How do Cities Grow?

A Nexus between Urban Policies and Citizen Decisions

Complex Systems Summer School 2023

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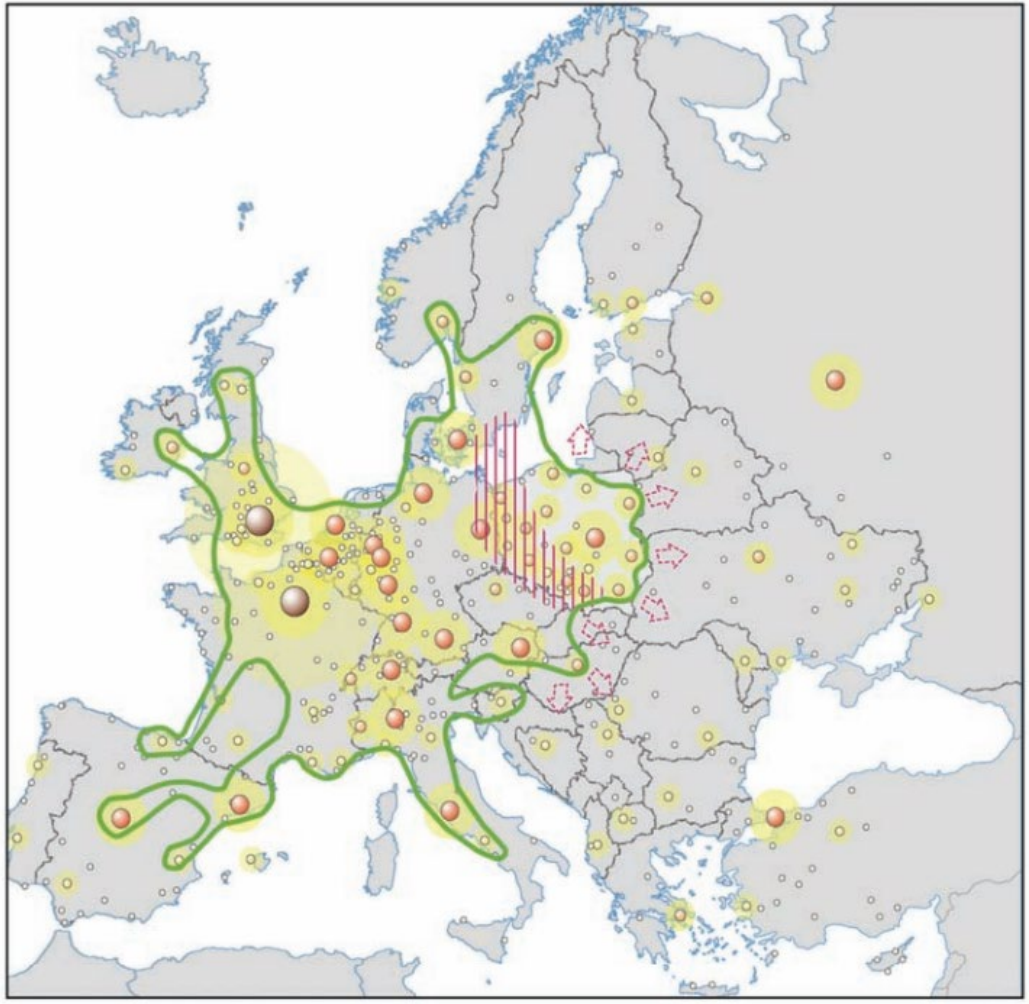
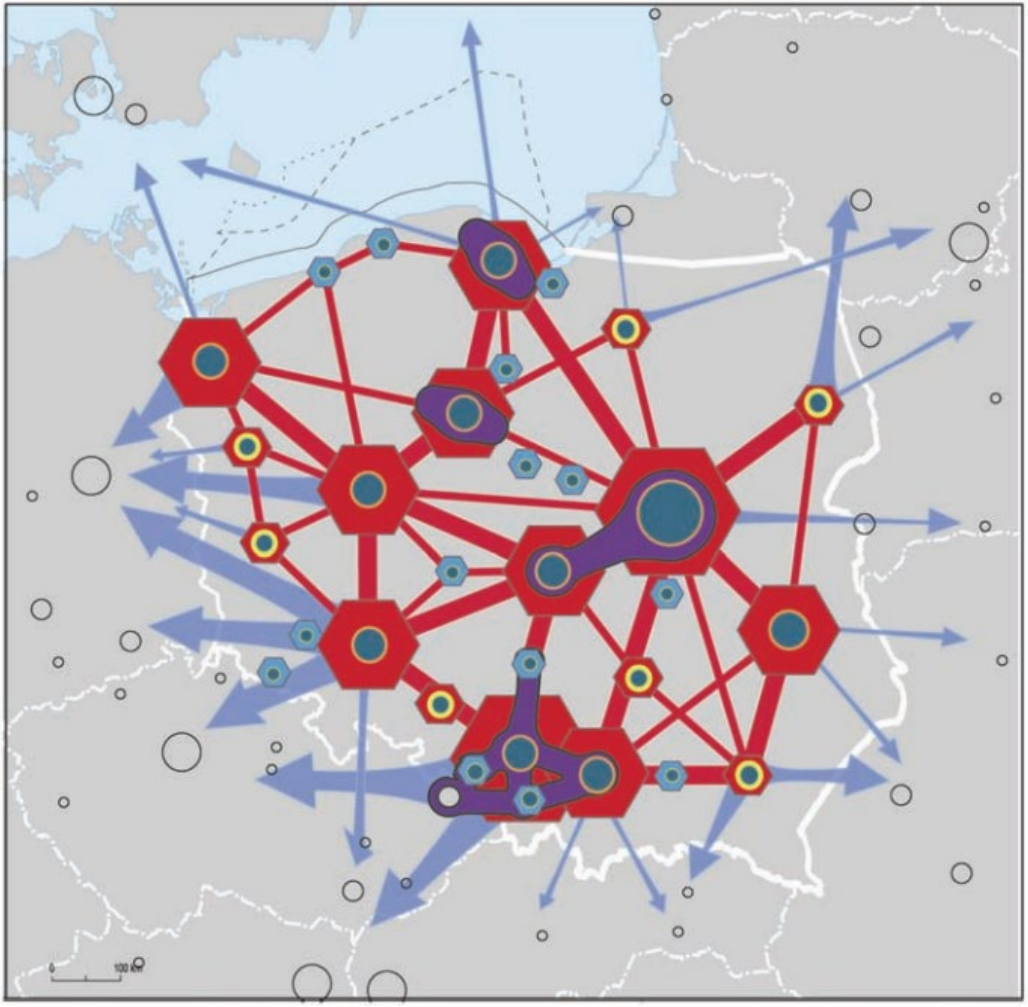
Urban systems are dynamic, complex and self-adapting human modified environments that encompass processes and subsystems at multiple scales and levels

(Elmqvist et al., 2019; McPhearson et al., 2016)

Scenarios of **cross-national** development



Source: http://eregion.wzp.pl/sites/default/files/kpzk.pdf



Scenarios of **cross-national** development

⇧ **National** spatial policy directions

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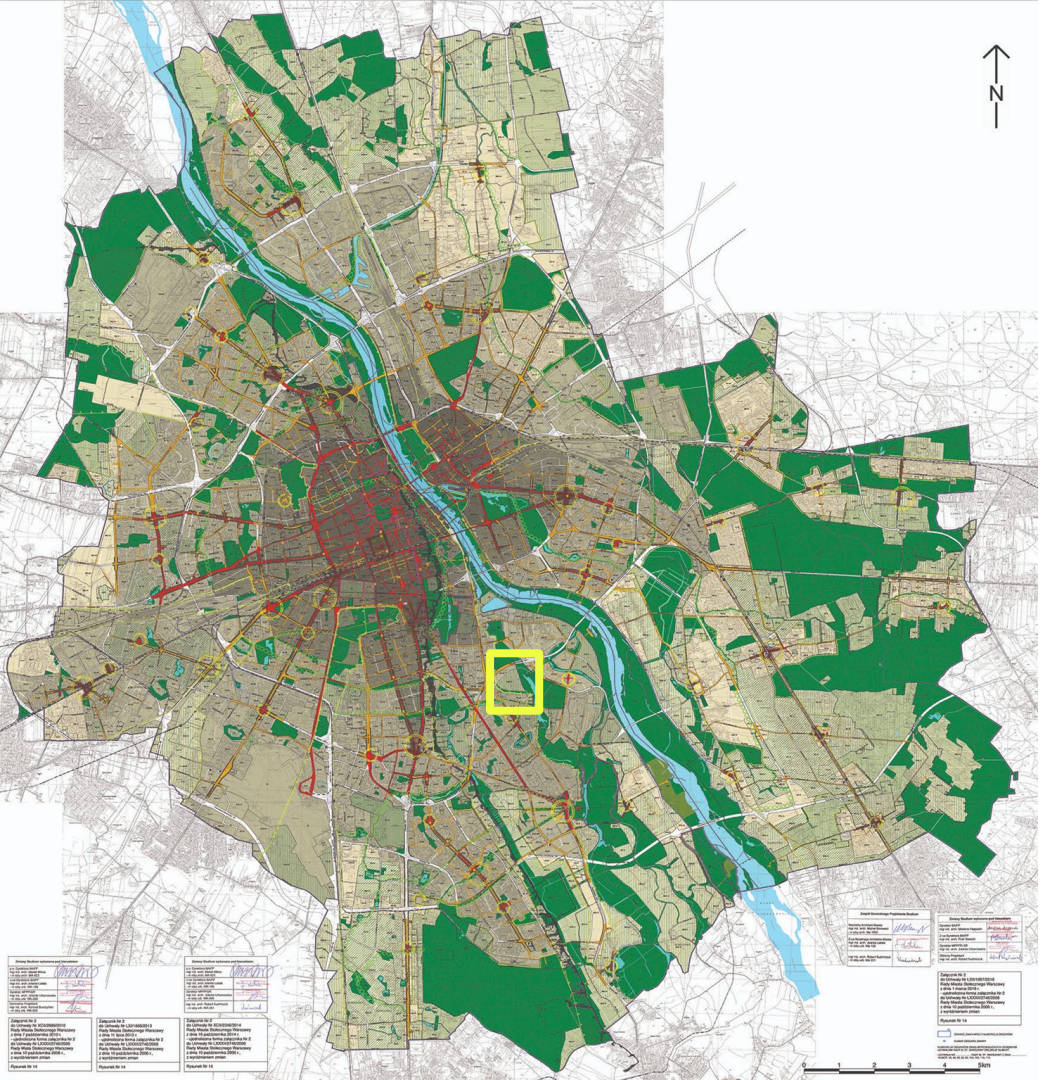
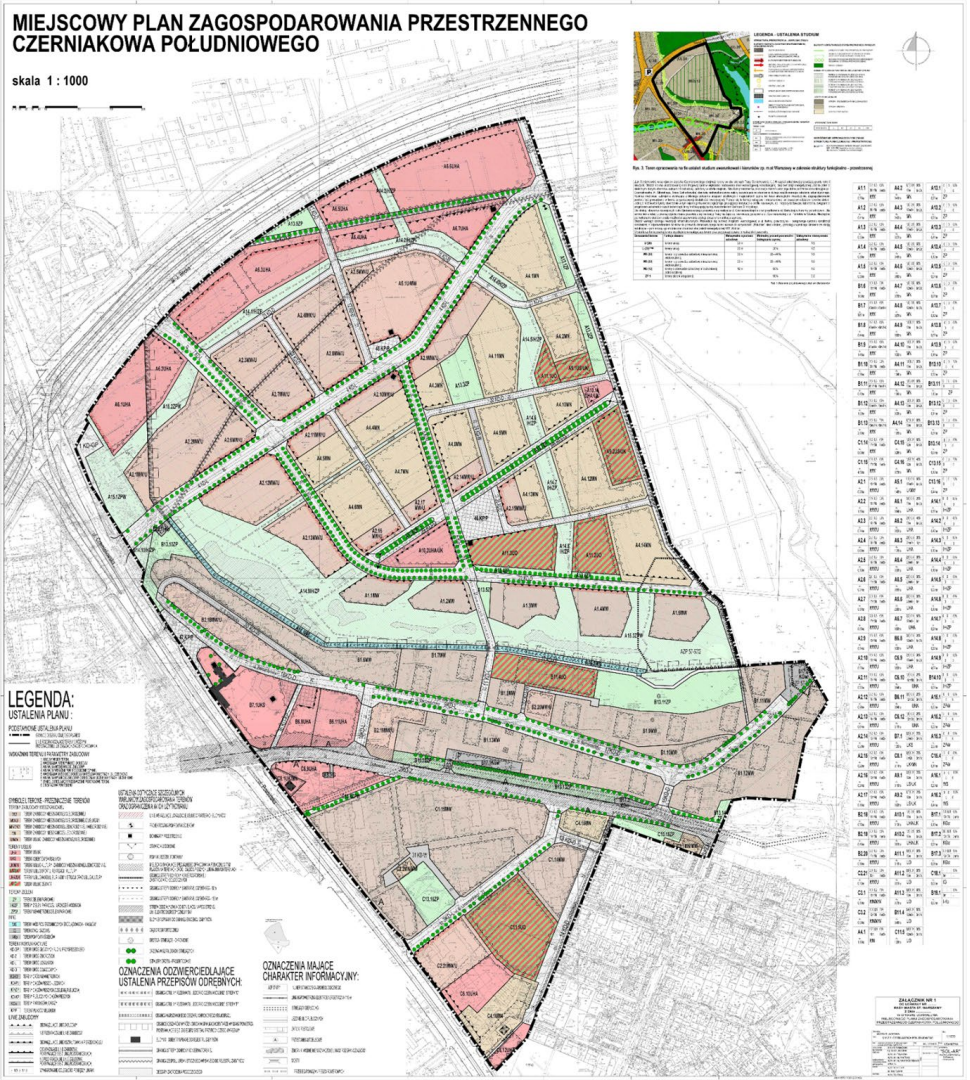


Scenarios of **cross-national** development

⇧ **National** spatial policy directions

⇧ **City-level** land use directions

Source:
http://robimystudium.beczmiana.pl/2018/04/01/studium-uwarunkowan-i-kierunkow-zagospodarowania-przestrzennego-m-st-warszawy-z-2006-r/



Scenarios of **cross-national** development

⇧ **National** spatial policy directions

⇧ **City-level** land use directions

⇧ **Local** development plans - local law

Source:
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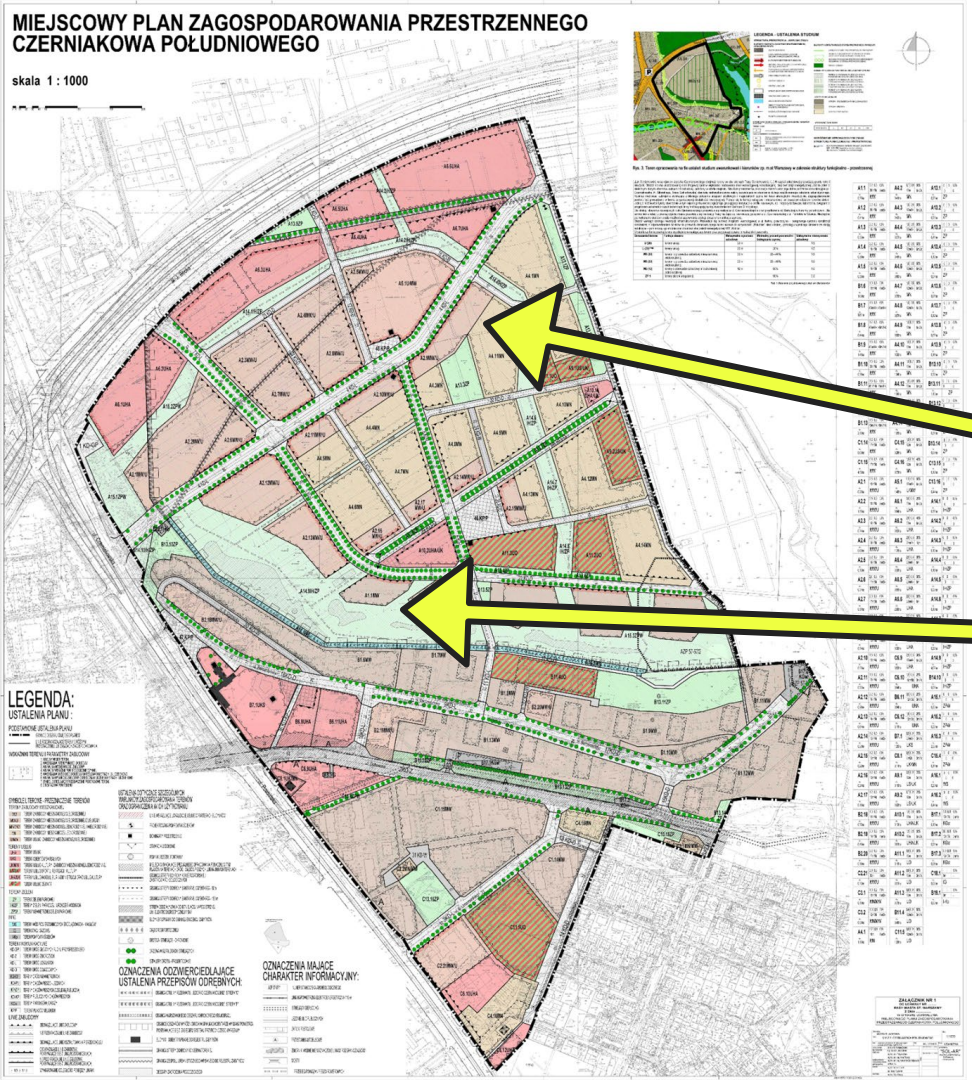

Scenarios of **cross-national** development

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Citizen decisions

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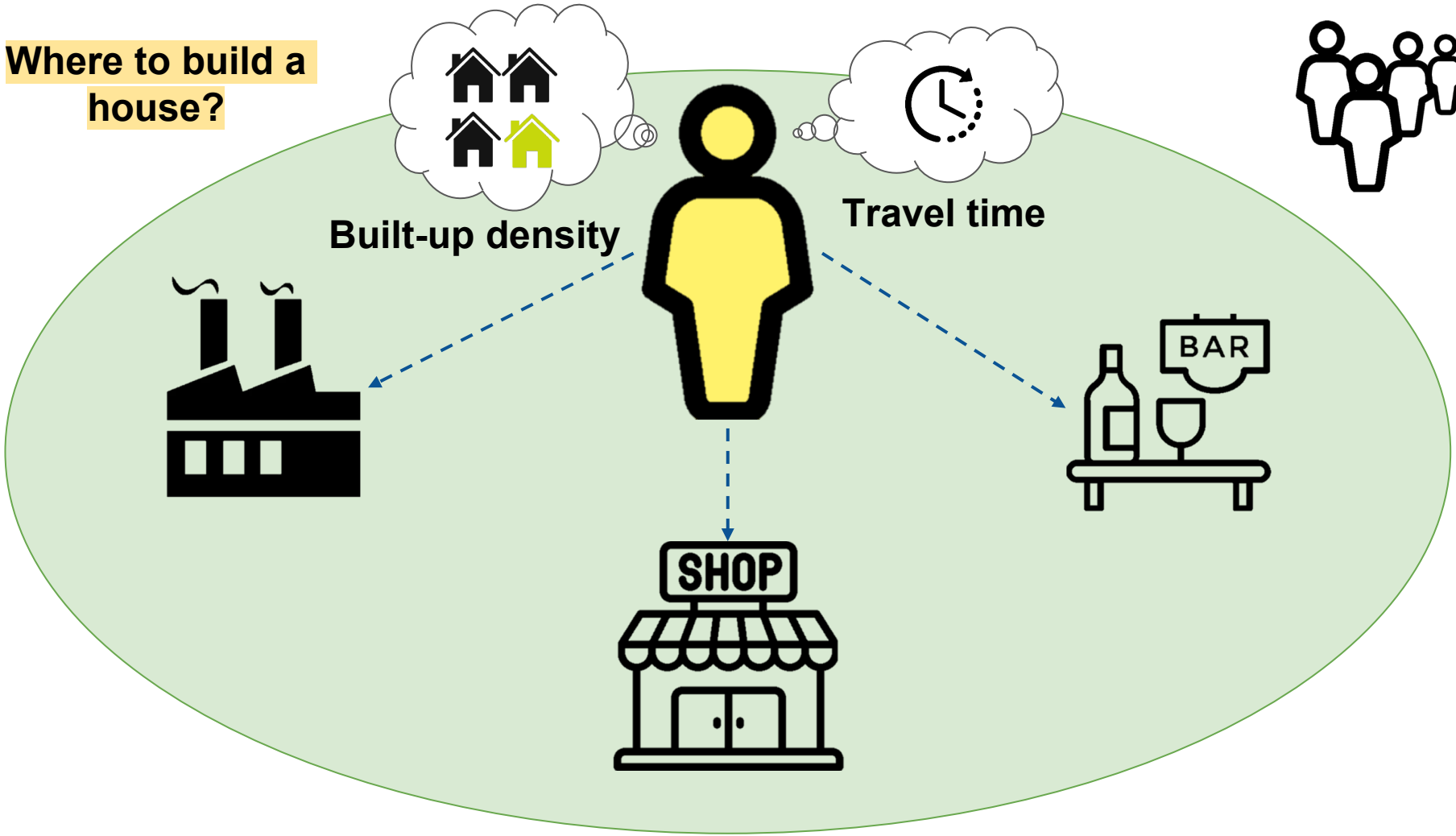
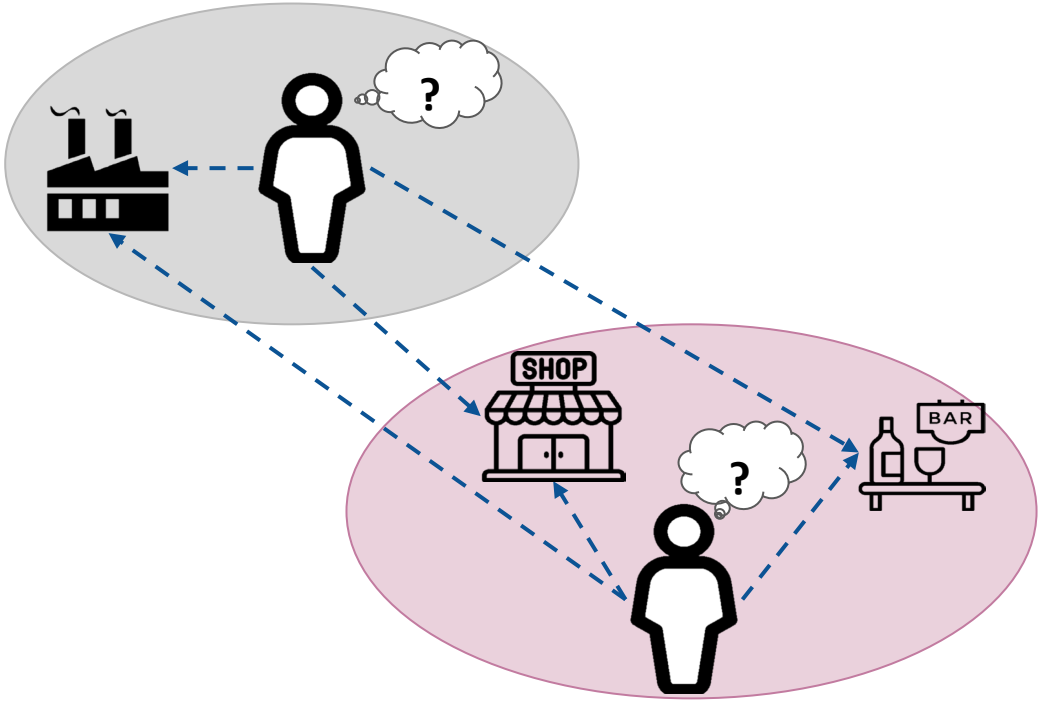
Research aim

To understand how planning-constrained location decisions of human individuals and their interactions shape urban land-use patterns.

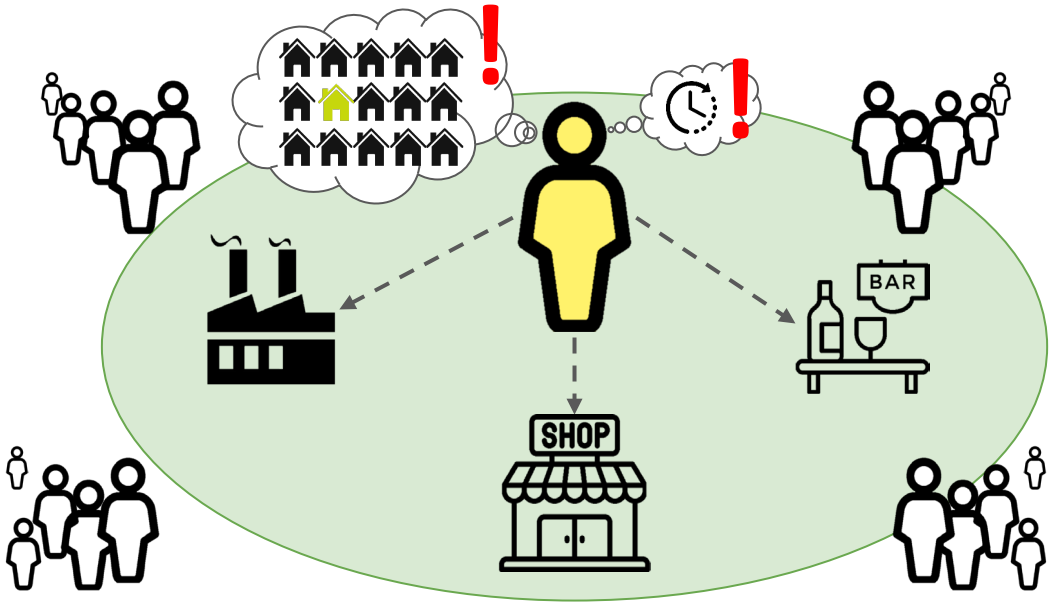
Where to build a house?



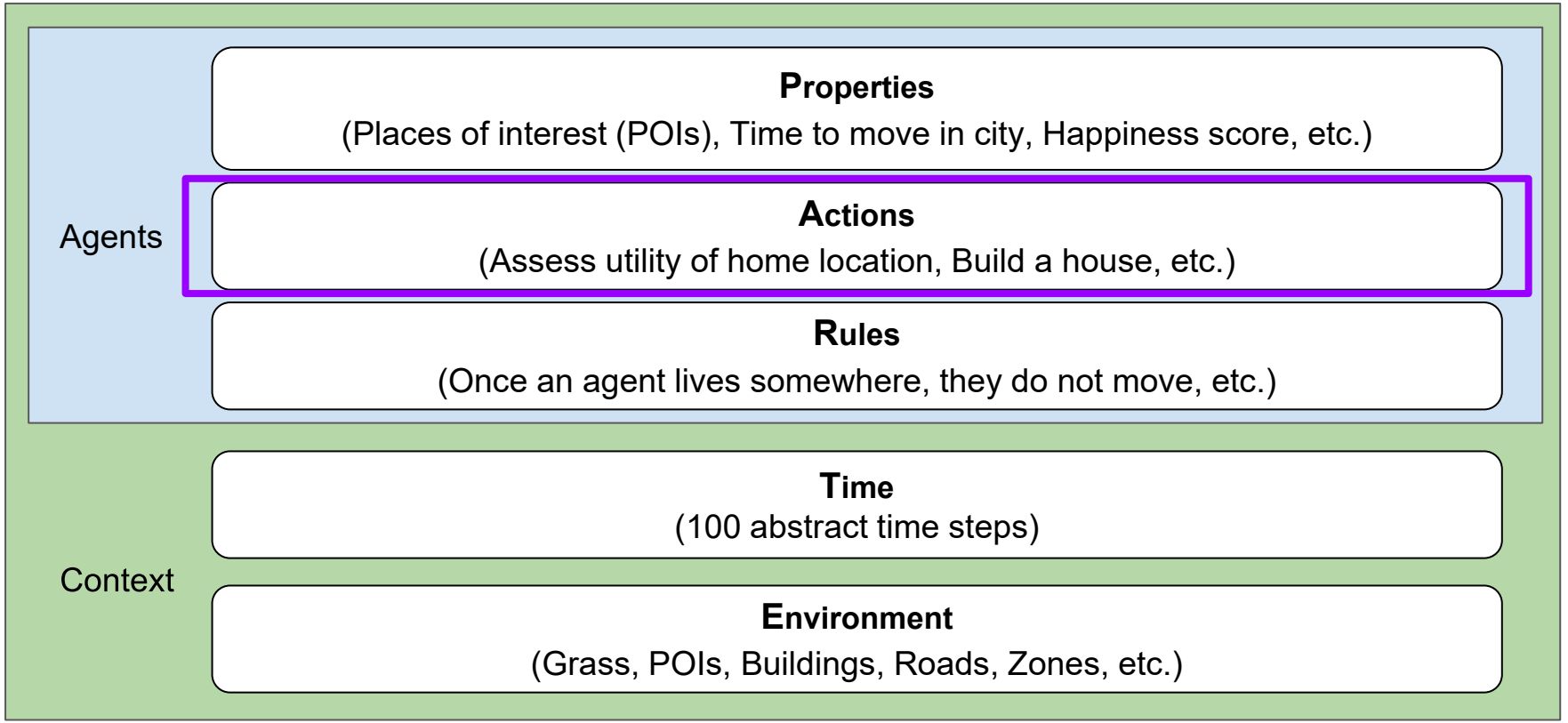
Research question 1: How citizens' subjective well-being are influenced by the trade-offs between top-down urban planning policies and bottom-up citizen decisions?



Research question 2: How urbanization patterns are influenced by or sensitive to the micro-level interactions of individual citizens?



Model specification - PARTE framework

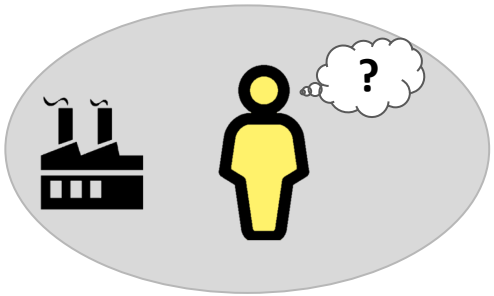


Hammond, R. A. (2015). Appendix A: Considerations and best practices in agent-based modeling to inform policy. *Assessing the Use of Agent-Based Models for Tobacco Regulation*, 161-193.

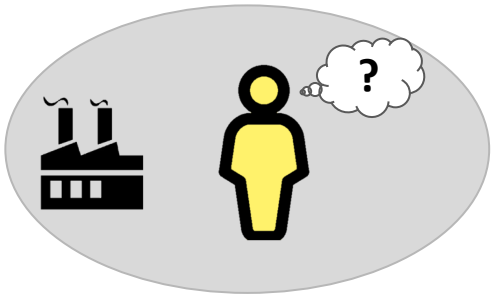
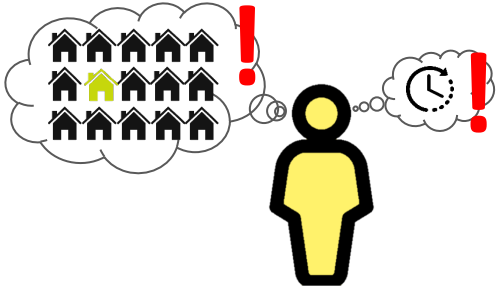
Utility functions to select house locations

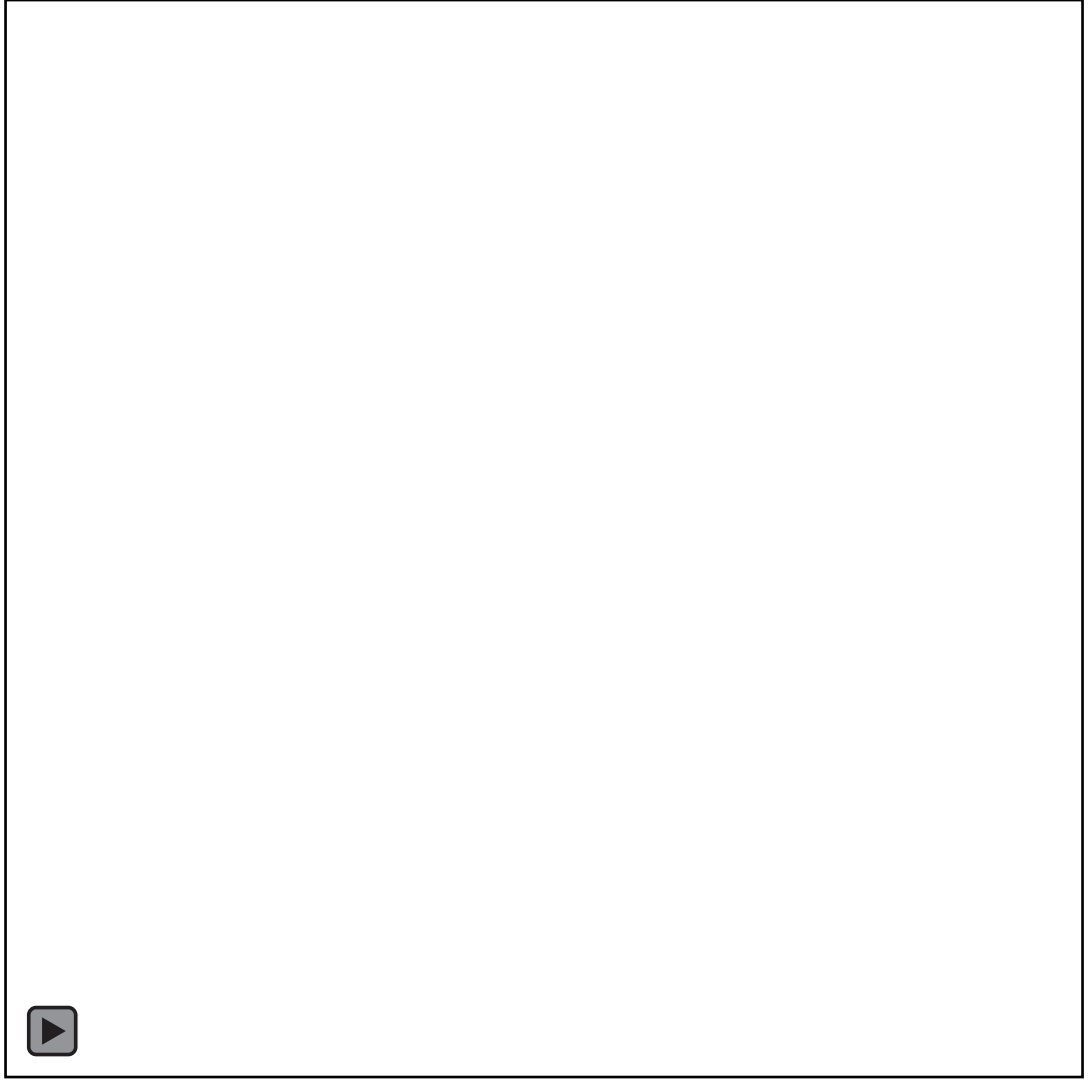
$U_0 = T$		
• travel time to POIs 		

Utility functions to select house locations

$U_0 = T$	$U_1 = T * Z$	
• travel time to POIs 	• travel time to POIs • land-use zoning 	

Utility functions to select house locations

$U_0 = T$	$U_1 = T * Z$	$U_2 = T_{\alpha,\beta} * Z * D_{\alpha,\beta}$
• travel time to POIs	• travel time to POIs • land-use zoning	• travel time to POIs with congestion • land-use zoning • overcrowding
		



julia

Agents.jl

Next steps

1. **Model implementation**
    a. Update utility functions of citizen agents
    b. Use real-world GIS environment (e.g., OpenStreetMap)
    c. Model calibration / validation
2. **Data analysis**
    a. Trajectories of happiness score of citizens
    b. Landscape metrics to see the dynamics of urban patterns
    c. What if scenarios on different zoning policies (e.g., transit-oriented city, modernization city)
    d. Sensitivity analysis of model parameters

References

Elmqvist, T., Andersson, E., Frantzeskaki, N., McPhearson, T., Olsson, P., Gaffney, O., Takeuchi, K., Folke, C., 2019. Sustainability and resilience for transformation in the urban century. Nat. Sustain. 2, 267–273. https://doi.org/10.1038/s41893-019-0250-1

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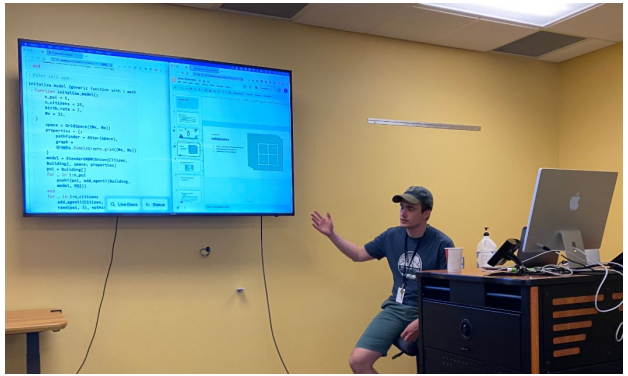
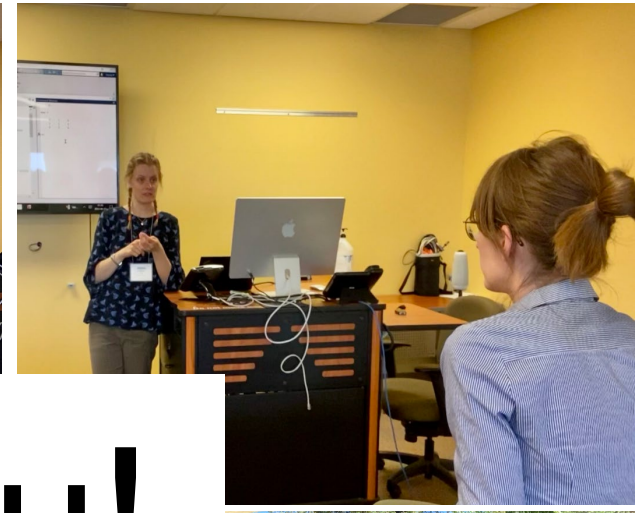
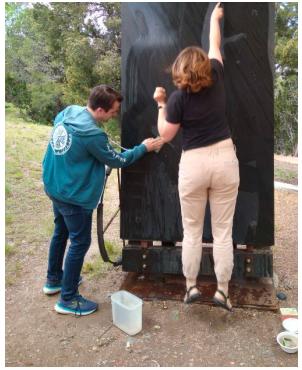
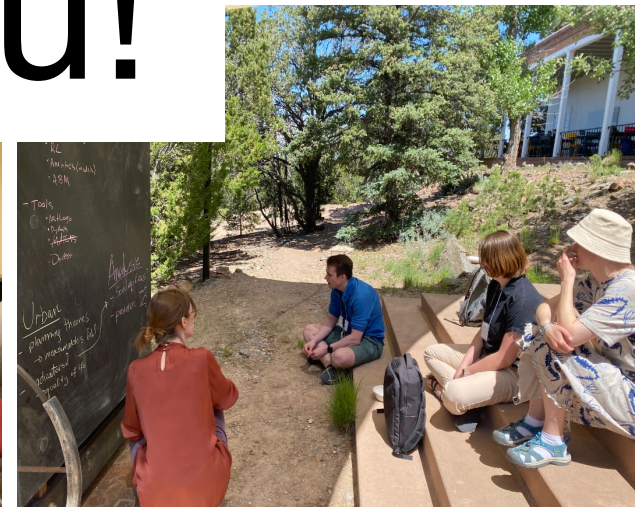
McPhearson, T., Pickett, S.T.A., Grimm, N.B., Niemelä, J., Alberti, M., Elmqvist, T., Weber, C., Haase, D., Breuste, J., Qureshi, S., 2016. Advancing Urban Ecology toward a Science of Cities. Bioscience 66, 198–212. https://doi.org/10.1093/biosci/biw002





Thank you!