Urban form influences on emissions from buildings and mobility

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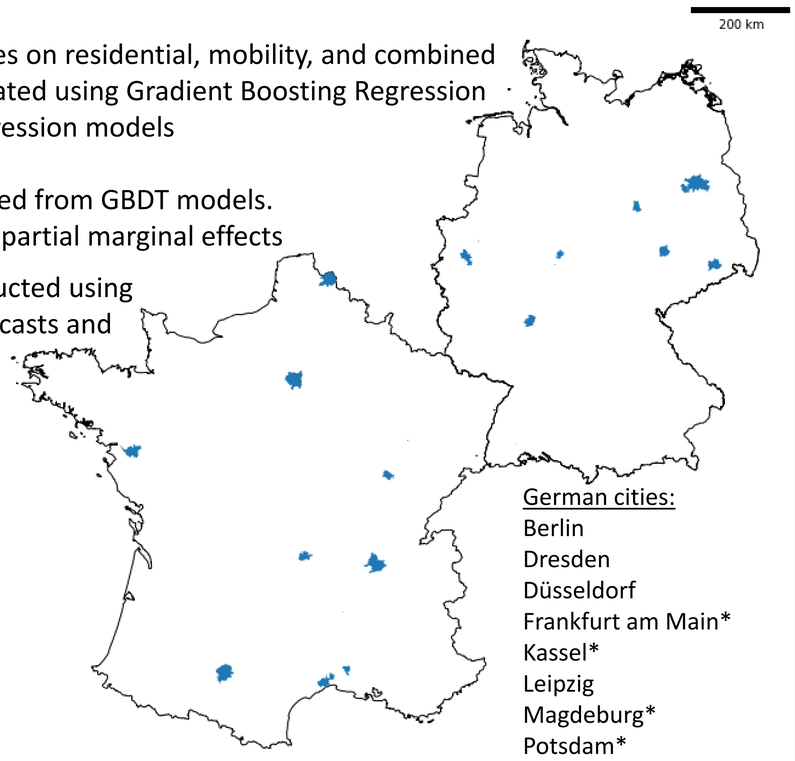
Methods

Urban form features (density, distances to center/subcenter, transit access, housing type mix) estimated at postcode level

Urban form influences on residential, mobility, and combined CO_2 emissions estimated using Gradient Boosting Regression Tree (GBDT) and regression models

SHAP values[1] extracted from GBDT models. These estimate local partial marginal effects

Scenarios are constructed using local population forecasts and assumptions on the location and type of new housing

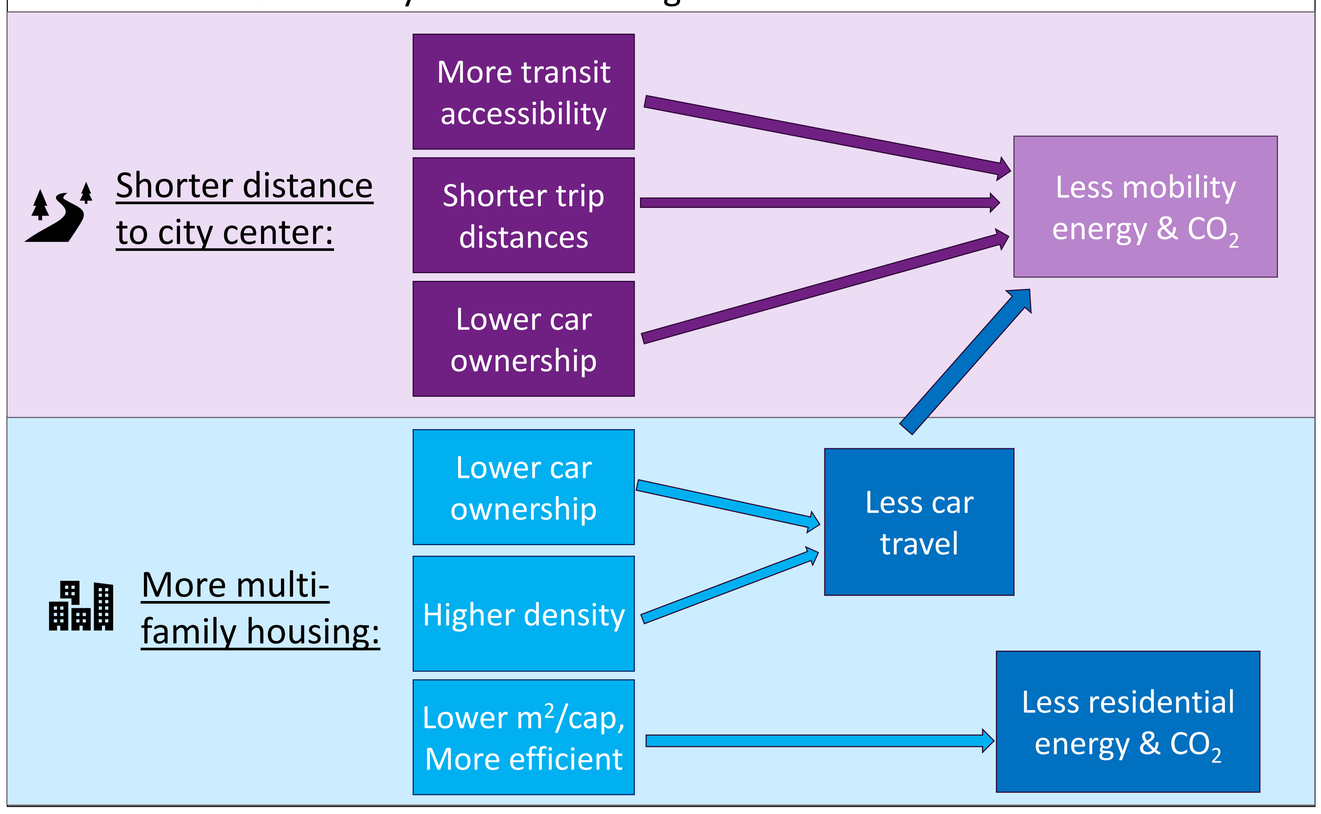


<u>French cities:</u>
Clermont-Ferrand
Dijon
Lille
Lyon
Montpellier
Nantes
Nimes
Paris
Toulouse

<u>German cities:</u>
Berlin
Dresden
Düsseldorf
Frankfurt am Main*
Kassel*
Leipzig
Magdeburg*
Potsdam*
*mobility data only

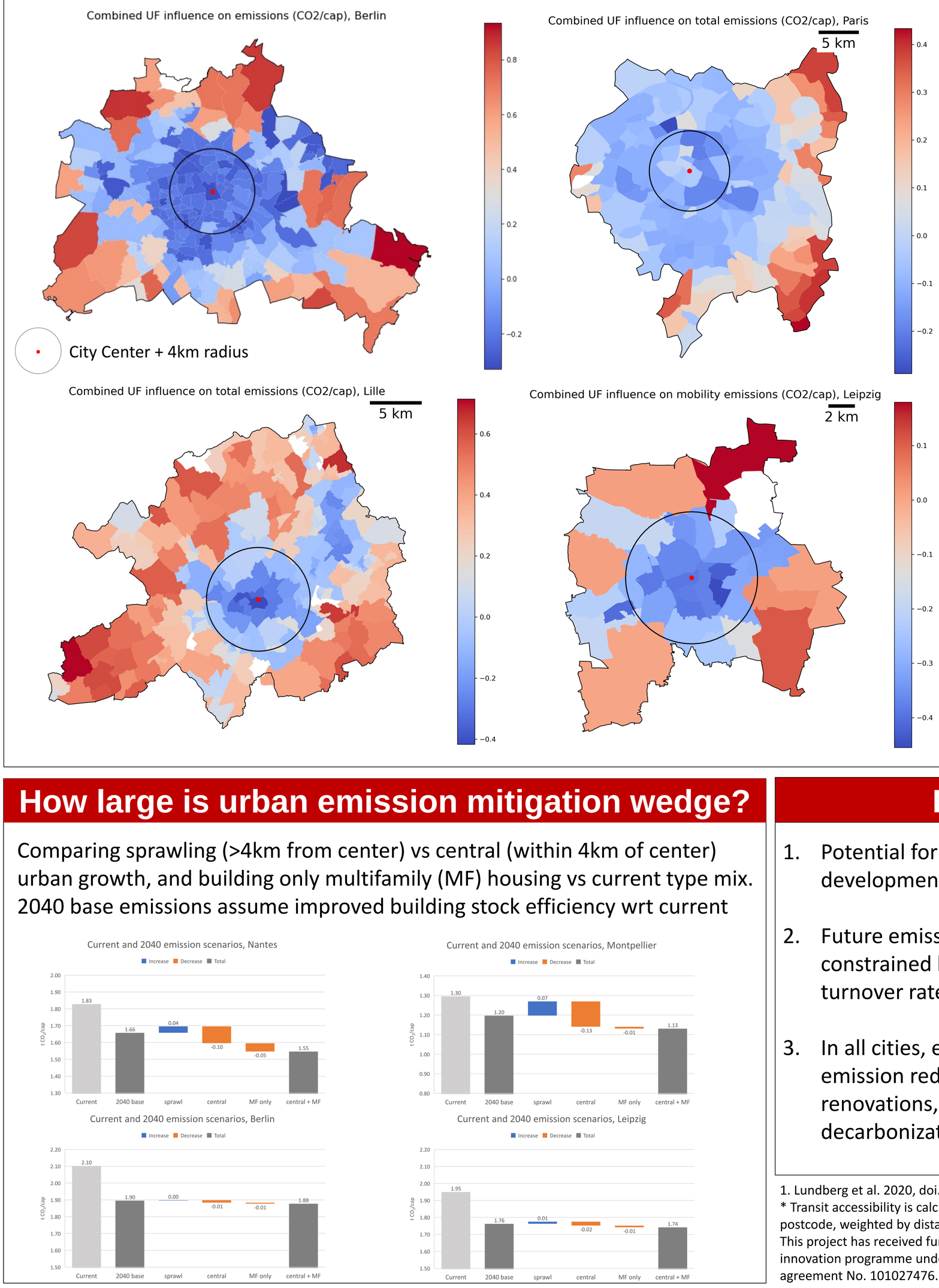
Urban form influence pathways

Summary findings from empirical analyses using GBDT and regression methods. Associations identified by models do not guarantee a causal basis.

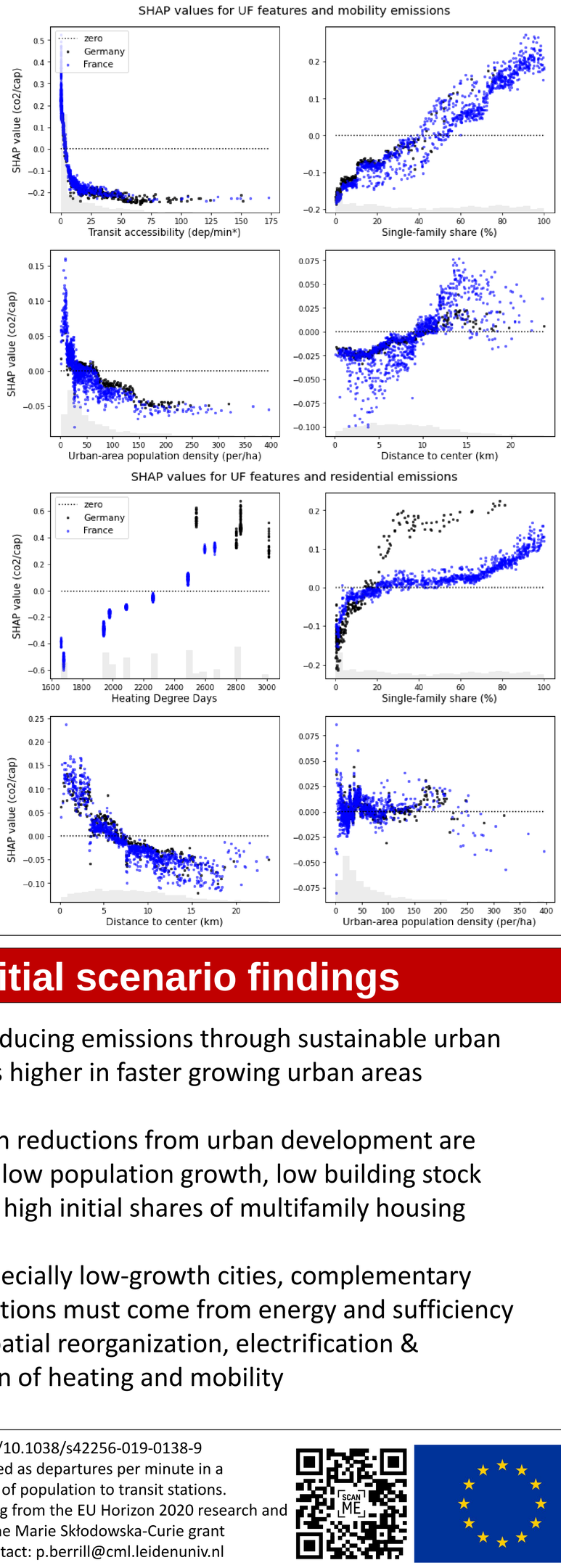


Influences of urban form on emissions, variation across space and sectors

Maps showing local combined influence of urban form features on total CO_2/cap. Blue/Red areas: Local urban former associated with lower/higher emissions.



Scatter plots of SHAP values (marginal effects) of features on mobility and residential CO_2/cap



How large is urban emission mitigation wedge?

Comparing sprawling (>4km from center) vs central (within 4km of center) urban growth, and building only multifamily (MF) housing vs current type mix. 2040 base emissions assume improved building stock efficiency wrt current

Initial scenario findings

1. Potential for reducing emissions through sustainable urban development is higher in faster growing urban areas

2. Future emission reductions from urban development are constrained by low population growth, low building stock turnover rates, high initial shares of multifamily housing

3. In all cities, especially low-growth cities, complementary emission reductions must come from energy and sufficiency renovations, spatial reorganization, electrification & decarbonization of heating and mobility

1. Lundberg et al. 2020, doi.org/10.1038/s42256-019-0138-9

* Transit accessibility is calculated as departures per minute in a postcode, weighted by distance of population to transit stations.

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