City Planning Dynamics: A Theoretical Framework of Urban Development Scenario of Belgium Provinces Using Logit Based Cellular Automata

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Project : Sustainable urban densification mapping using statistical modelling techniques

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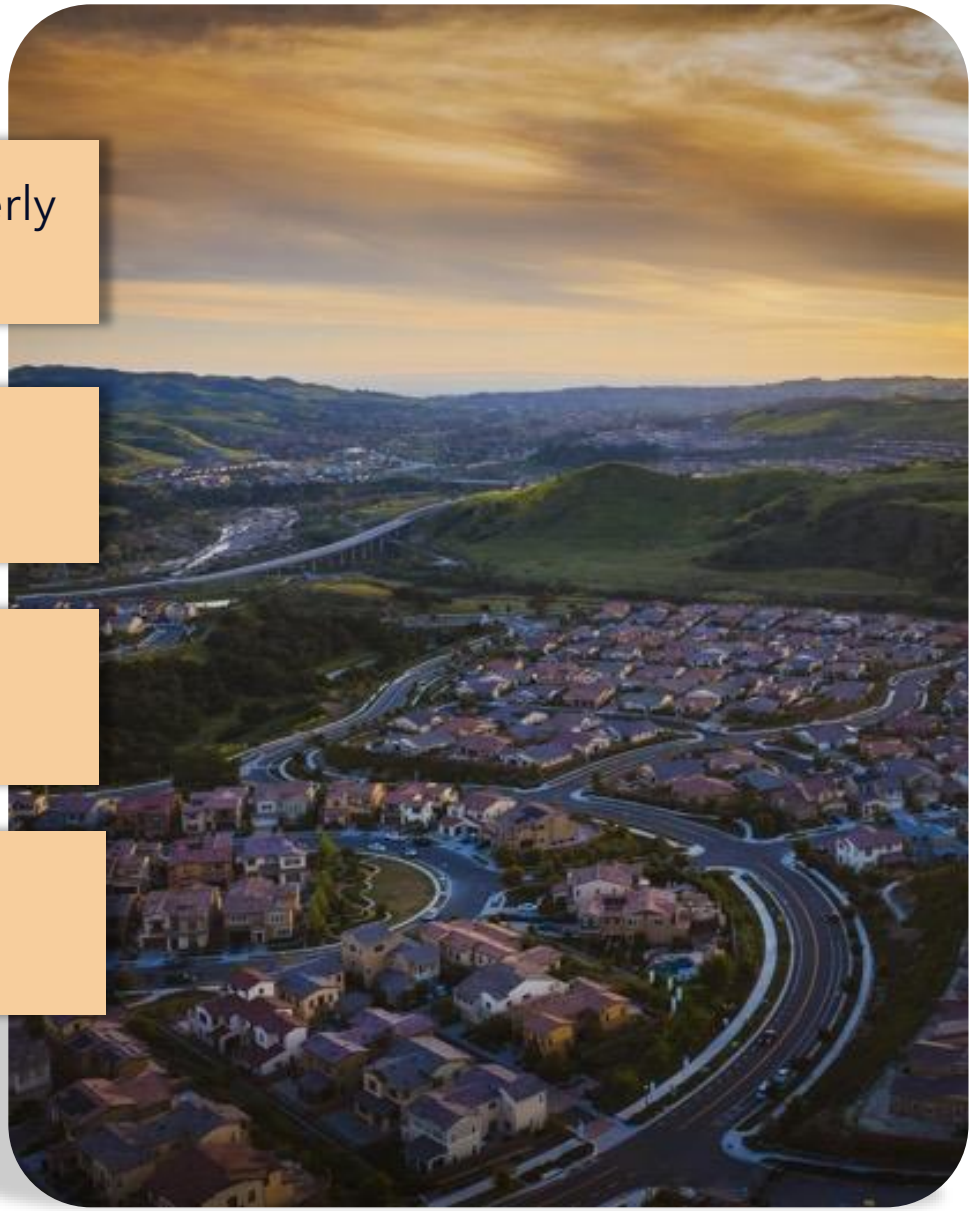
Project Background

Development of new urban units on land that is formerly open

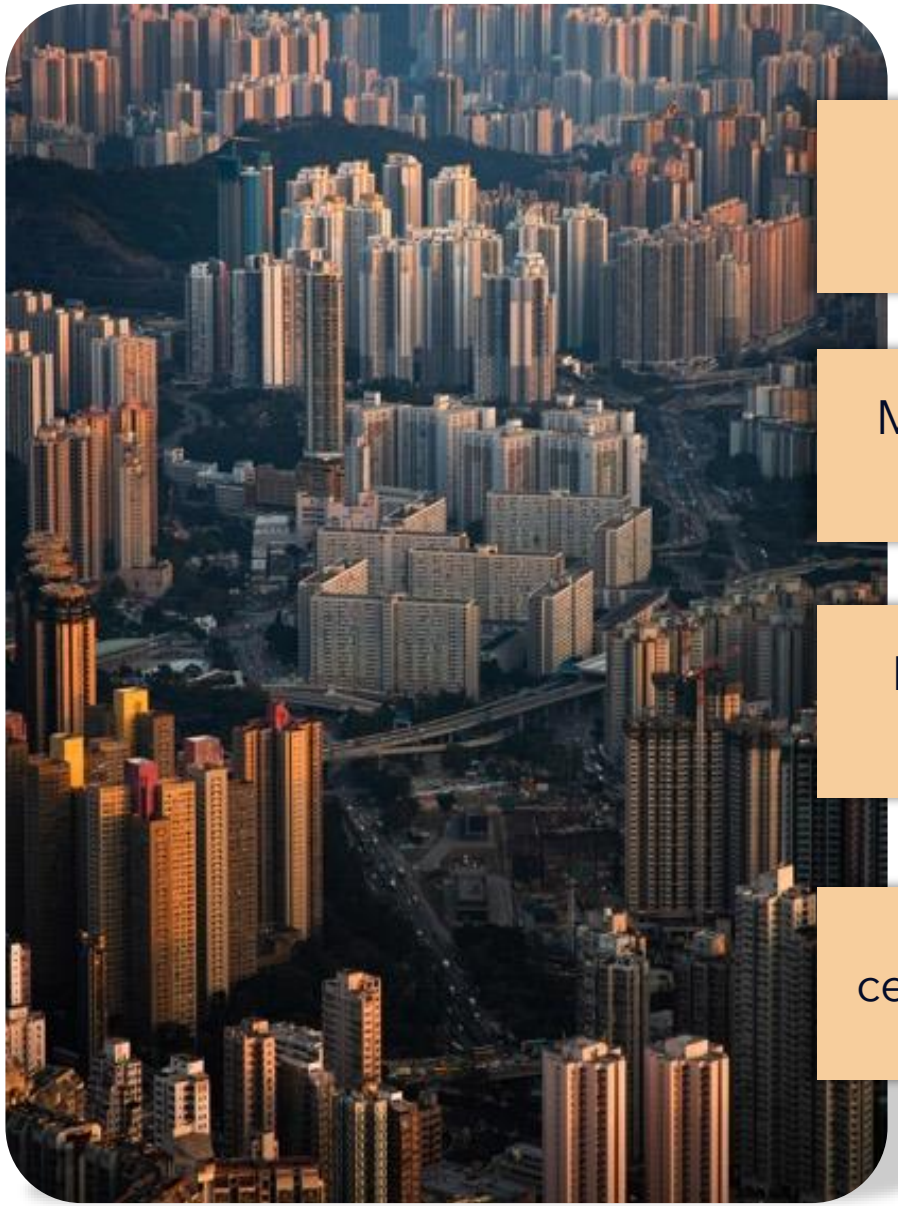
Leads to loss of agricultural land and green spaces

Increased travel time from source to destination

Habitat fragmentation



Densification as a solution



Construction of new housing units within existing residential areas

More efficient land use by maximizing the utilization of available space

No net land take and maintaining a balance between growing population and housing necessity

Economic opportunities by fostering vibrant urban centers with diverse businesses, cultural institutions, and employment opportunities

Aims and objectives

To ***understand*** the impact of causative drivers on urban densification

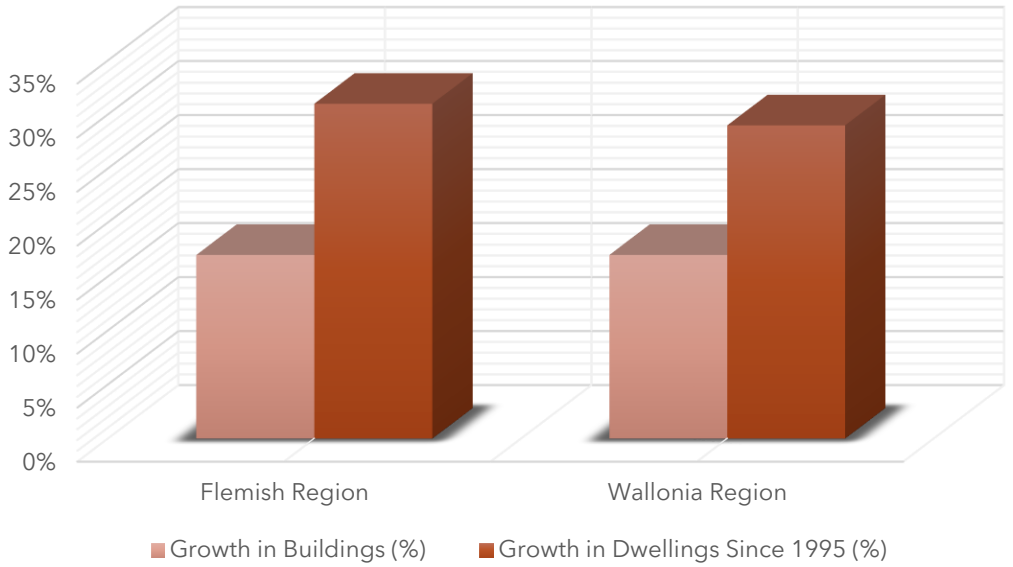
Mapping the spatio-temporal trend of demand for urban built-up areas.

To ***simulate*** futuristic urban densification scenario

To ***analyze*** the idea of densification as a pragmatic solution for 2050 No net land take

Study Area

- 6th most of urbanized countries in the Europe and 22nd most densely populated country in the world.
- The country is governed by three different federal bodies.
- Our area of interest consist of Brabant of Flanders in north, Brussels capital region and Brabant of Wallonia in south.



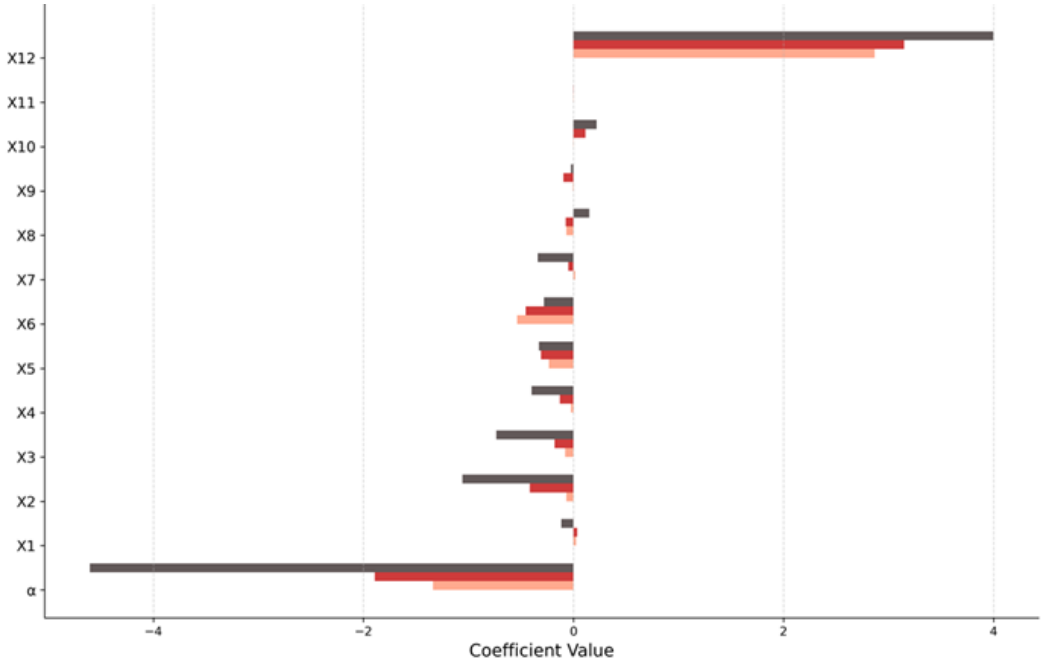
Methods and Materials

Variable	Name	Type	Unit	Resolution	Source
UB	Urban Built-up Density	1	m		
Geophysical Variables					
X1	Elevation	1	m	a	Planning authority of Wallonia, brussels and Flanders
X2	Slope	1	%	A	Calculated from DEM using geospatial software
Accessibility Variables					
X3	Euclidean distance to Highways	1	m	a	Open Street Maps
X4	Euclidean distance to Primary Roads	1	m	a	Open Street Maps
X5	Euclidean distance to Secondary Roads	1	m	a	Open Street Maps
X6	Euclidean distance to Residential Roads	1	m	a	Open Street Maps
X7	Cost Distance to Railways Stations	1	m	a	Open Street Maps
X8	Euclidean distance to large-sized Cities	1	m	a	Open Street Maps
X9	Euclidean distance to medium-sized Cities	1	m	a	Open Street Maps
Socio-Economic Variables					
X10	Jobs density	1	Num/100m 2	b	Self Calculation based on Belgian Statistical Institute
X11	Population Density	1	Inh/km2	d	Self Calculation based on Belgian Statistical Institute
Policy and planning variables					
X12	Zoning status	2	Binary	a	Self Calculation based on Belgian Statistical Institute

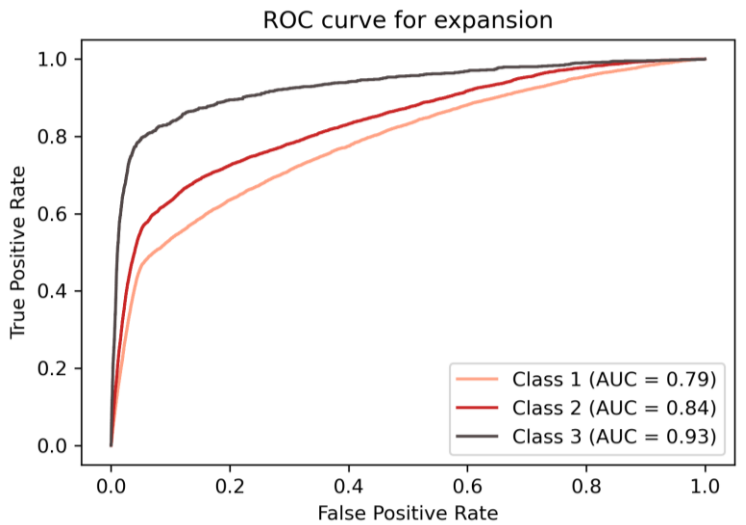
X 1.Continous, 2. Categorical. Y ; a. Cell level, b. Municipal level, c. Statistical level, d. Grid level

- The independent variables are calibrated using Multinomial logistic regression model (MNL).
- cellular automata model has been used to calibrate the neighborhood interaction based on a push-pull effect.
- Genetic algorithm has been proven to simulate futuristic scenarios more precisely than other commonly used models.

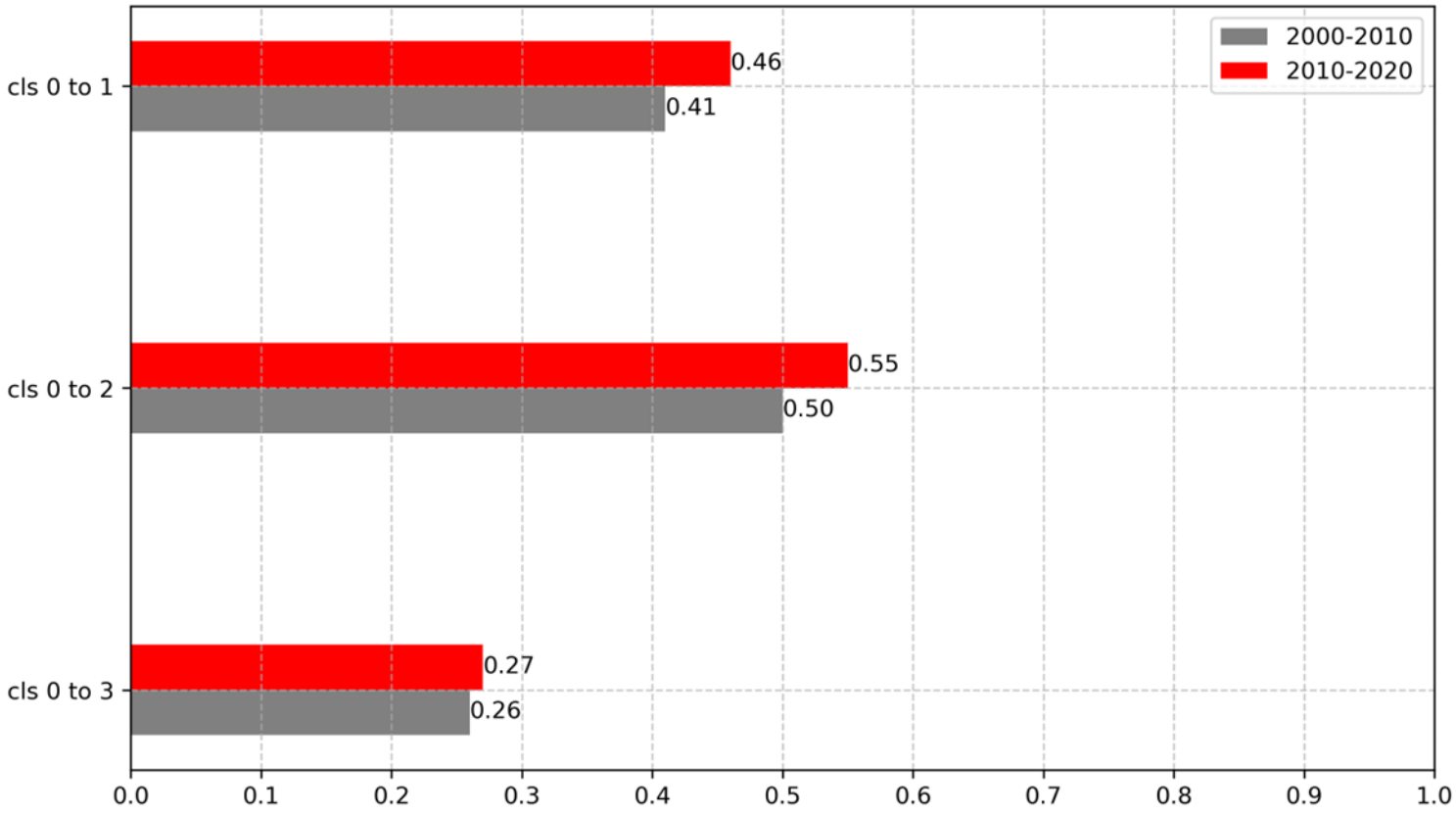
Result : Calibration



X1 Elevation (DEM)
X2 Slope
X3 Dist. to Road1
X4 Dist. to Road2
X5 Dist. to Road3
X6 Dist. to Road4
X7 Dist. to railway stations
X8 Dist. to large-sized cities
X9 Dist. to med-sized cities
X10 Employment rate
X11 Population
X12 Zoning

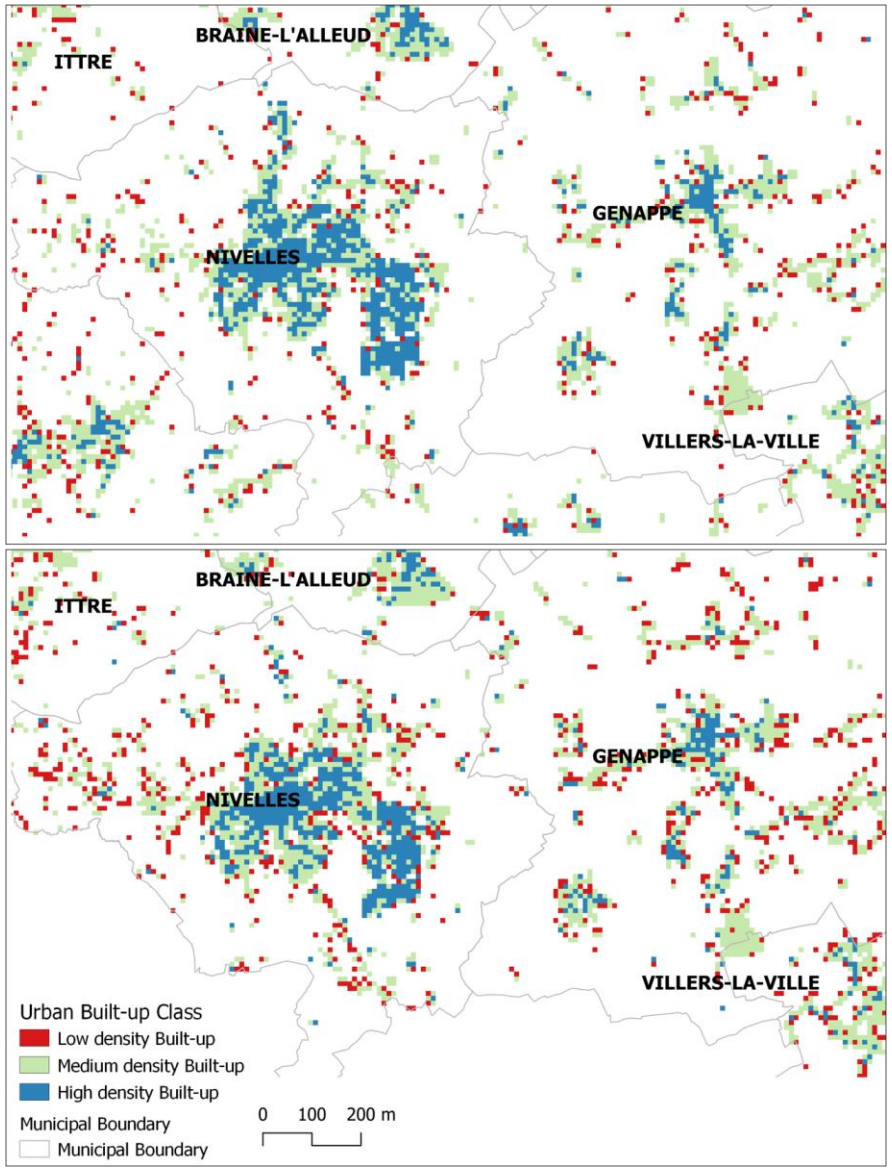


Result : Validation

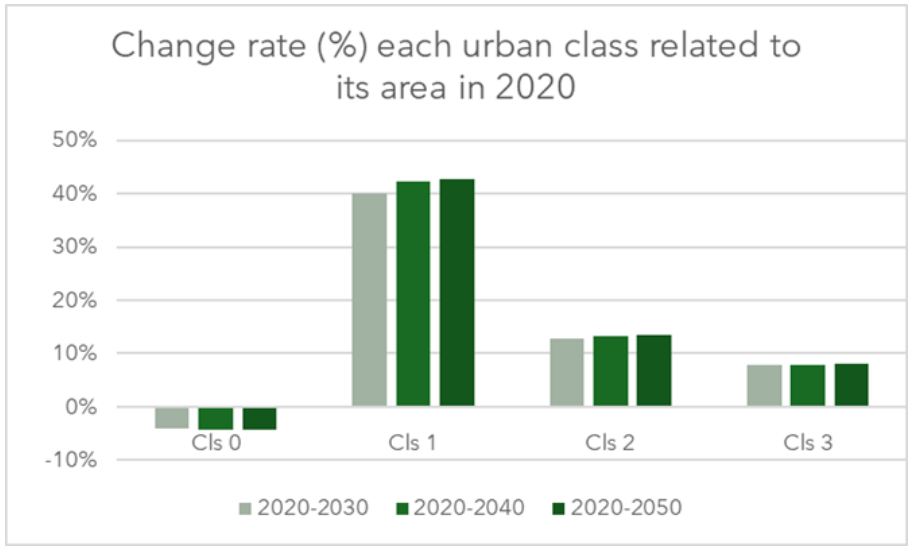


Fuzzy similarity rate between calibration and validation period

Discussion



- This research presents a theoretical framework for modelling urban growth scenarios by utilizing the power of multinomial logit-based cellular automata modelling.
- Three scenarios present divergent ideas for the cross-border scenario of Brabant's future development: BAU, Stop au béton (STOP), and Centralities.
- BAU anticipates urban growth as a continuum of the past pattern of growth.



Going Forward…

1

WHAT

To simulate futuristic urban growth based on historic trend

HOW

Built up as usual scenario and its implication on Land take .

2

WHAT

Identifying problems of BAU scenarios

HOW

Simulating Stop Concrete scenario as a counterpart of urban expansion .

3

WHAT

Solution for No net land take

HOW

CENTRAL aims to promote compact, integrated urban centers by 2040 and reduce growth outside of central zones i.e., largely encouraging development in and around the center of cities

“If we knew what it was, we were doing, it would not be called research, would it?”

- Albert Einstein

Thank you for your attention!