Involved partners and their roles



- Empa, Technology & Society Laboratory
  - project lead.
- Core project team
  - iteratively develops, implements and applies the simulation game in a series of workshops and two game series;
- Advisory board
  - monitors project progress, advises core project team and suggests experts and stakeholders;
- Expert and stakeholder pool
  - contributes to the development, application and validation of the simulation game



Thank you for your attention!