

FP 7 Research Project:

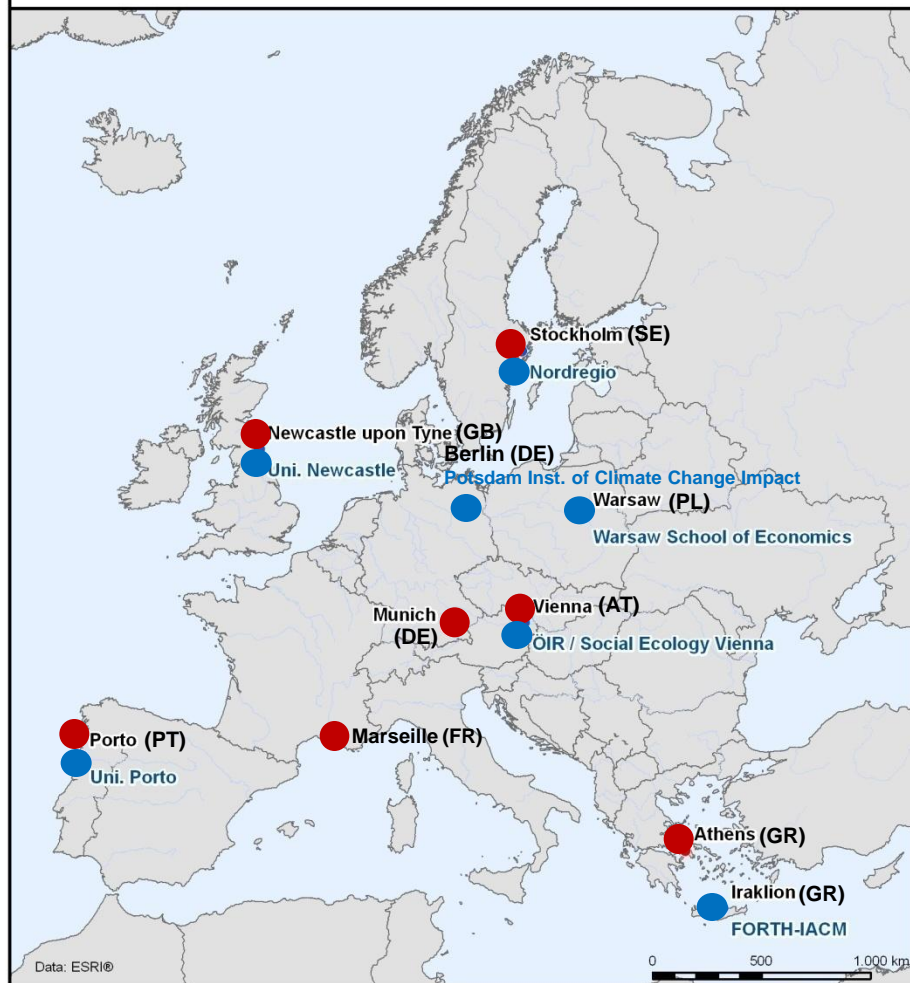
Sustainable Urban Metabolism for Europe – SUME

Christof Schremmer, SUME project coordinator

ÖIR
Austrian Institute for Regional Studies and Spatial
Planning (Vienna)



SUME Project Partners & Case study cities

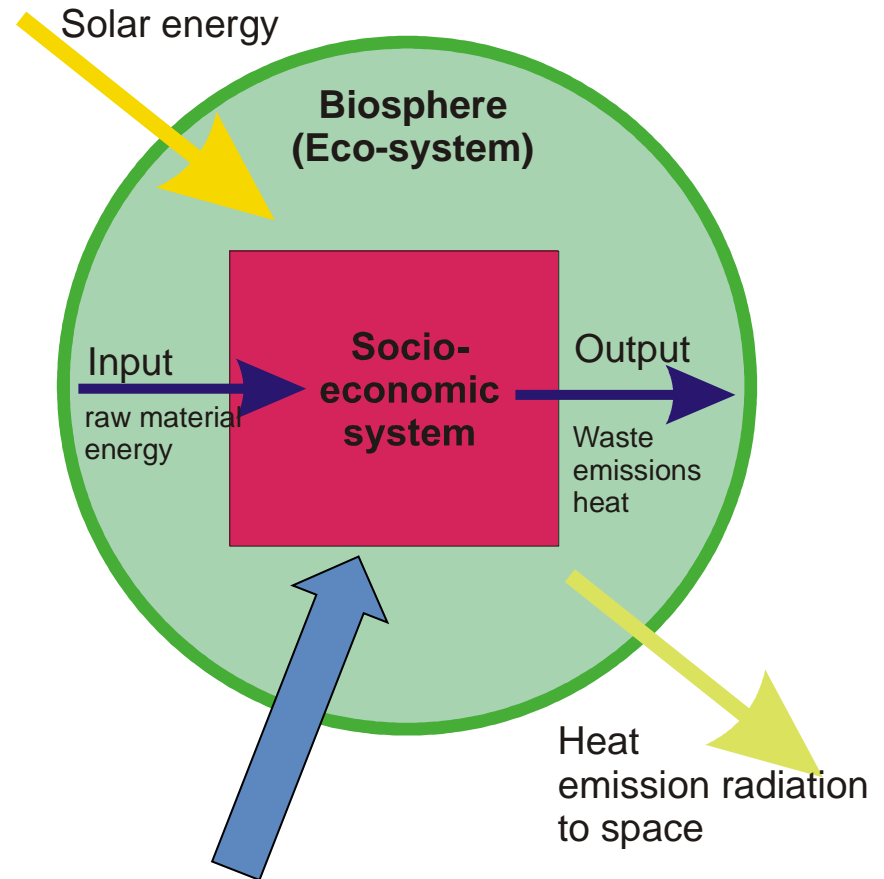


- Scenario Cities (Countries)
- SUME Project Partner



Background: Social Metabolism

- ▶ Social systems as thermodynamically open
- ▶ Energy and material flows into socio-economic system
- ▶ Internal energy and material flows
- ▶ Energy and material flows back to nature
- ▶ Main operationalizations:
 - Material and energy flows
 - LCA
 - Stocks and flows dynamics

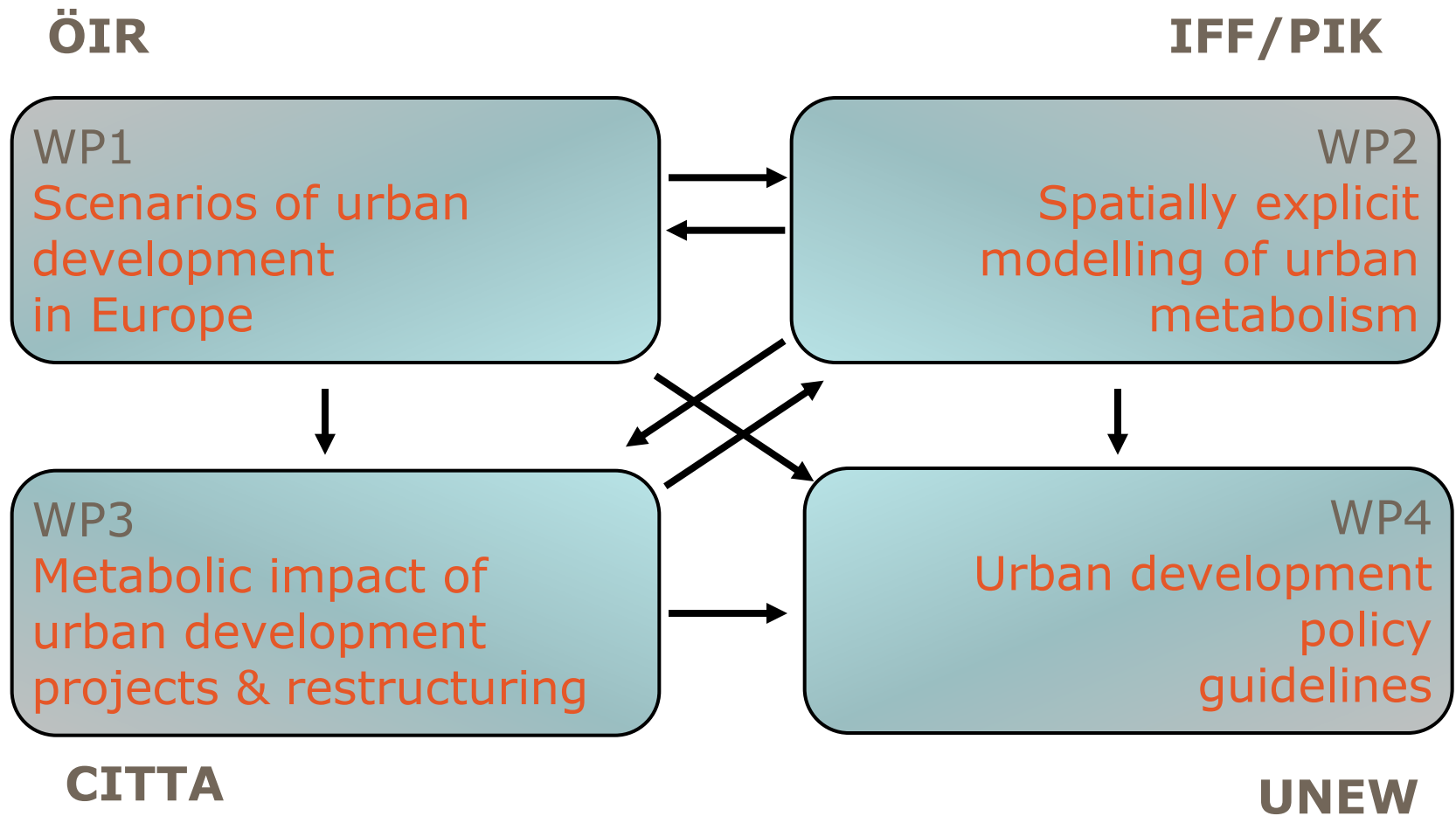


Spatial form of urban socio-economic systems

Challenges for urban development, viewed by an urban metabolism approach

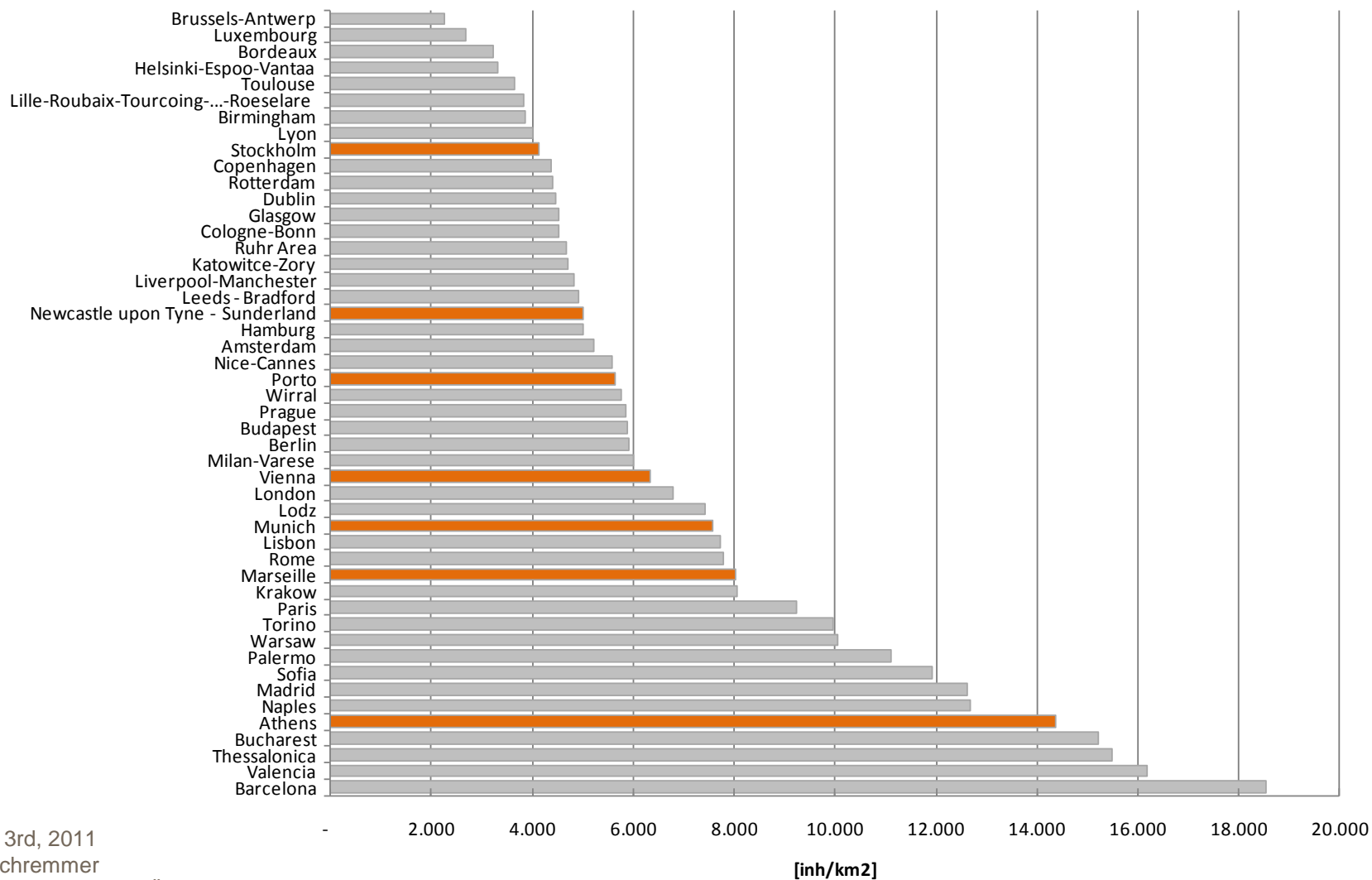
- ▶ What are the developmental perspectives of European urban agglomerations in spatial terms – what are potential impacts on the **urban metabolic performance** (→ GHG, climate change, resource use)?
- ▶ Are there consistently better **urban spatial structures/urban forms** with respect to urban metabolism – resource use?
- ▶ How can **growth, change, rebuilding cities** over time be steered towards a future improvement of the energy-material balance ?
- ▶ What are the **policies** currently applied and how can there be a more comprehensive, resource-minded urban development?

SUME – project: Workpackages

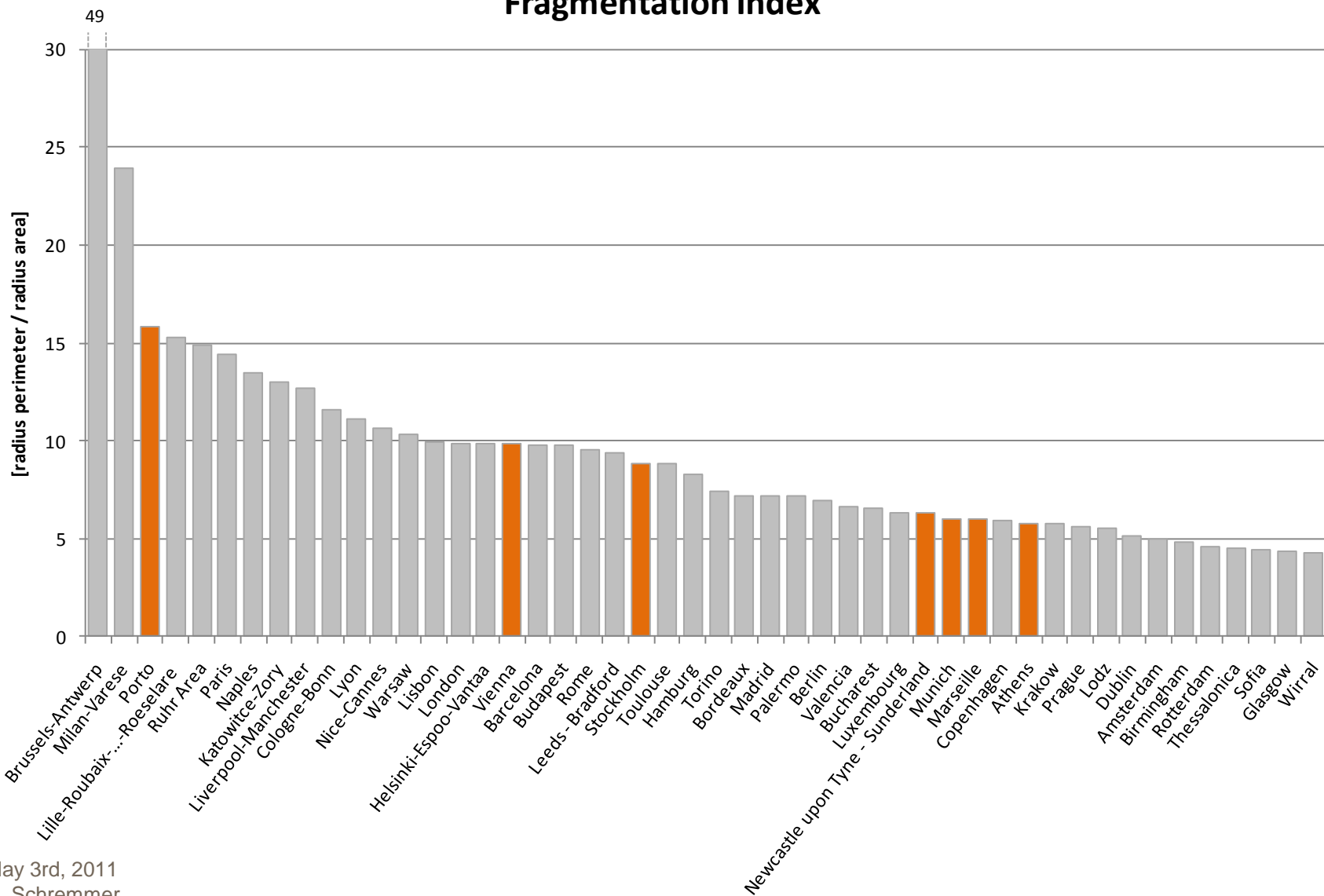


Urban form and development in Europe: Diversity of form and dynamics

Population density on urban fabric (II)



Fragmentation Index



SUME scenario approach

Urban development scenarios 2050: Inputs and guiding principles

- Spatial development paths for different cities, 2000 – 2050
- Main drivers:
population and job change (projections),
development of living space per capita
- Inputs:
Land use, densities and building typologies, protected areas and restrictions, infrastructure plans, larger development projects, development plans

Urban development scenarios: Guiding principles

- **BASE scenario** as the continuation of current spatial trends (densities, spatial configurations)
- **SUME scenario** as a path of sustainable spatial planning – focusing on the interrelations between urban form and metabolic performance
- SUME – scenarios **4 planning principles**:
 - gradual step up of densities in existing urban fabric
 - where attractive public transport can be provided
 - mix of functions (esp. in PT nodes)
 - enforced thermal renovation and reconstruction (combining replacement activities with densification)

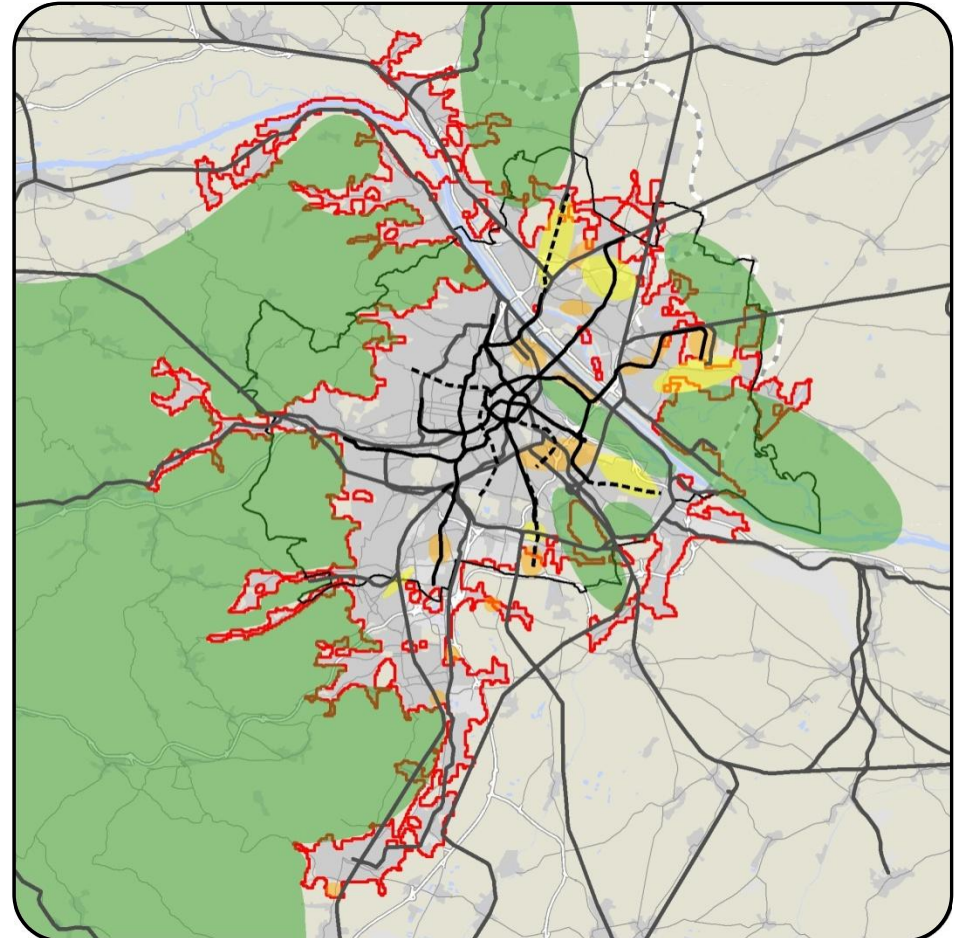
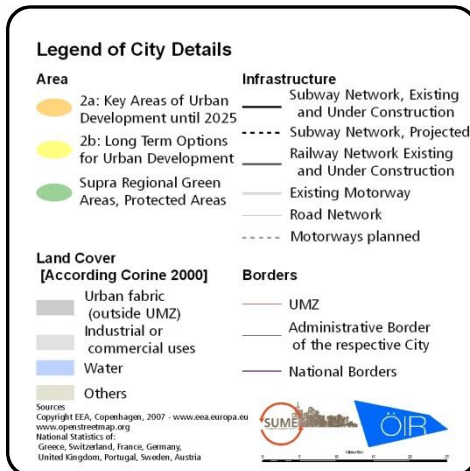
Scenarios 2050: Overview

- ▶ Vienna
- ▶ Athens
- ▶ Marseille
- ▶ Munich
- ▶ Newcastle upon Tyne
- ▶ Oporto
- ▶ Stockholm



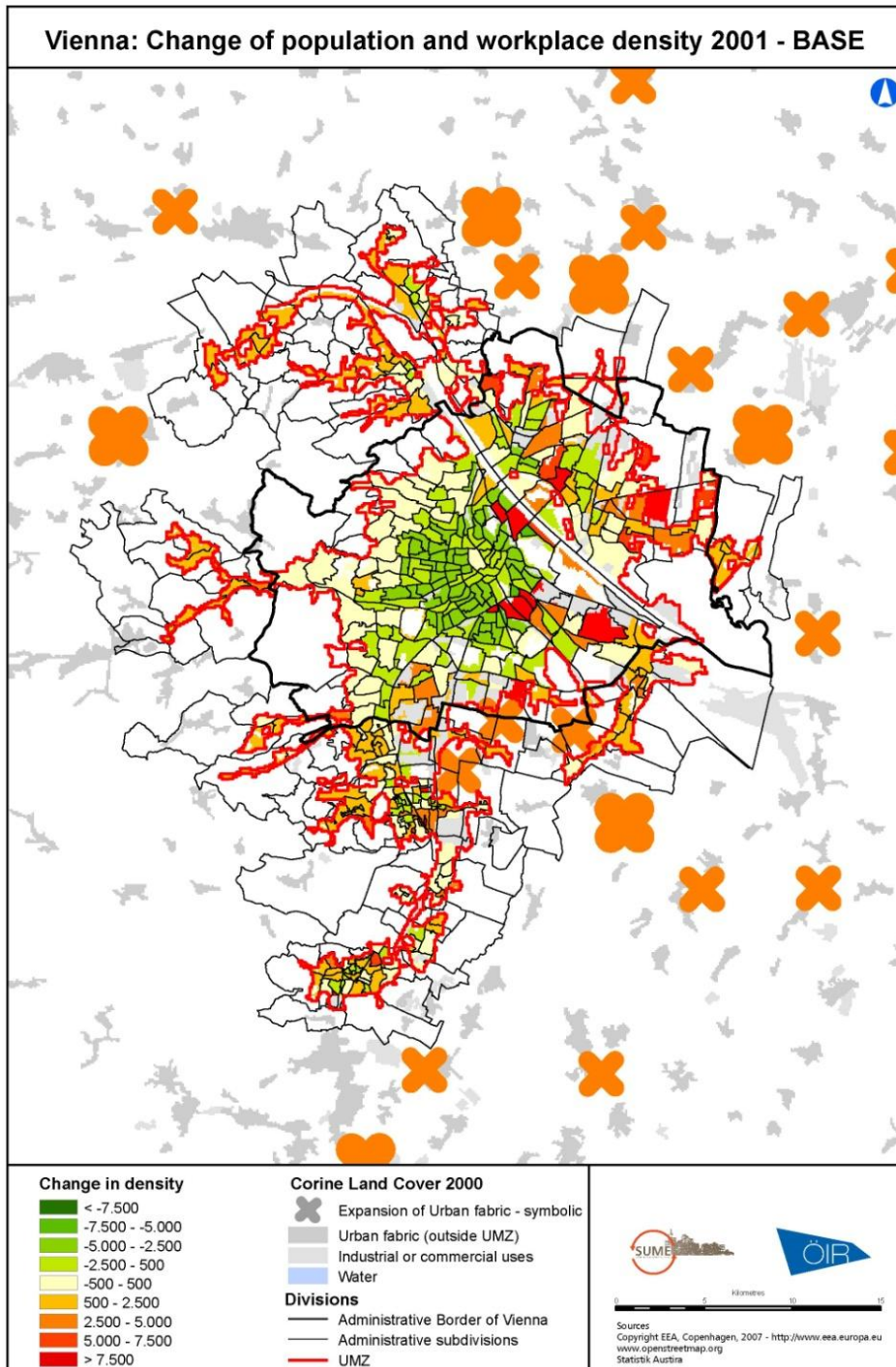
Vienna

- ▶ 1.8 Mio. population
- ▶ → 2050: + 35 %
- ▶ Pop.+jobs/km2 in urban fabric: 7.251

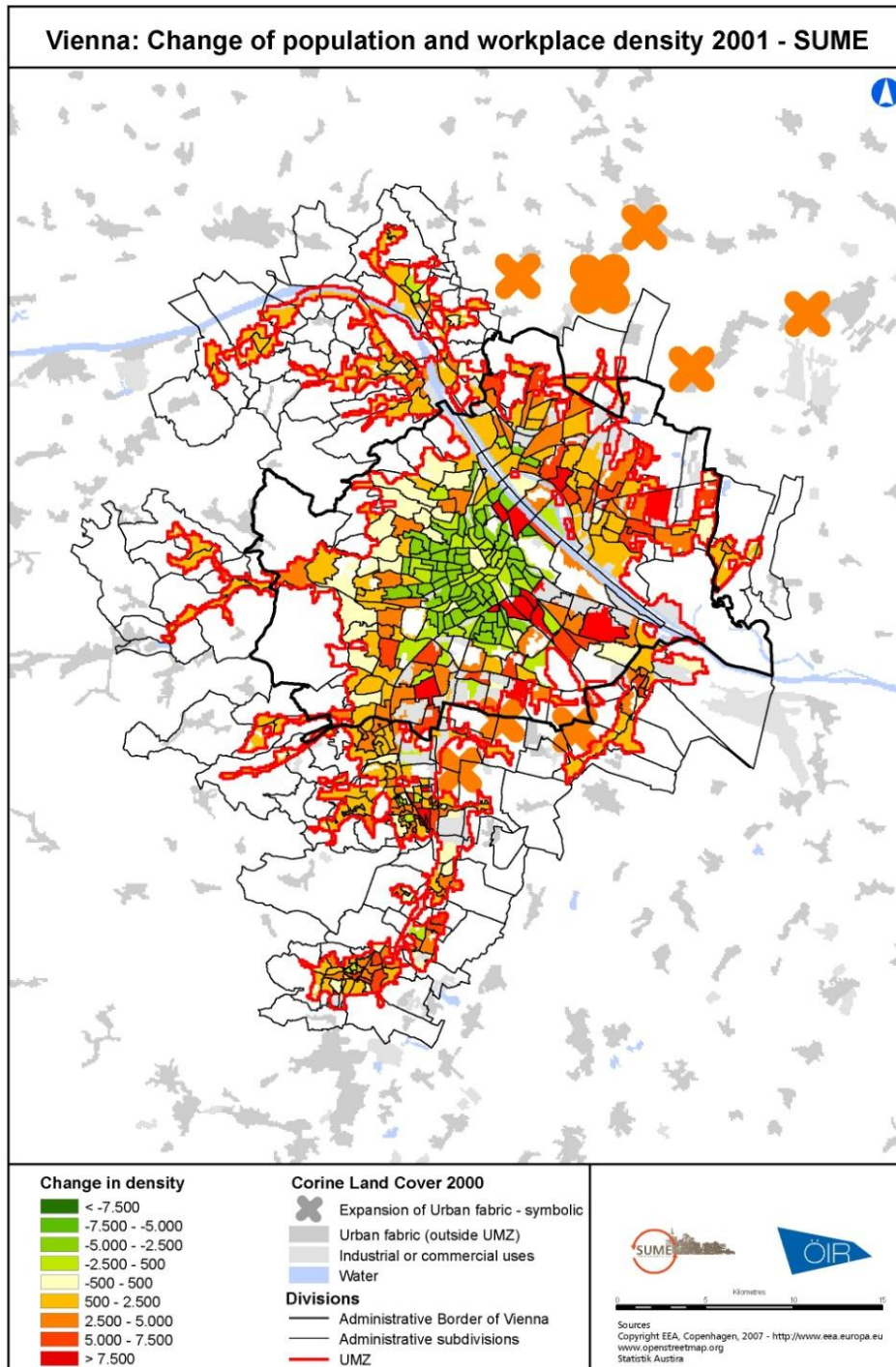


► **BASE**
scenario
2050:

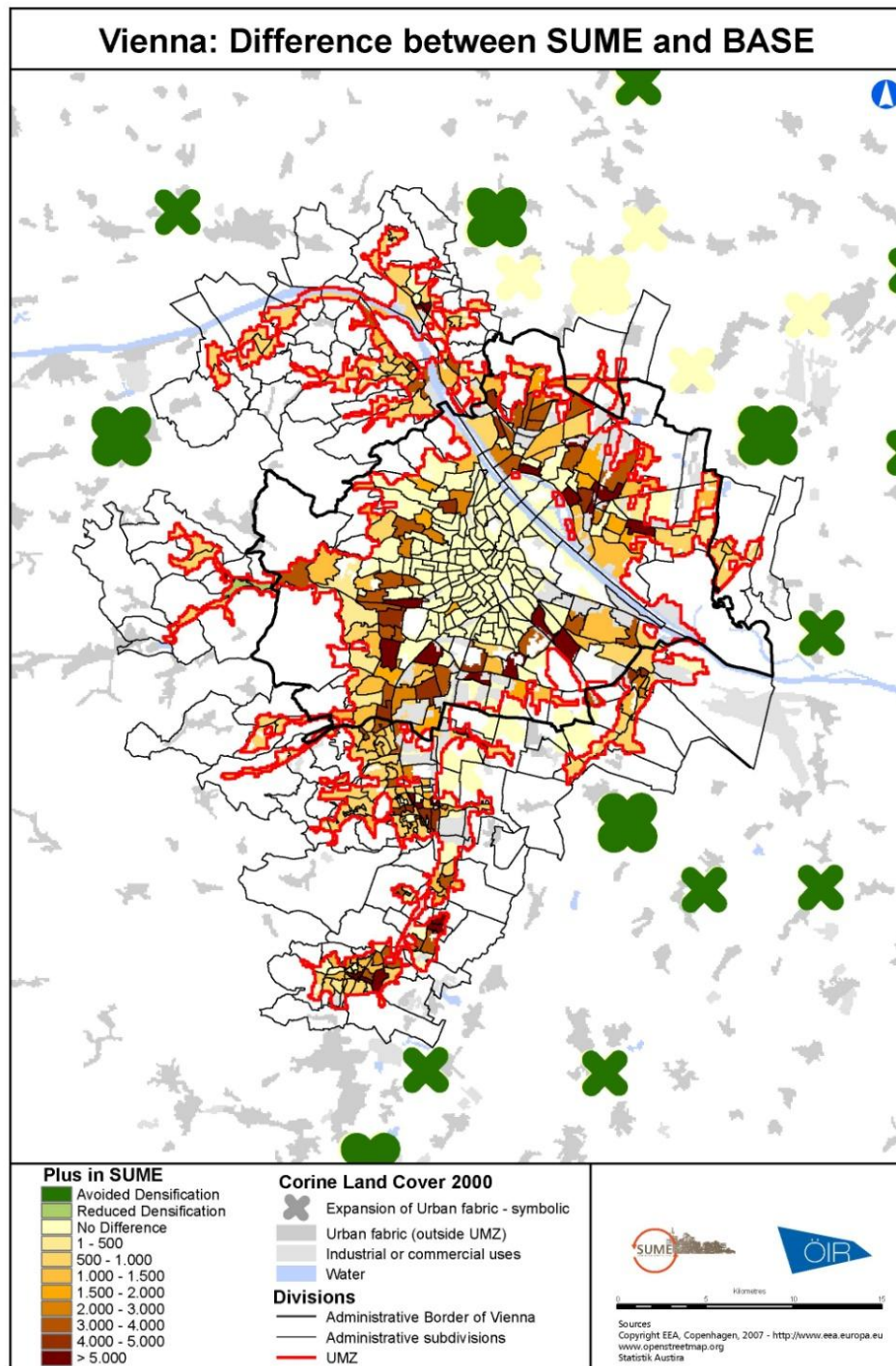
**urban
fabric
+ 55%**



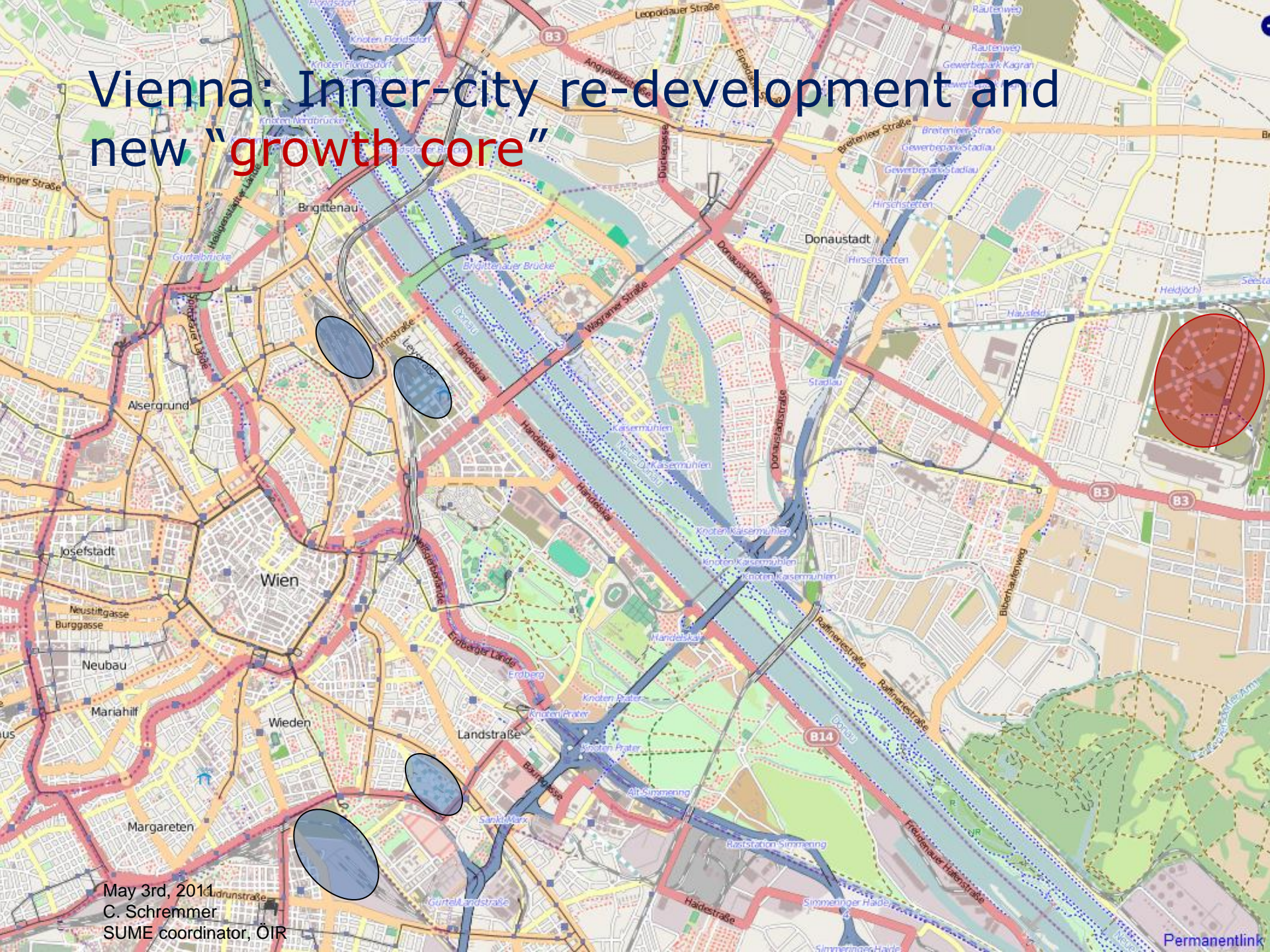
► **SUME**
scenario
2050:
**urban
fabric
+ 14%**



► **urban
fabric
expansion
reduced**



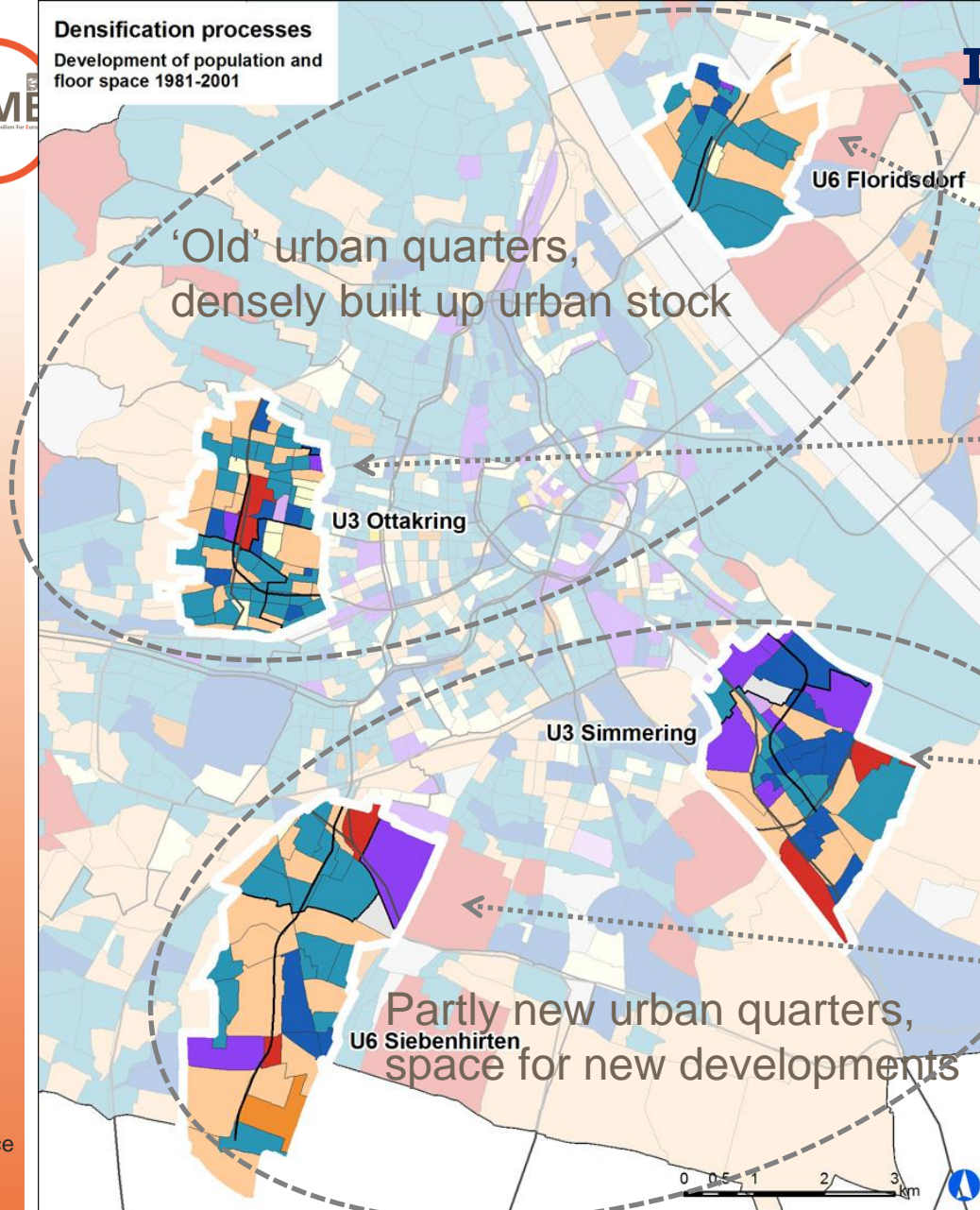
Vienna: Inner-city re-development and new "growth core"



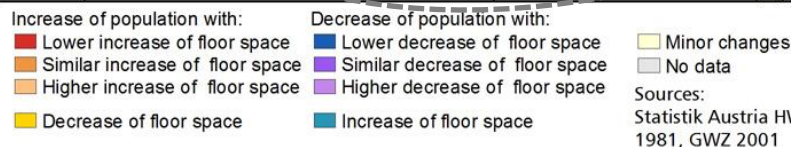
May 3rd, 2014
C. Schremmer
SUME coordinator, ÖIR

[Permanently link](#)

Inner-city densification/ new subway lines

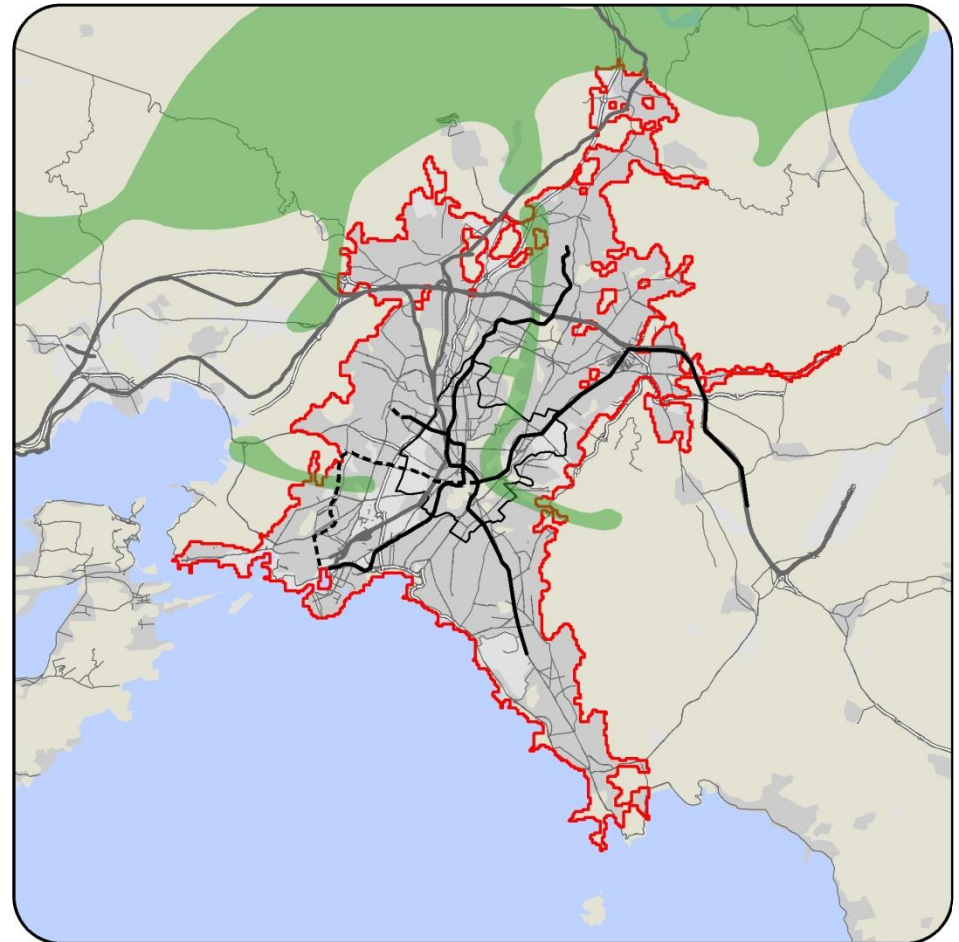
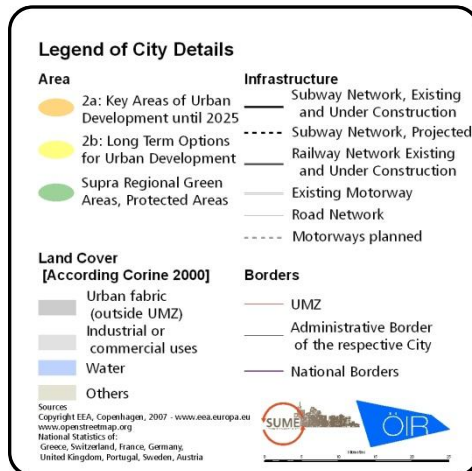


- extension of floor space in cells near the new station
- scattered development of densification, structural change and some population losses
- Concentration of structural change (office – residential)
- Extensive increase of population and floor space, some structural changes



Athens

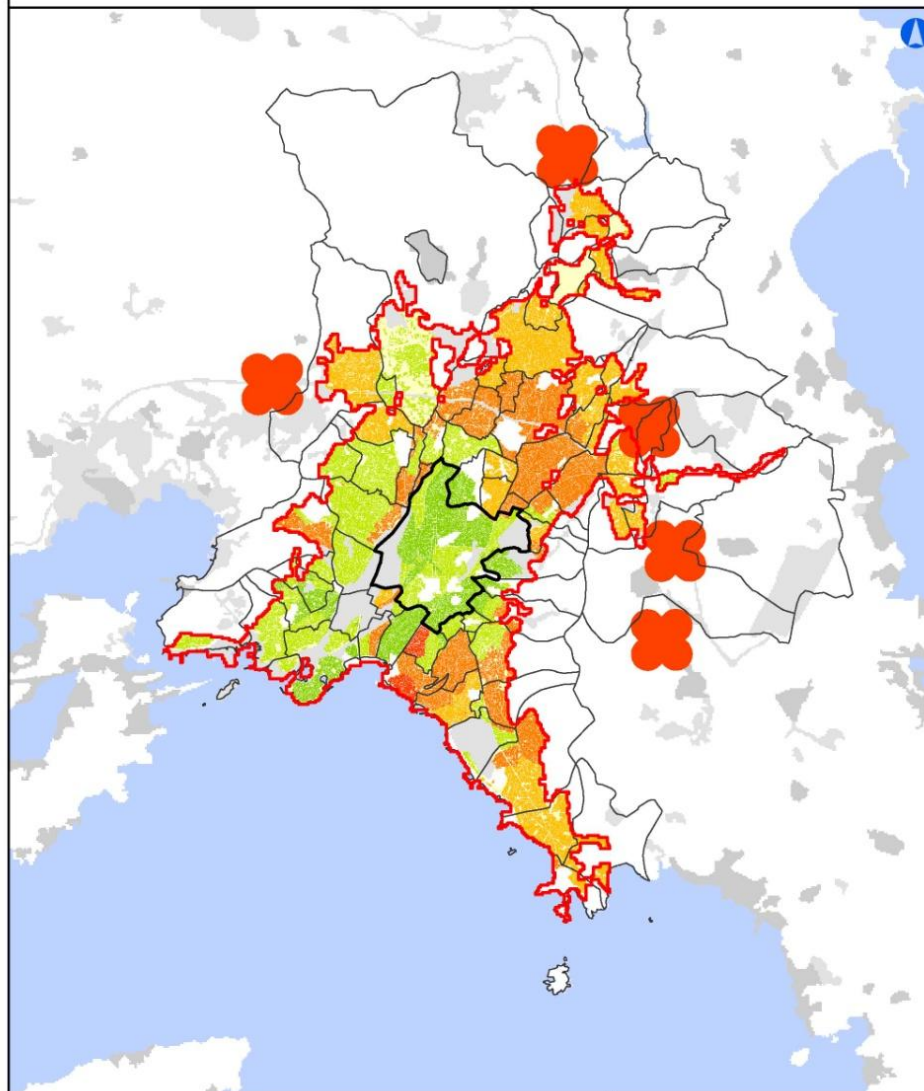
- ▶ 3.4 Mio. population
- ▶ → 2050: + 9 %
- ▶ Pop.+jobs/km2 in urban fabric: 18.584



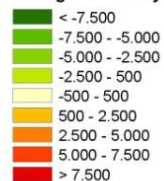
Athens: Change of population and workplace density 2001 - BASE

► **BASE**
scenario
2050:

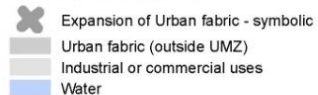
**urban
fabric
+ 24%**



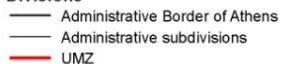
Change in density



Corine Land Cover 2000



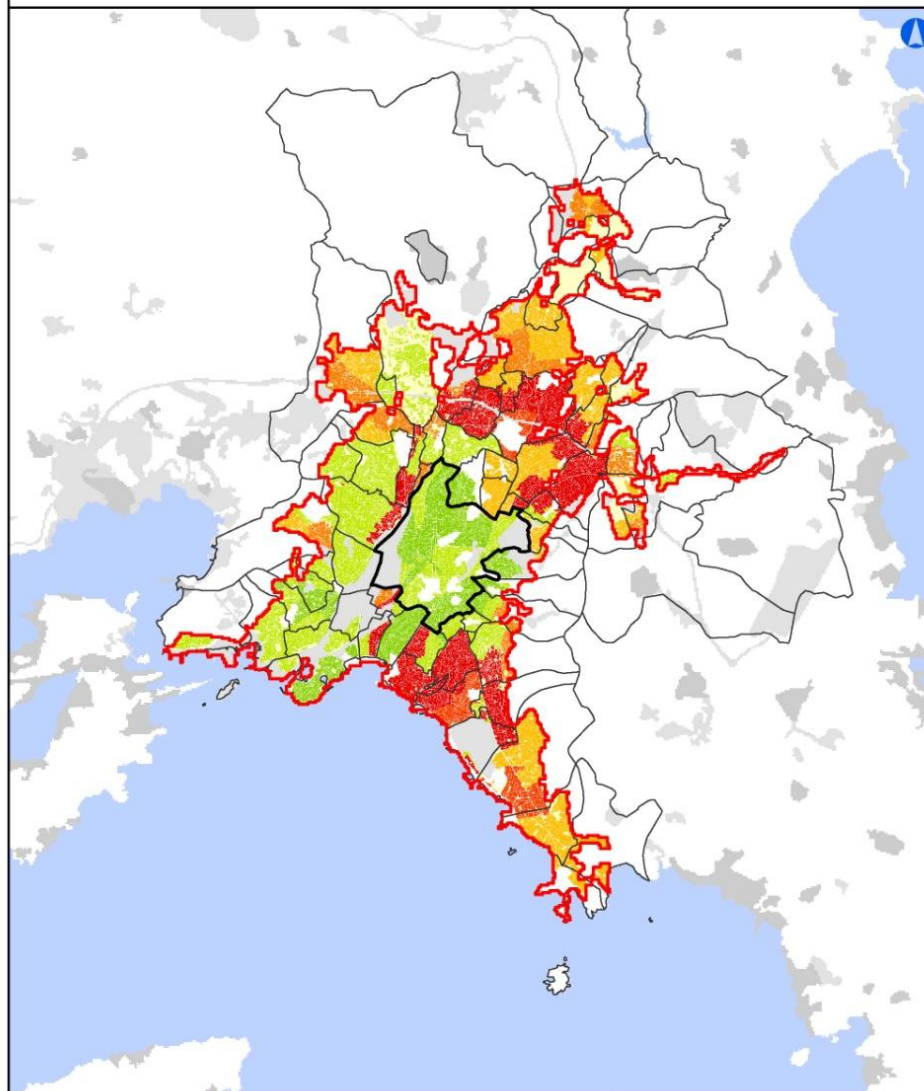
Divisions



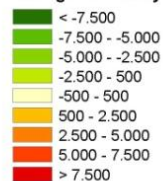
Sources
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www.openstreetmap.org
Statistik Austria

Athens: Change of population and workplace density 2001 - SUME

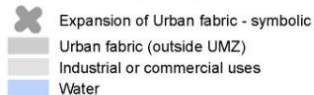
► **SUME**
scenario
2050:
**urban
fabric
+ 0%**



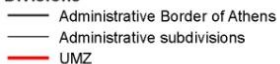
Change in density



Corine Land Cover 2000

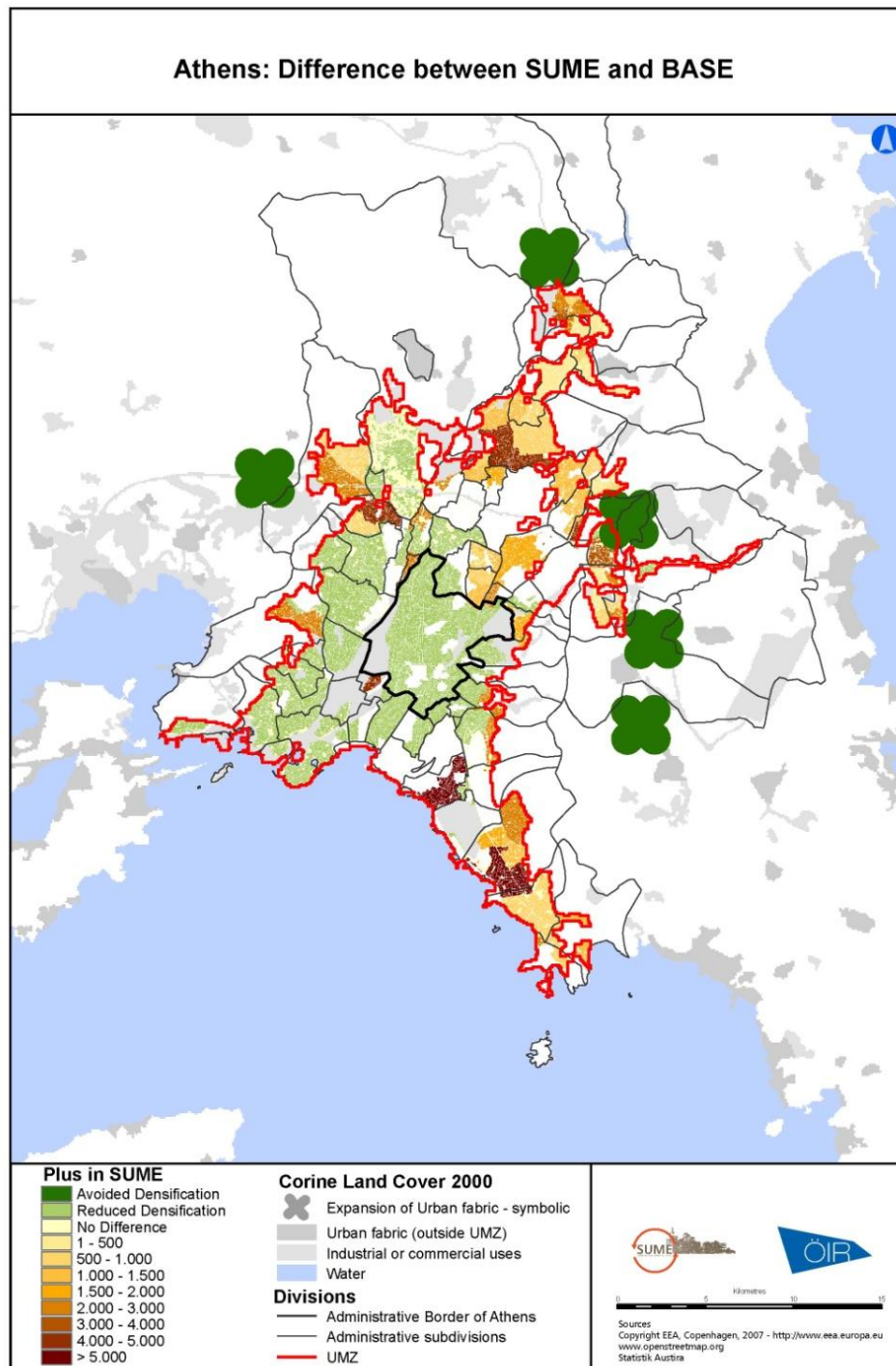


Divisions



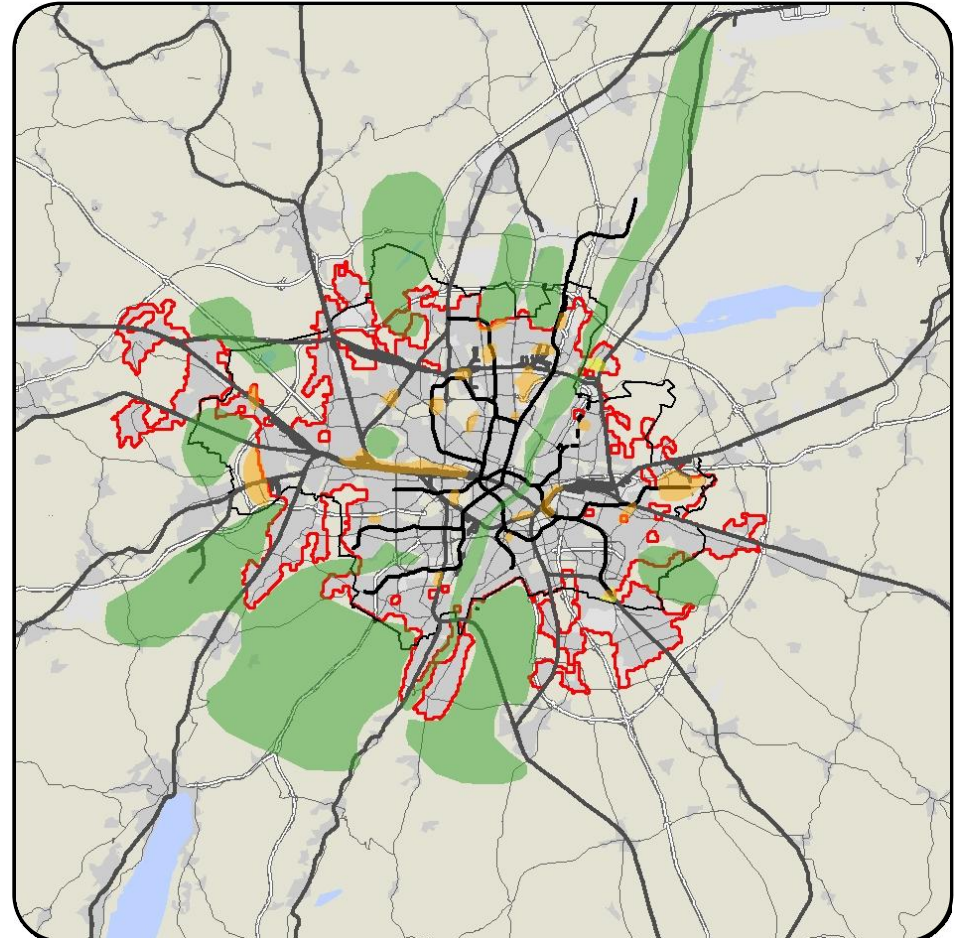
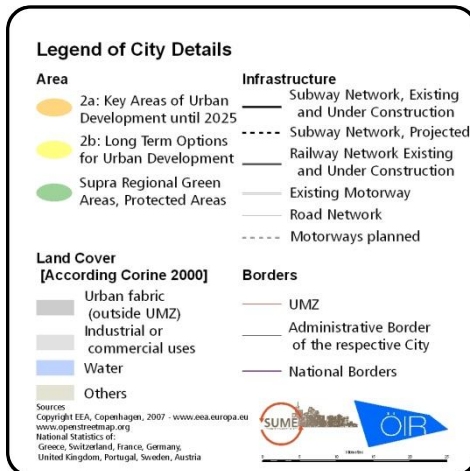
Sources
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www.openstreetmap.org
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► urban fabric expansion avoided



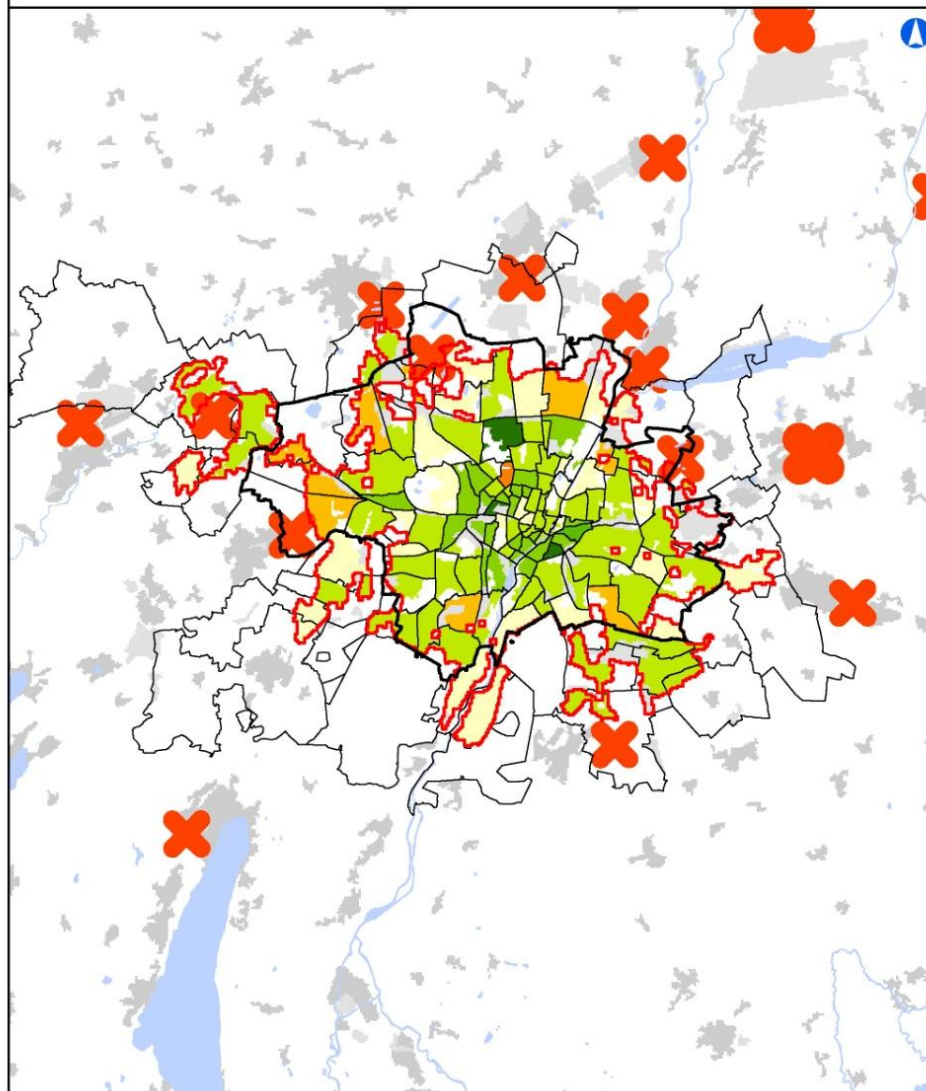
Munich

- ▶ 1.7 Mio. population
- ▶ → 2050: + 18 %
- ▶ Pop.+jobs/km2 in urban fabric: 8.759

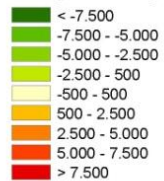


Munich: Change of population and workplace density 2008 - BASE

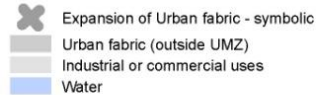
► **BASE**
scenario
2050:
**urban
fabric
+ 41%**



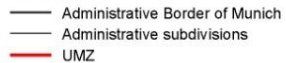
Change in density



Corine Land Cover 2000



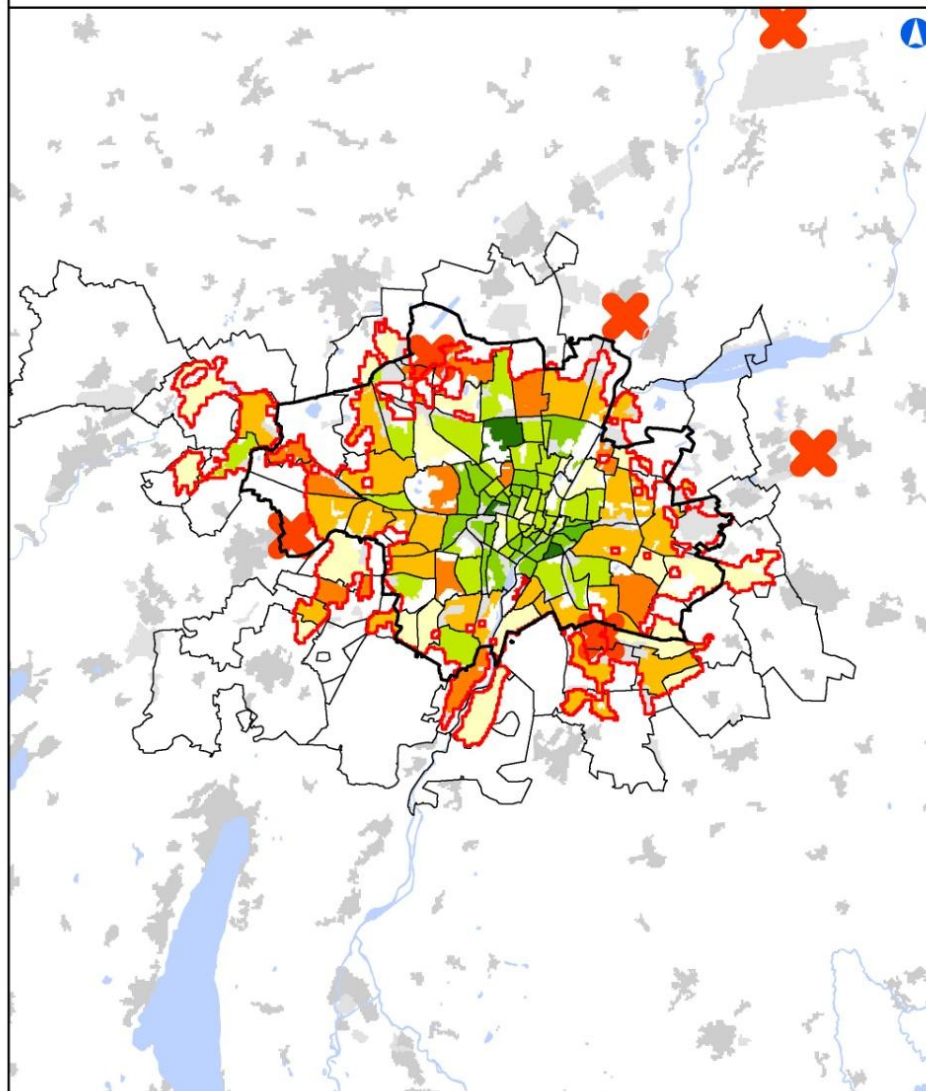
Divisions



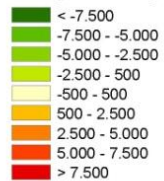
Sources
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Statistik Austria

Munich: Change of population and workplace density 2008 - SUME

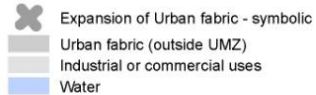
► **SUME**
scenario
2050:
**urban
fabric
+ 13%**



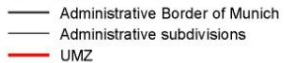
Change in density



Corine Land Cover 2000

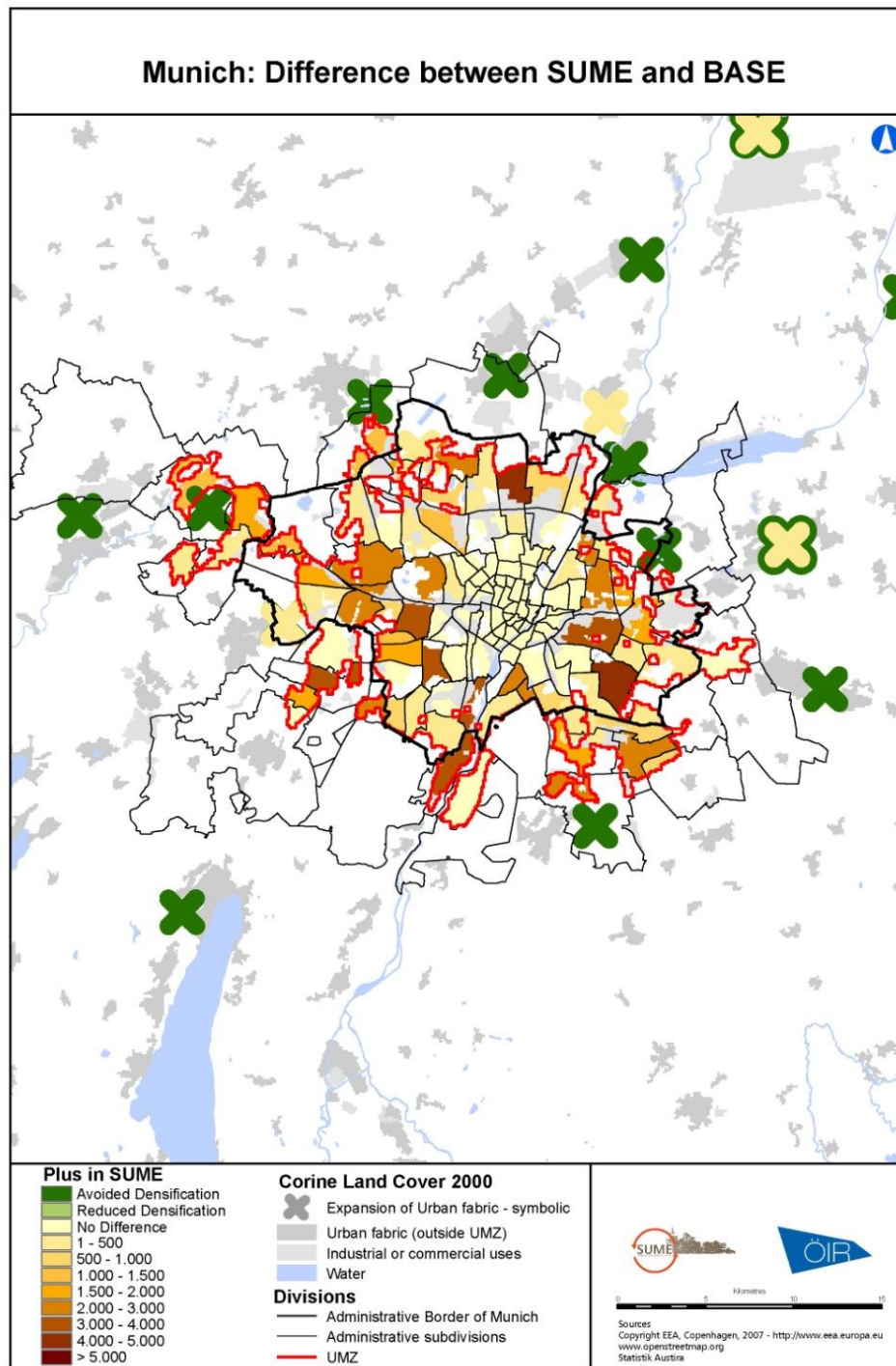


Divisions



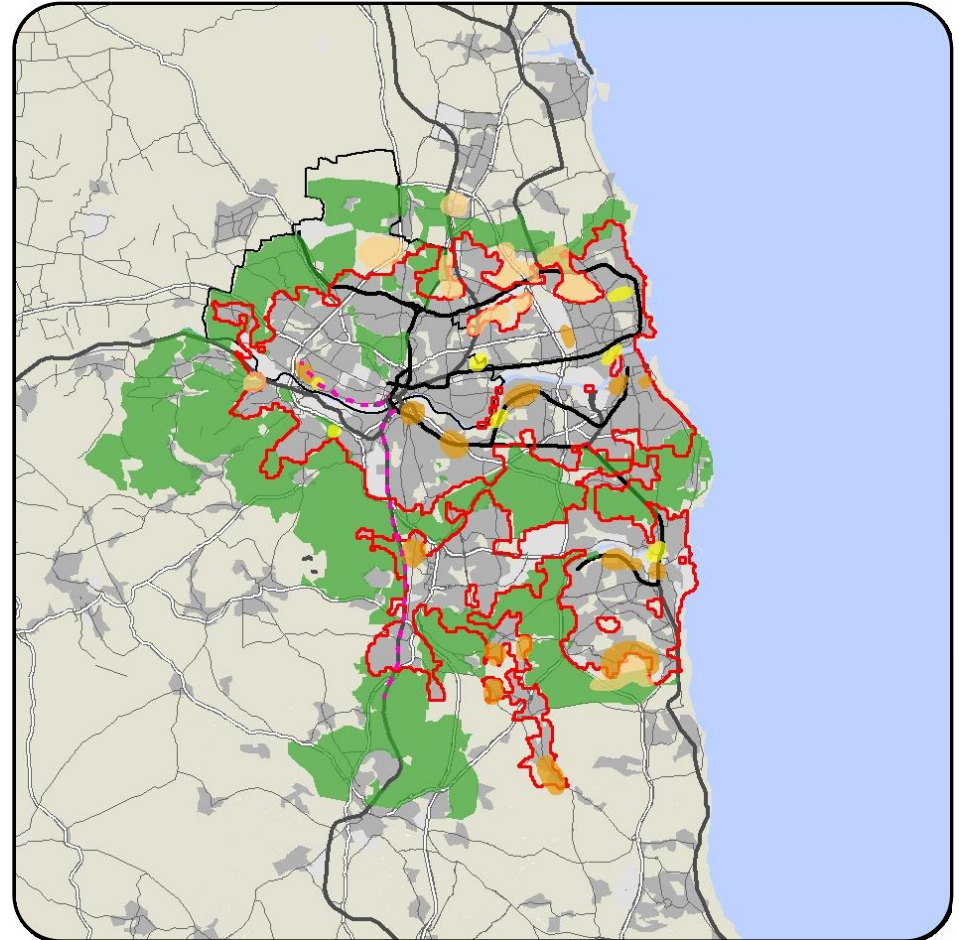
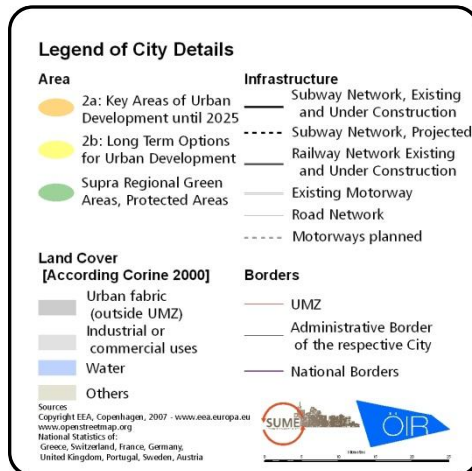
Sources
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Statistik Austria

► **urban
fabric
expansion
reduced**



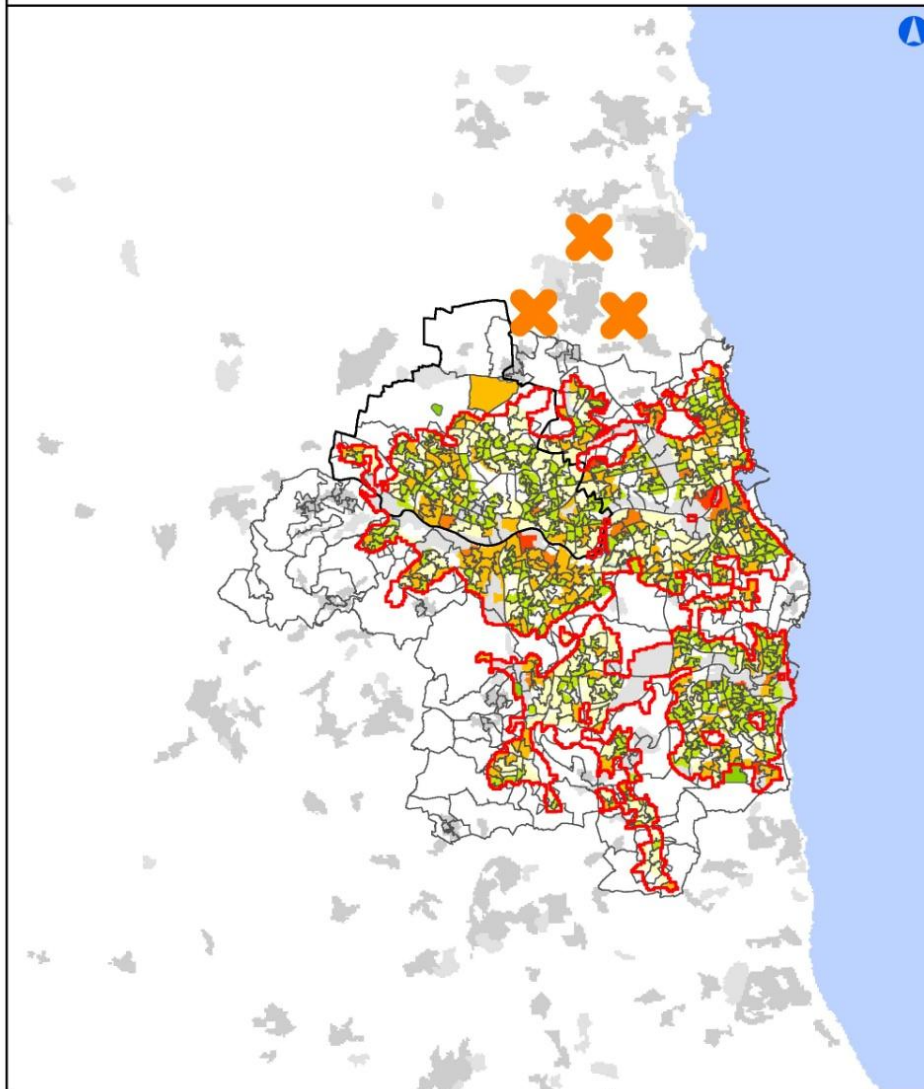
Newcastle upon Tyne

- ▶ 1.1 Mio. population
- ▶ → 2050: + 12 %
- ▶ Pop.+jobs/km2 in urban fabric: 6.700

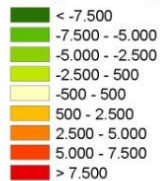


► **BASE**
scenario
2050:
**urban
fabric
+ 7%**

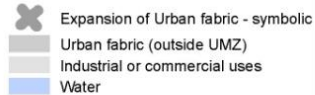
Newcastle upon Tyne Change of population and workplace density 2001 - BASE



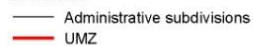
Change in density



Corine Land Cover 2000



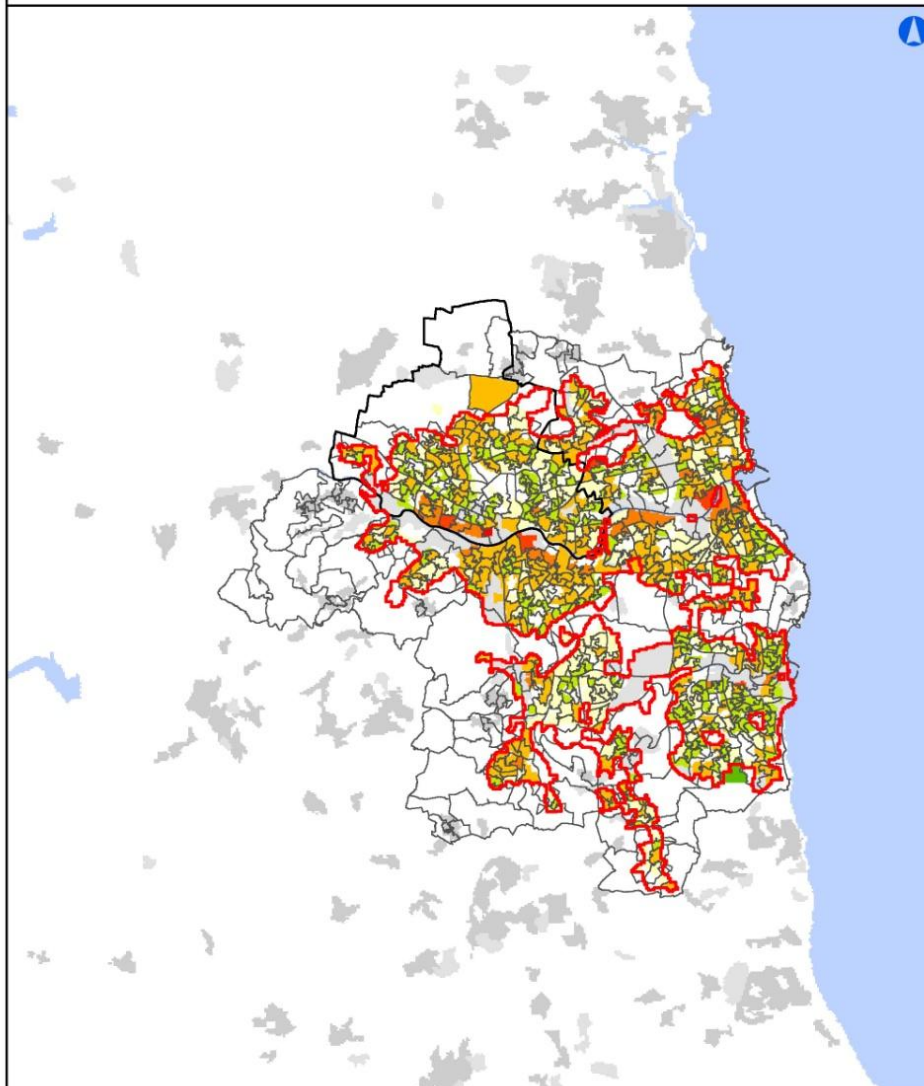
Divisions



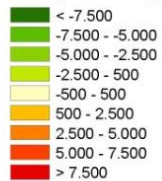
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www.openstreetmap.org
Statistik Austria

► **SUME**
scenario
2050:
**urban
fabric
+ 0%**

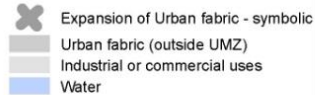
Newcastle upon Tyne Change of population and workplace density 2001 - SUME



Change in density



Corine Land Cover 2000



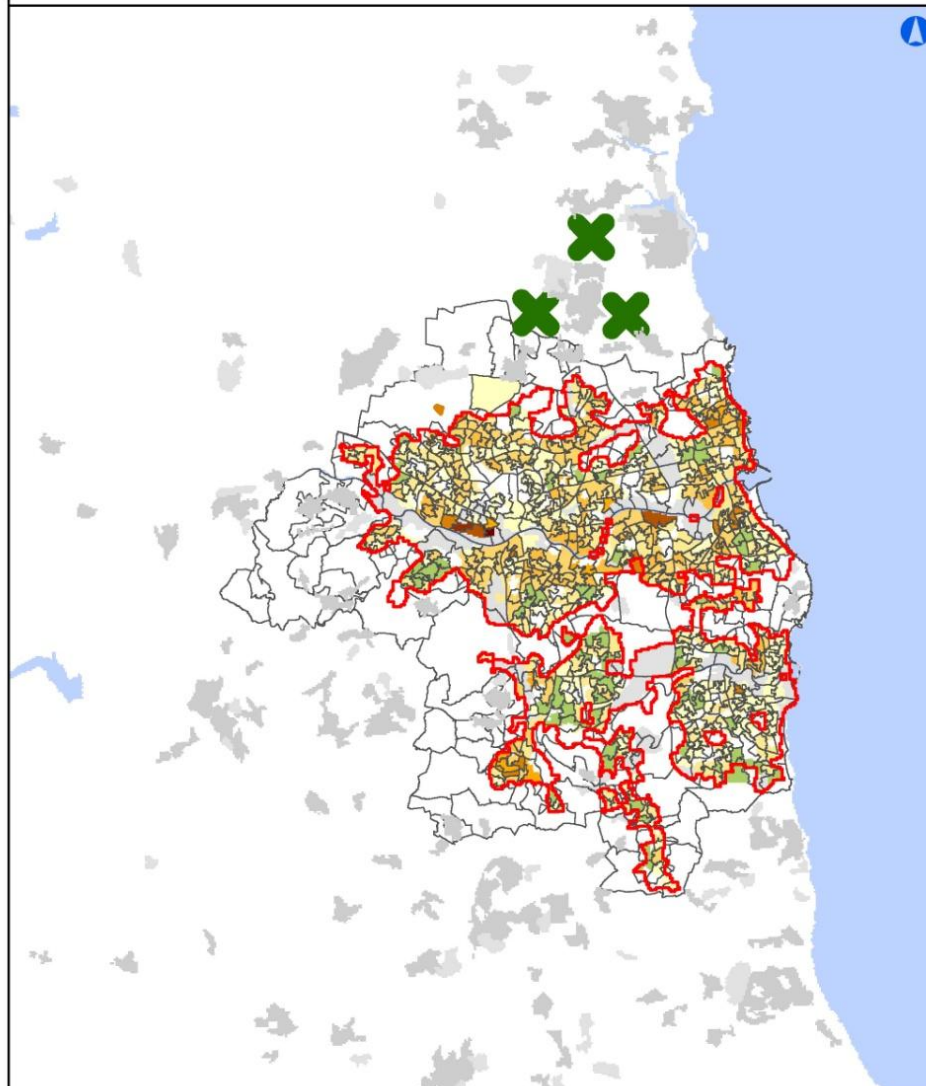
Divisions



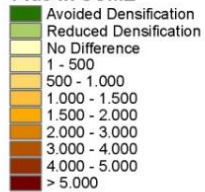
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www.openstreetmap.org
Statistik Austria

► **urban
fabric
expansion
avoided**

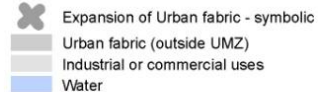
Newcastle upon Tyne Difference between SUME and BASE



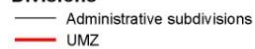
Plus in SUME



Corine Land Cover 2000



Divisions

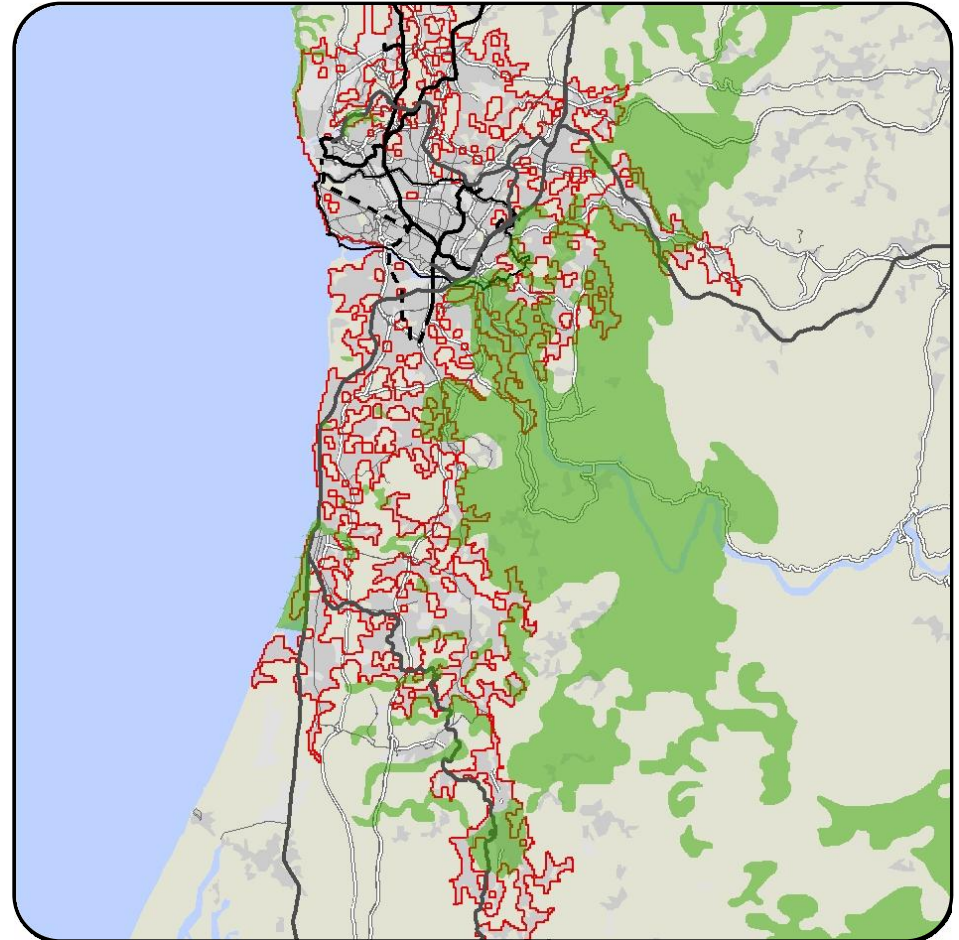
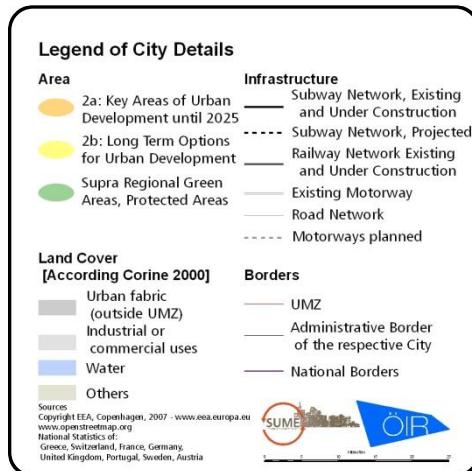


0 5 10 15
Kilometres

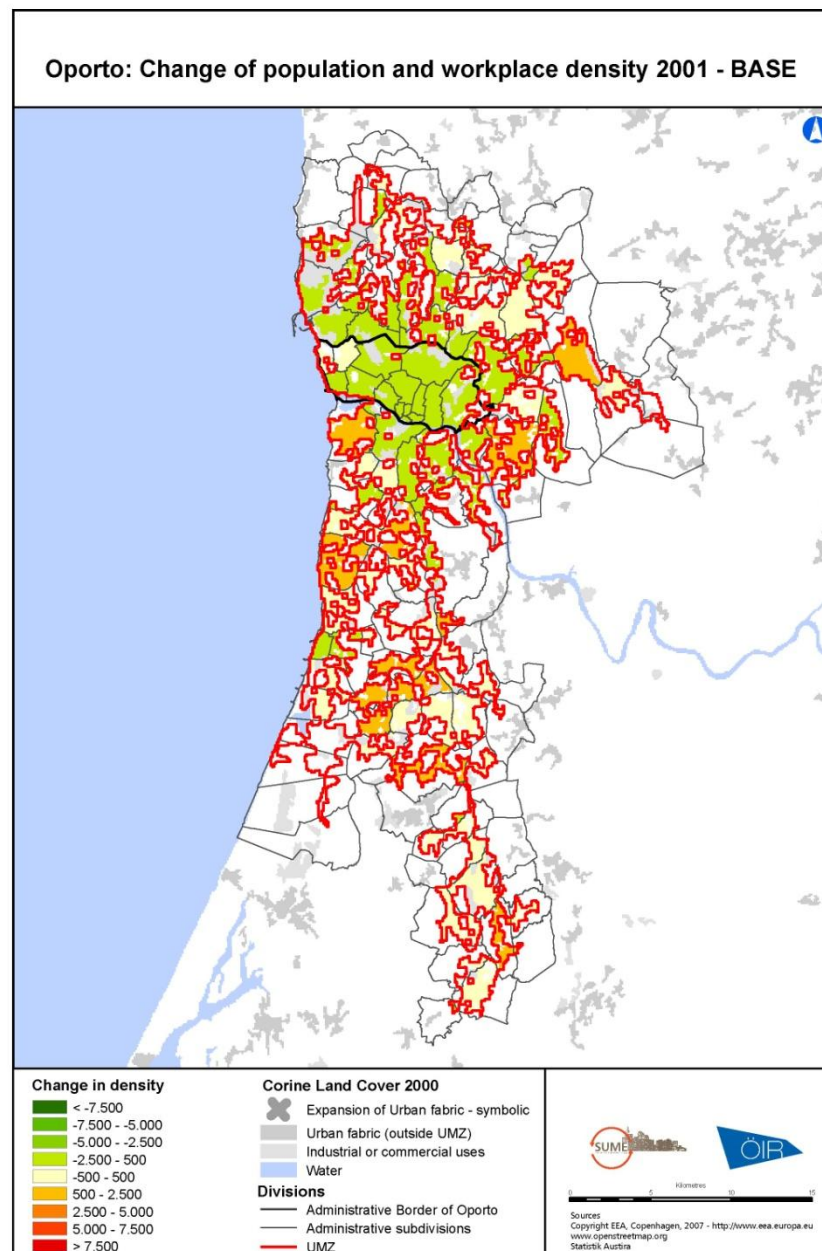
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Oporto

- ▶ 1.3 Mio. population
- ▶ → 2050: - 4 %
- ▶ Pop.+jobs/km2 in urban fabric: 5.403

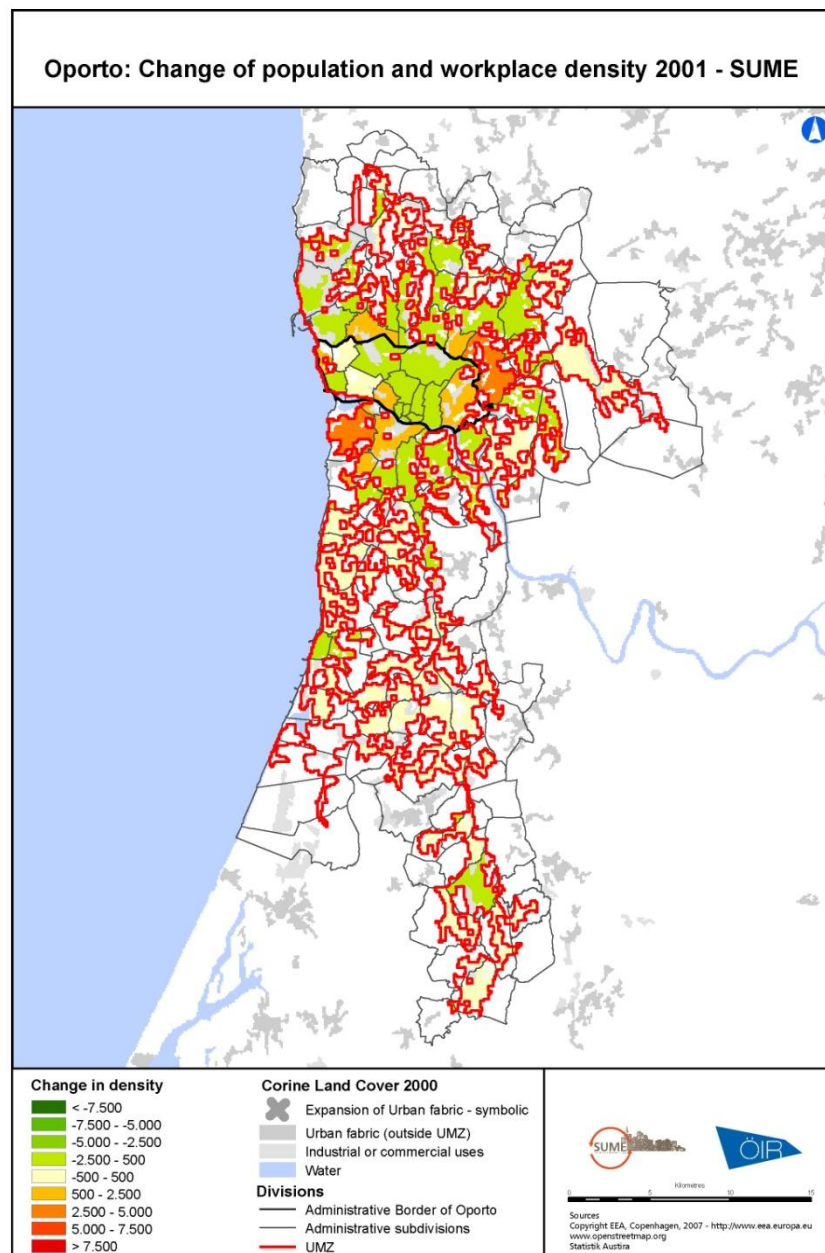


► **BASE**
scenario
2050:
**urban
fabric
+ 0%**

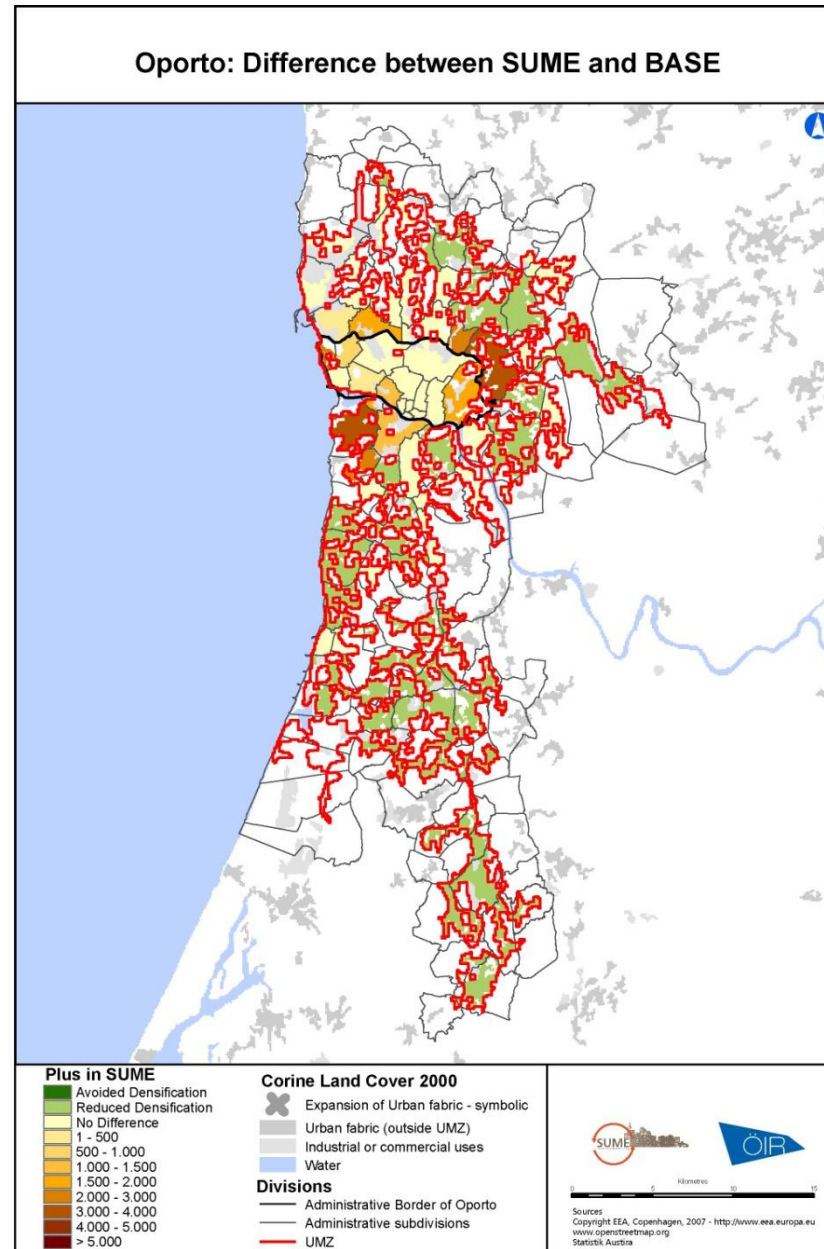


► **SUME**
scenario
2050:

**urban
fabric
+ 0%
PT-focus**

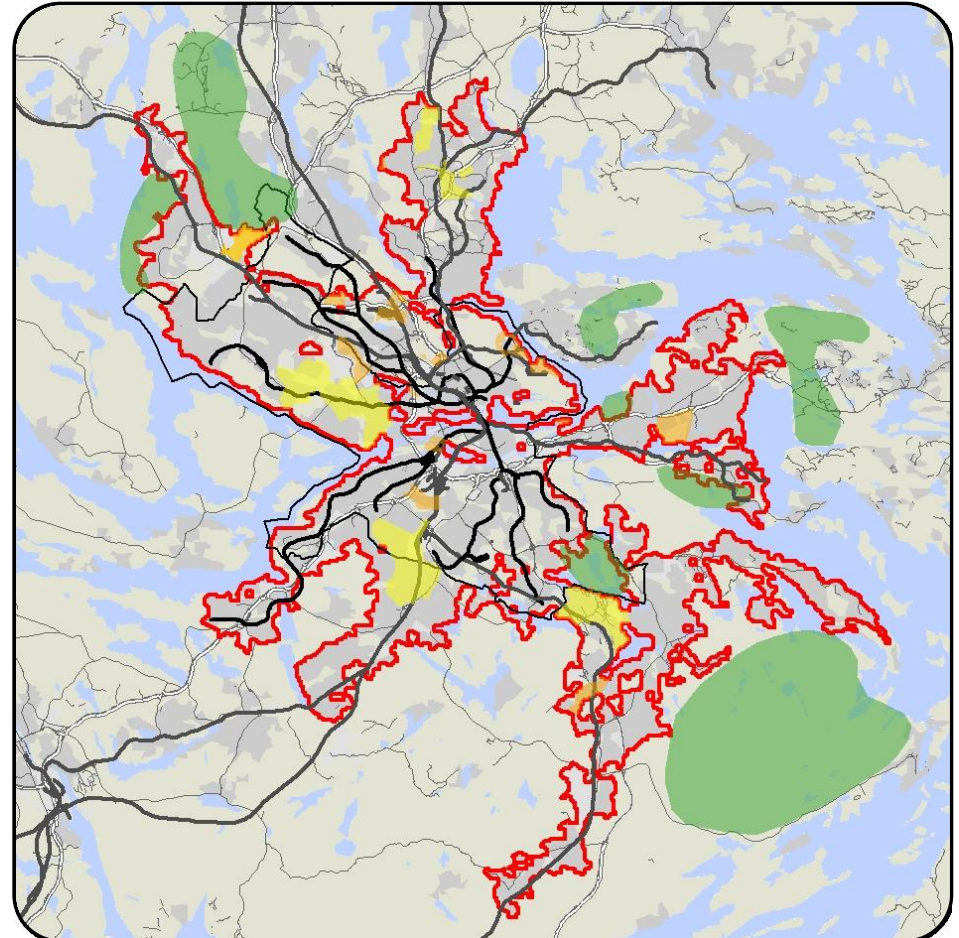
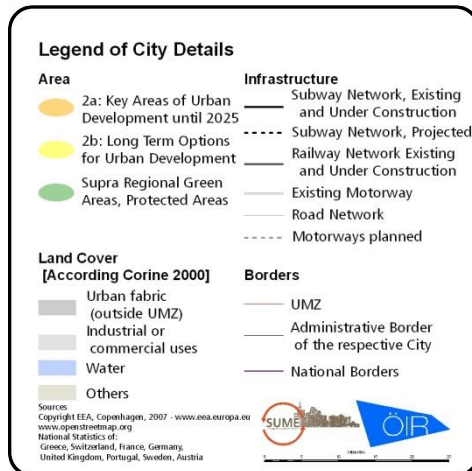


► Shift within urban fabric



Stockholm

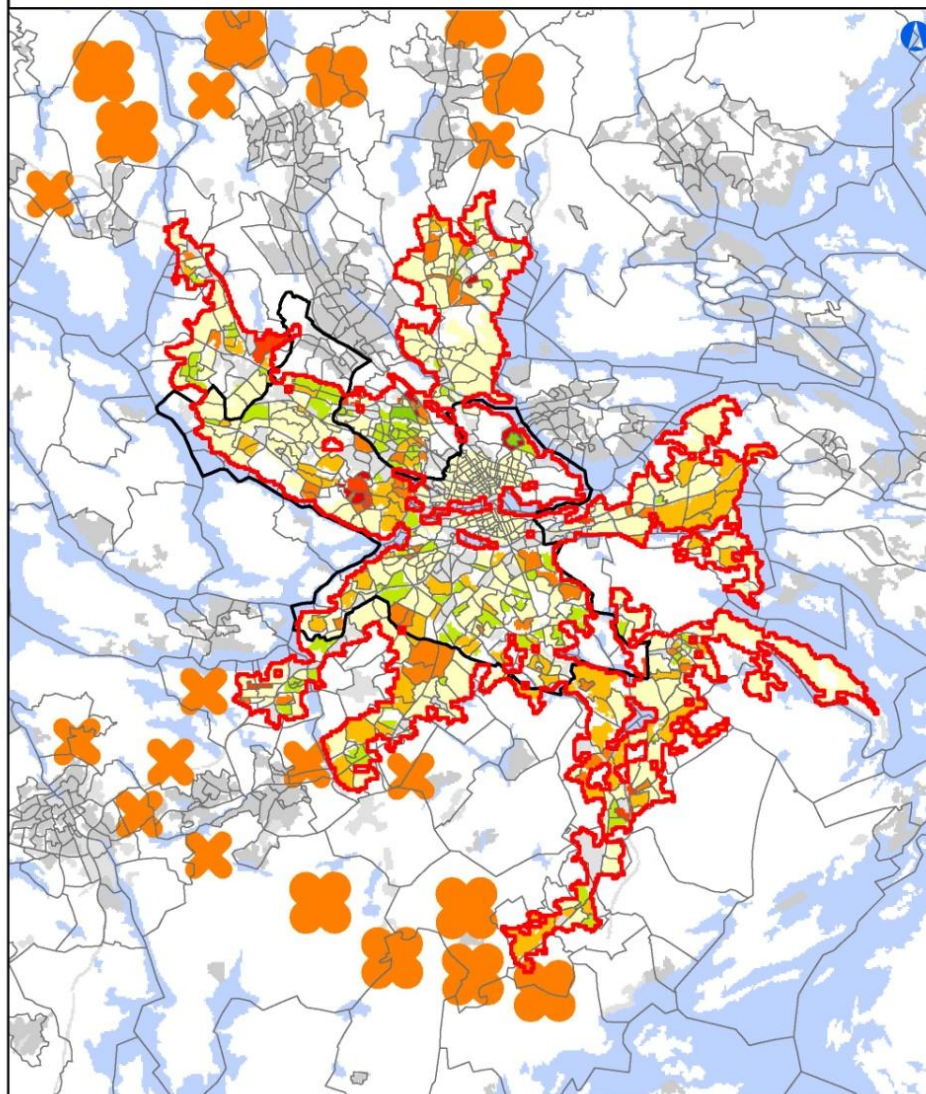
- ▶ 1.3 Mio. population
- ▶ → 2050: + 44 %
- ▶ Pop.+jobs/km2 in urban fabric: 5.278



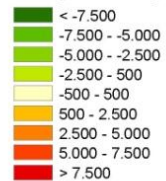
► **BASE**
scenario
2050:

**urban
fabric
+ 47%**

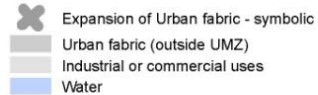
Stockholm: Change of population and workplace density 2001 - BASE



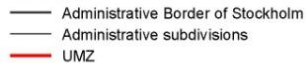
Change in density



Corine Land Cover 2000



Divisions

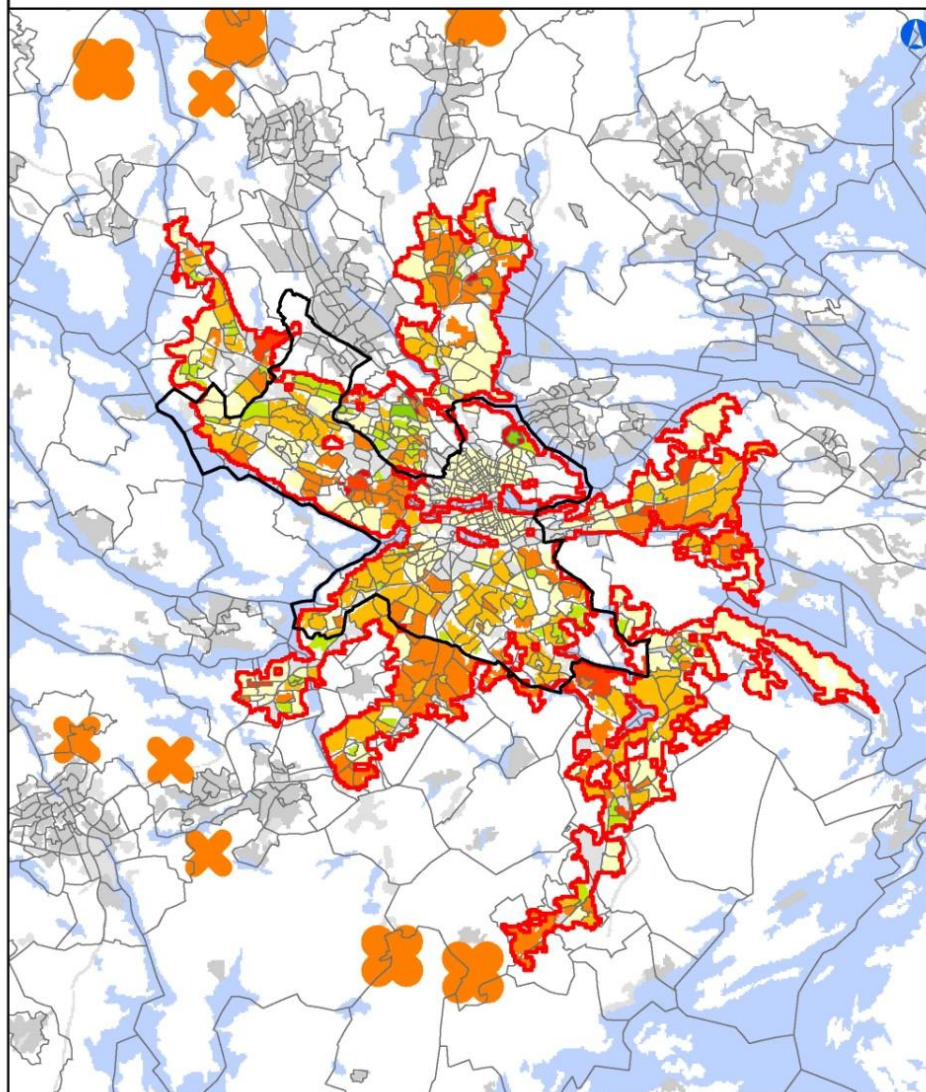


0 5 10 Kilometers

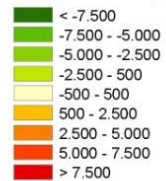
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www.openstreetmap.org
Statistik Austria

► **SUME**
scenario
2050:
**urban
fabric
+20%**

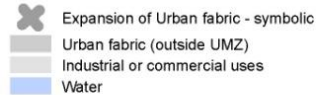
Stockholm: Change of population and workplace density 2001 - SUME



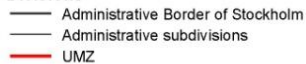
Change in density



Corine Land Cover 2000

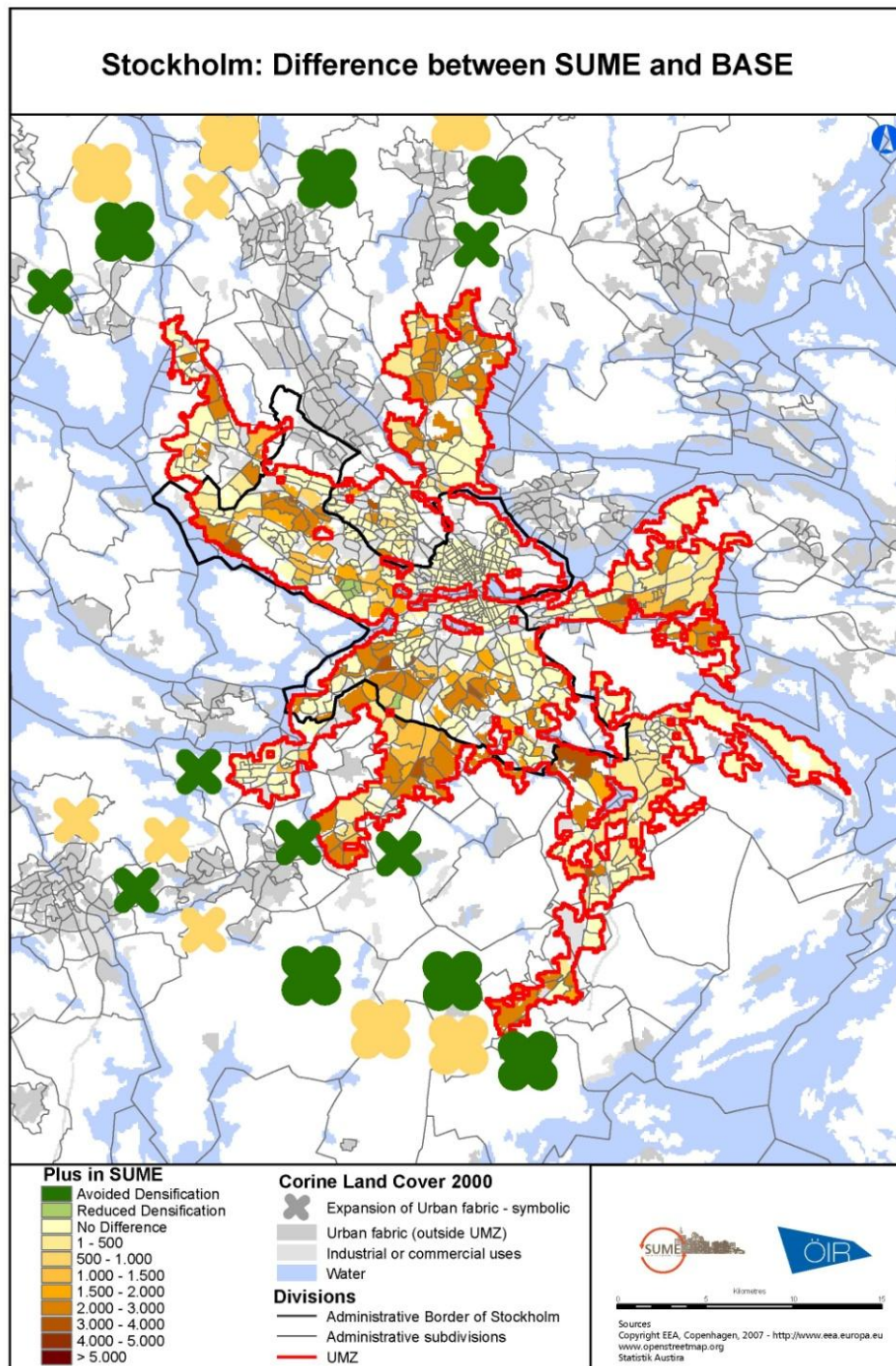


Divisions



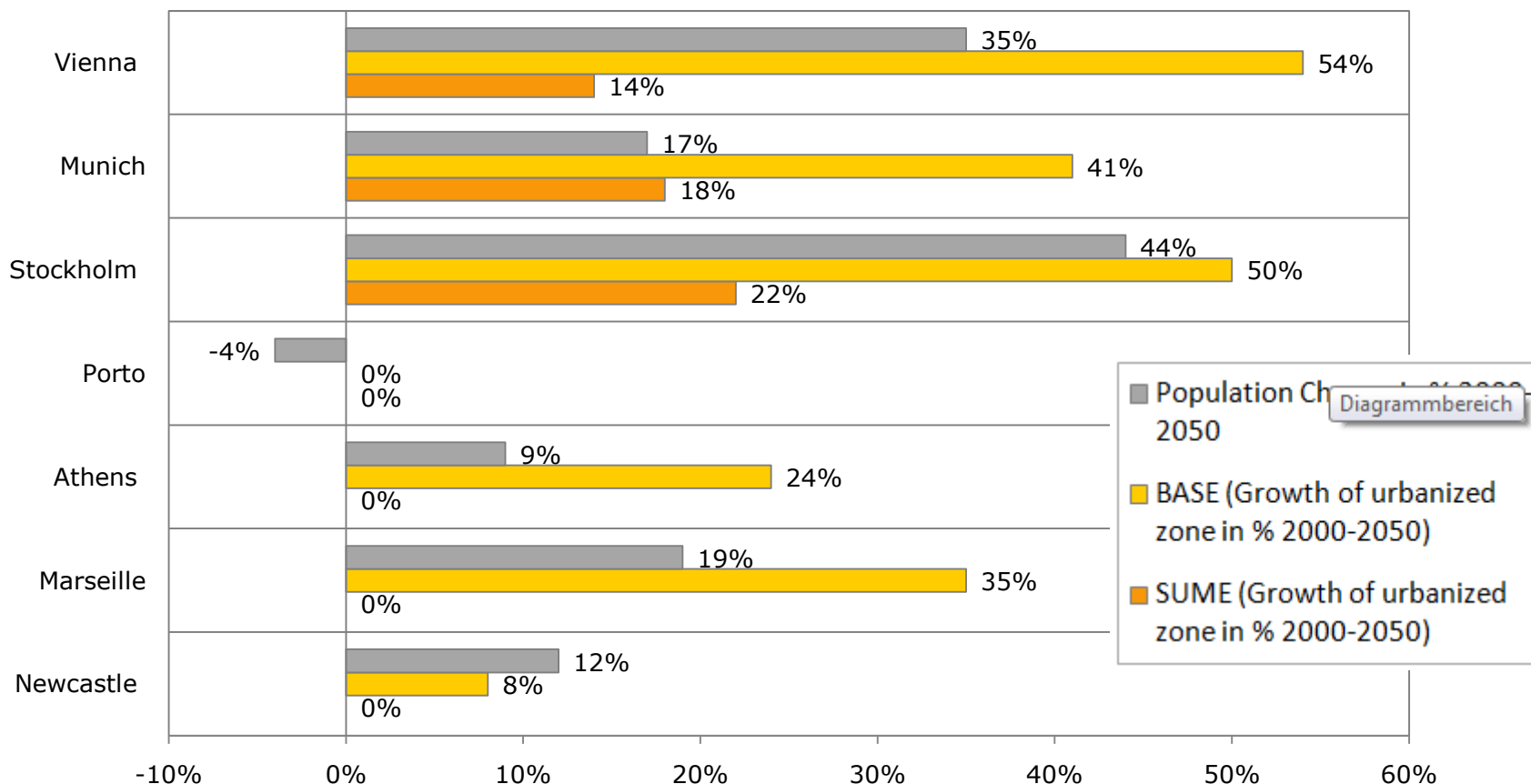
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www.openstreetmap.org
Statistik Austria

► **urban
fabric
expansion
reduced**



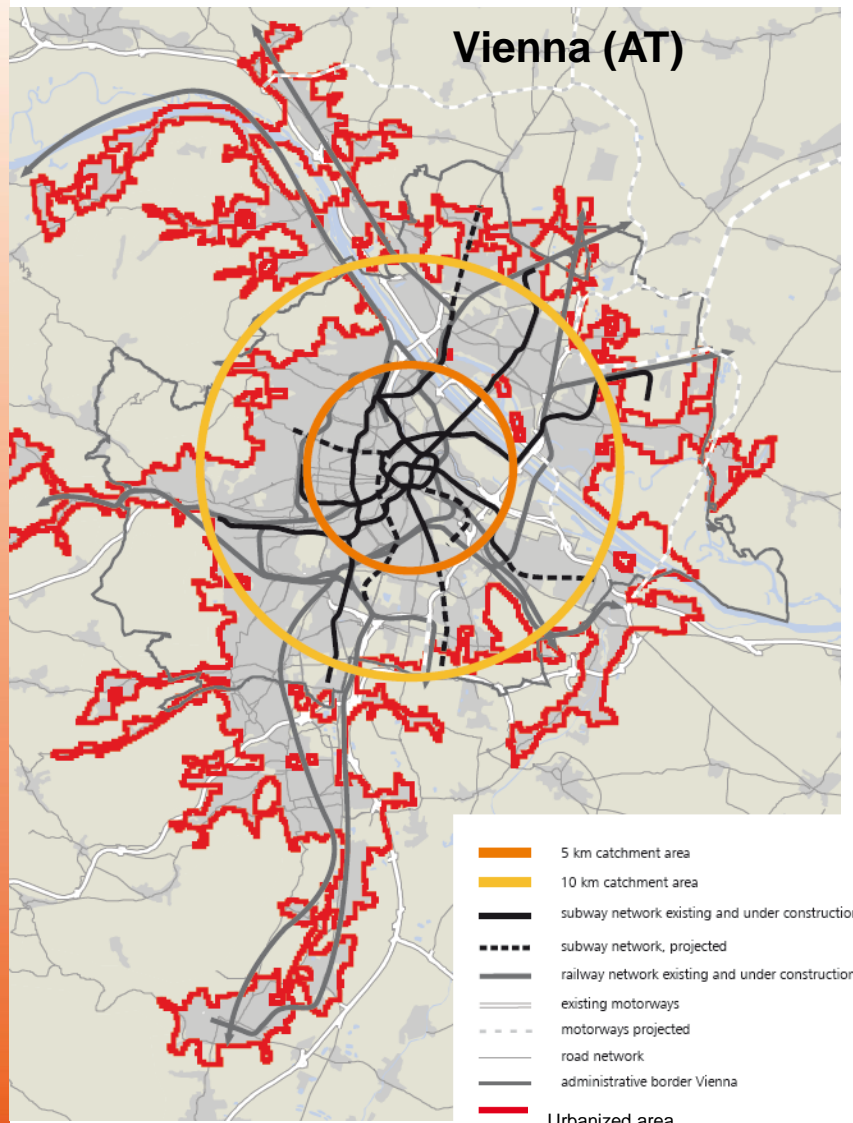
Urban spatial development: BASE and SUME scenarios

Scenarios BASE and SUME: Growth of “urbanized zones” 2000 – 2050



Urban form: Impact on transport (→ energy)

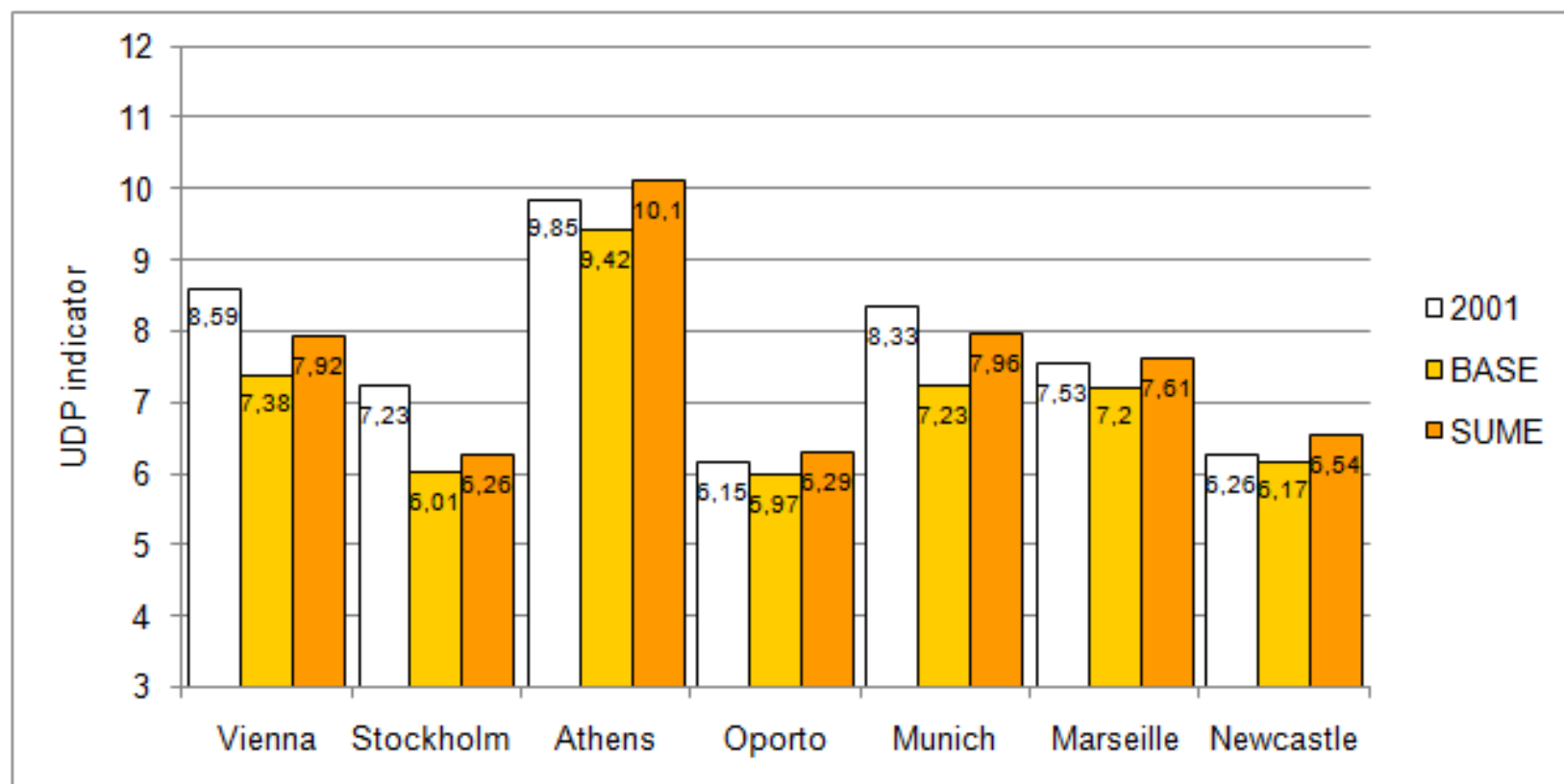
The second challenge: Transport



- The share of car use for daily trips is influenced by the accessibility of good quality public transport
- Growing cities tend to expand spatially, they loose in compactness and access to public transport lines
- But: Urban spatial development scenarios show the trends, SUME scenarios show the potential to improve accessibility

The potential to use public transportation, depending on spatial development 2000 - 2050: UDP indicator for BASE and SUME scenarios

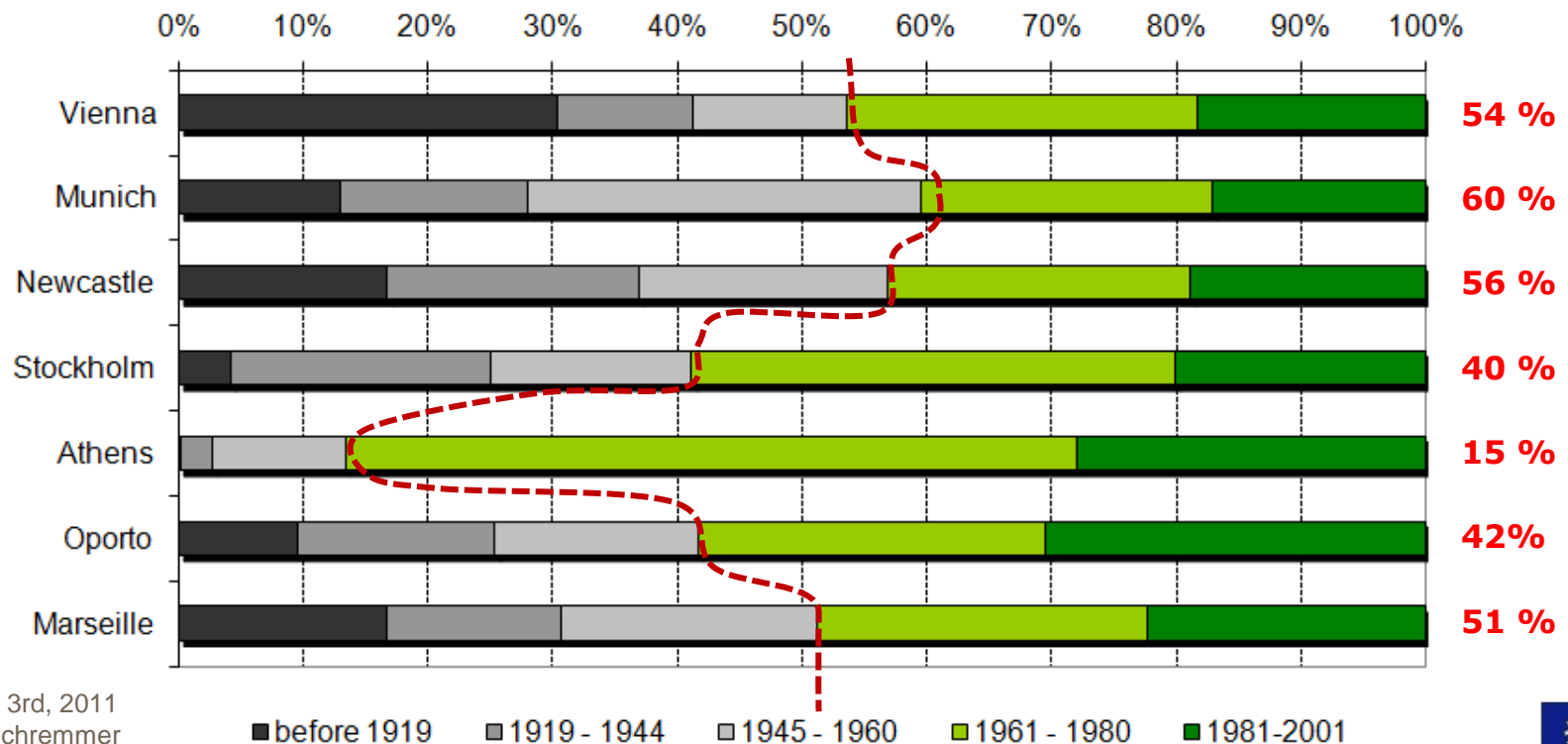
UDP = Integrated public transport potential indicator: 12 = max., 3 = min.



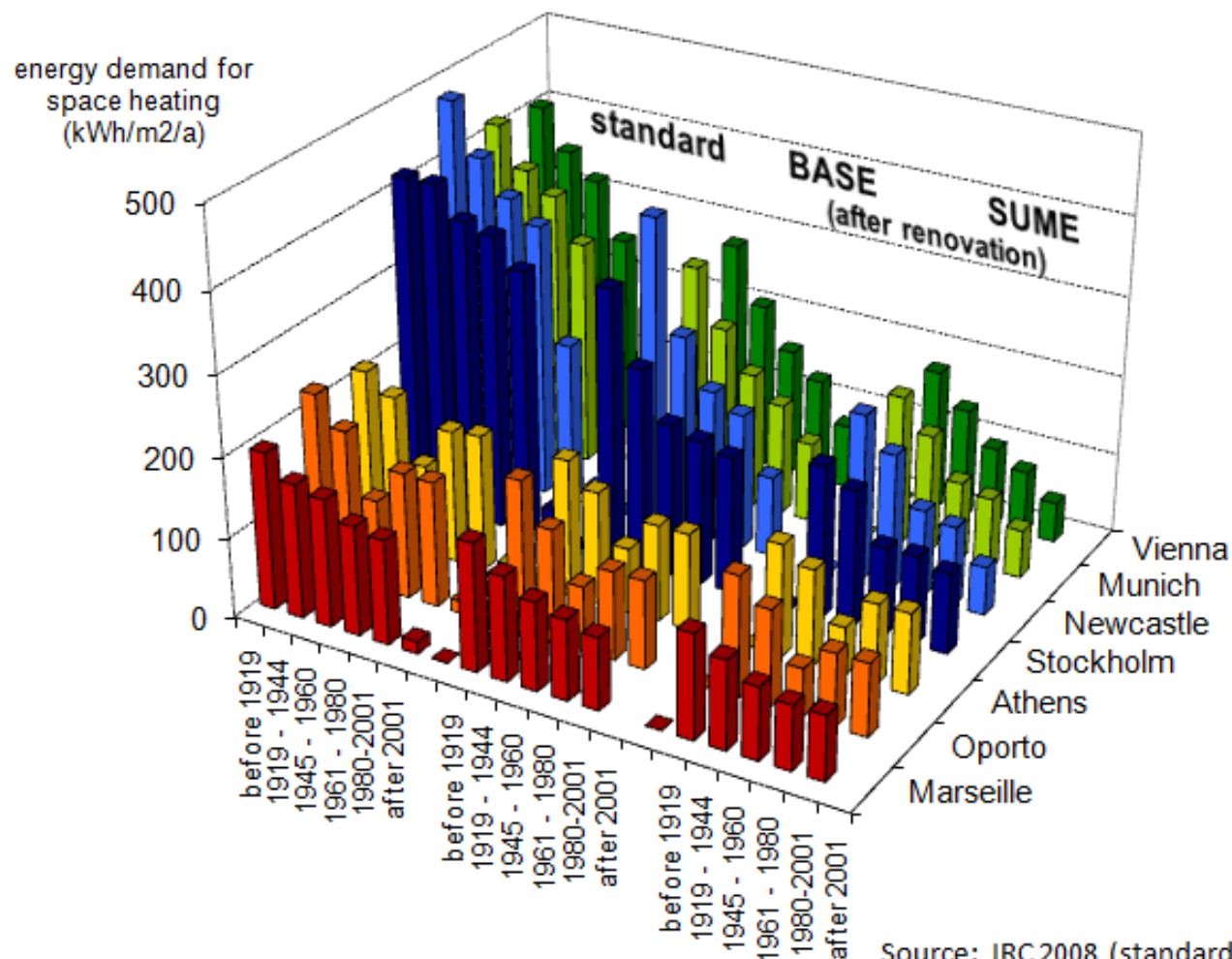
Urban building structures: Future options to reduce energy consumption for heating/cooling

Transforming urban building stock to reduce energy consumption

- Cities have different building age structures (and corresponding technical standards), which are decisive for the potential to reduce their energy consumption for heating
- Replacing after 80 years: → the option for putting in zero-energy housing until 2050 in % of total is :

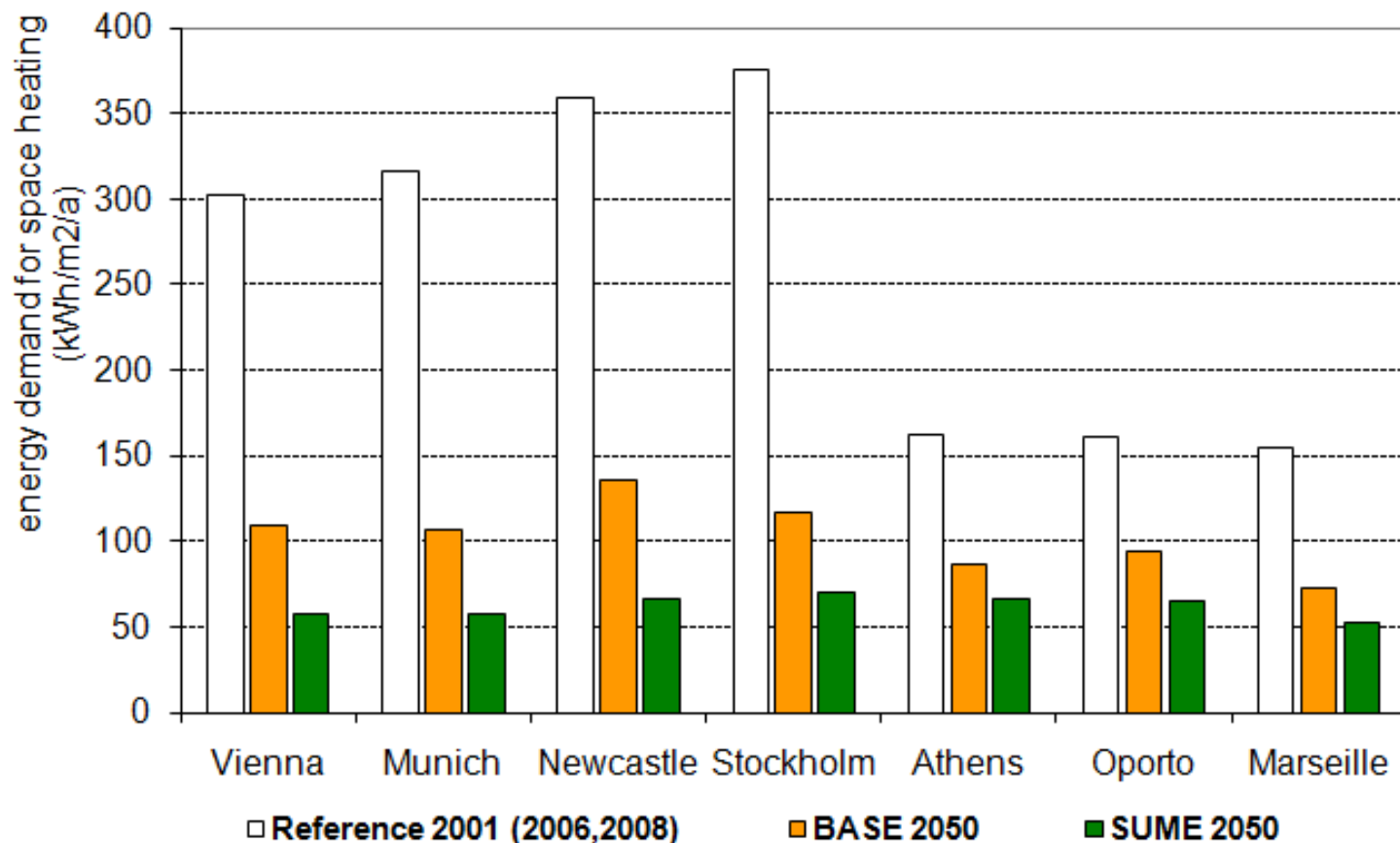


Building age – energy standards



Source: JRC 2008 (standard)
and own estimation

How energy demand for space heating can be reduced 2001 - 2050: Scenarios BASE and SUME



Urban development scenarios: Key findings and conclusions

Conclusions – European policy perspective

- Great diversity of starting situations and development perspectives
- BASE scenarios 2050 show urban spatial expansion faster than population dynamics, also in stagnant urban agglomerations with deteriorating access to public transport
- The SUME-scenario development principles show the large action space for cities over time, esp. in fast growing agglomerations - e.g. reducing of new urbanization in fast growing agglomerations up to 80%
- Major efforts in the urban agglomeration transport infrastructure will be needed, closely coupled with policies to spatially focus housing, residential and economic development → links between sectoral policies needed

For the urban agglomerations: Key strategy is re-development of urbanized areas

- Re-development of existing urbanized areas with excellent public transport is the key to reduce large-scale future expansion
- A new policy-set beyond green-field and brown-field development is needed:
 - 1 Building and energy-oriented renovation strategies +
 - 2 attractiveness: better green area and open space quality of inner-city neighborhoods +
 - 3 densification strategies and mobilizing building land in areas with lower densities and good access to public transport
- Large scale development-projects are to form new centers and nodes of transport as strategy to improve the overall urban diversity pattern (mix of uses, services) and give an impulse to densification

Inner-city densification/ old railway station I



May 3rd, 2011
C. Schremmer
SUME coordinator, ÖIR

Inner-city densification/ old railway station II



An aerial photograph of a city park area. In the center-left, there is a large green sports field with a curved running track and a white water tower. To the right of the field is a swimming pool complex with several pools and a large building. The park is surrounded by dense green trees and various urban buildings, including residential houses and larger apartment blocks. The text "Urban re-densification in areas of good transport service" is overlaid in yellow at the top left.

Urban re-densification in areas of good transport service

May 3rd, 2011
C. Schremmer
SUME coordinator, ÖIR

Thank you.