Integrated Modelling in Europe with PROPOLIS

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Portland, Oregon, 15-17 November 2005

PROPOLIS

PROPOLIS (2000-2004)

PROPOLIS (***P***lanning and ***R***esearch ***o***f ***Po***licies for ***L***and Use and Transport for ***I***ncreasing Urban ***S***ustainability) was a project in the Key Action *City of Tomorrow and Cultural Heritage* of the 5th Framework Programme of the European Commission.

Partners

LT Consultants, Helsinki (Co-ordinator)

Institute of Spatial Planning, Dortmund

Spiekermann & Wegener, Dortmund

University College London, London

Marcial Echenique & Partners, Cambridge

Trasporti e Territorio, Milan

Marcial Echenique y Compañia, Bilbao

STRATEC, Brussels

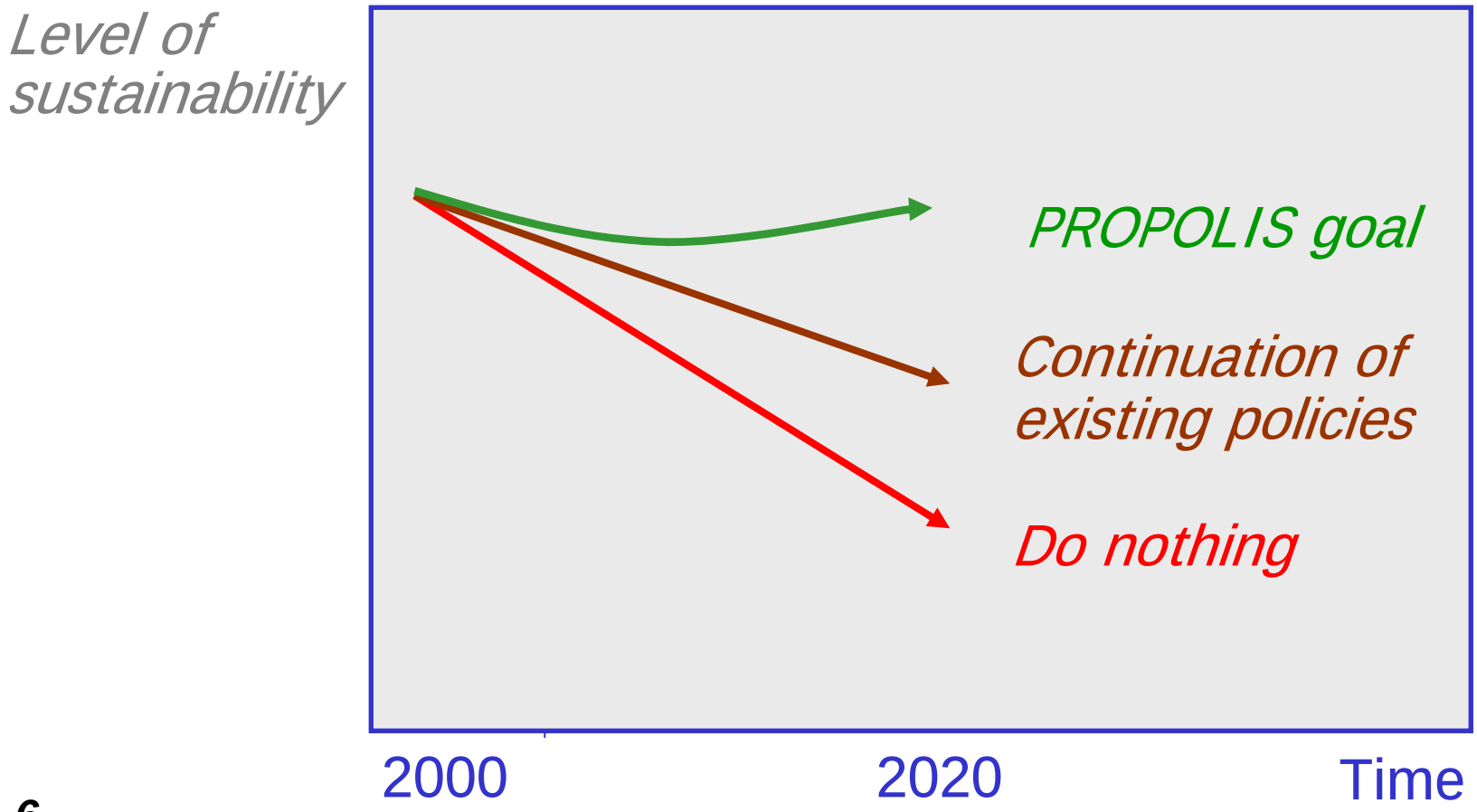
Objectives

The ***objectives*** of **PROPOLIS** were

- to ***research***, ***develop*** and ***test integrated land use and transport policies***, ***tools*** and comprehensive ***assessment methodologies*** ...

- in order to ***define*** sustainable long-term ***urban strategies*** and to ***demonstrate their effects*** in European cities.

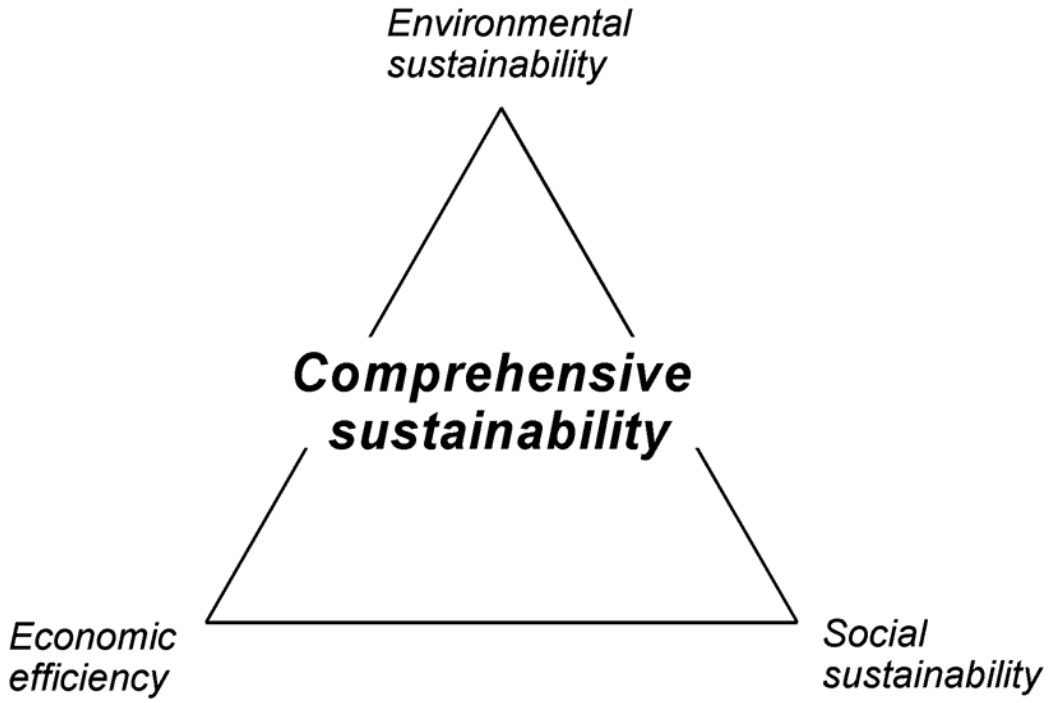
What are the current trends -
What do we try to achieve?
What are the instruments to reach the goal?



Sustainability

In **PROPOLIS**, sustainable development consists of three interconnected components:

- ***ecological*** or environmental sustainability
- ***social*** or human sustainability
- ***economic*** efficiency



Sustainability

Indicators are used to measure the three dimensions of sustainability.

Conditions for selecting indicators:

- ***Relevance***
- ***Policy sensitiveness***
- ***Predictability***, i.e. ability of each model to produce the indicator values
- ***Follow the impact chain***

Sustainability Indicators

Environmental	***Global climate change***
	Air pollution
	Consumption of natural resources
	Environmental quality
Social	***Health***
	Equity
	Opportunities
	Accessibility and traffic
Economic	***Total net benefit from transport***

Environmental Indicators

Global climate change	Greenhouse gases from transport
Air pollution	Acidifying gases from transport Volatile organic compounds from transport
Natural resources	Consumption of mineral oil products Land coverage Need for additional new construction
Environmental quality	Fragmentation of open space Quality of open space

Social Indicators

Health	Exposure to PM from transport at housing Exposure to NO_2 at housing Exposure to traffic noise Traffic fatalities Traffic injuries
Equity	Justice of distribution of economic benefits Justice of exposure to PM Justice of exposure to NO_2 Justice of exposure to noise Segregation
Opportunities	Housing standard Vitality of city centre Vitality of surrounding region Productivity gain from land use
Accessibility and traffic	Total time spent in traffic LOS of public transport and slow modes Accessibility to city centre Accessibility to services Accessibility to open space

Economic Indicators

Total net benefit from transport

Transport investment costs
Transport user benefits
Transport operator benefits
Government benefits from transport
Transport external accident costs
Transport external emissions costs
Transport external greenhouse gases costs
Transport external noise costs

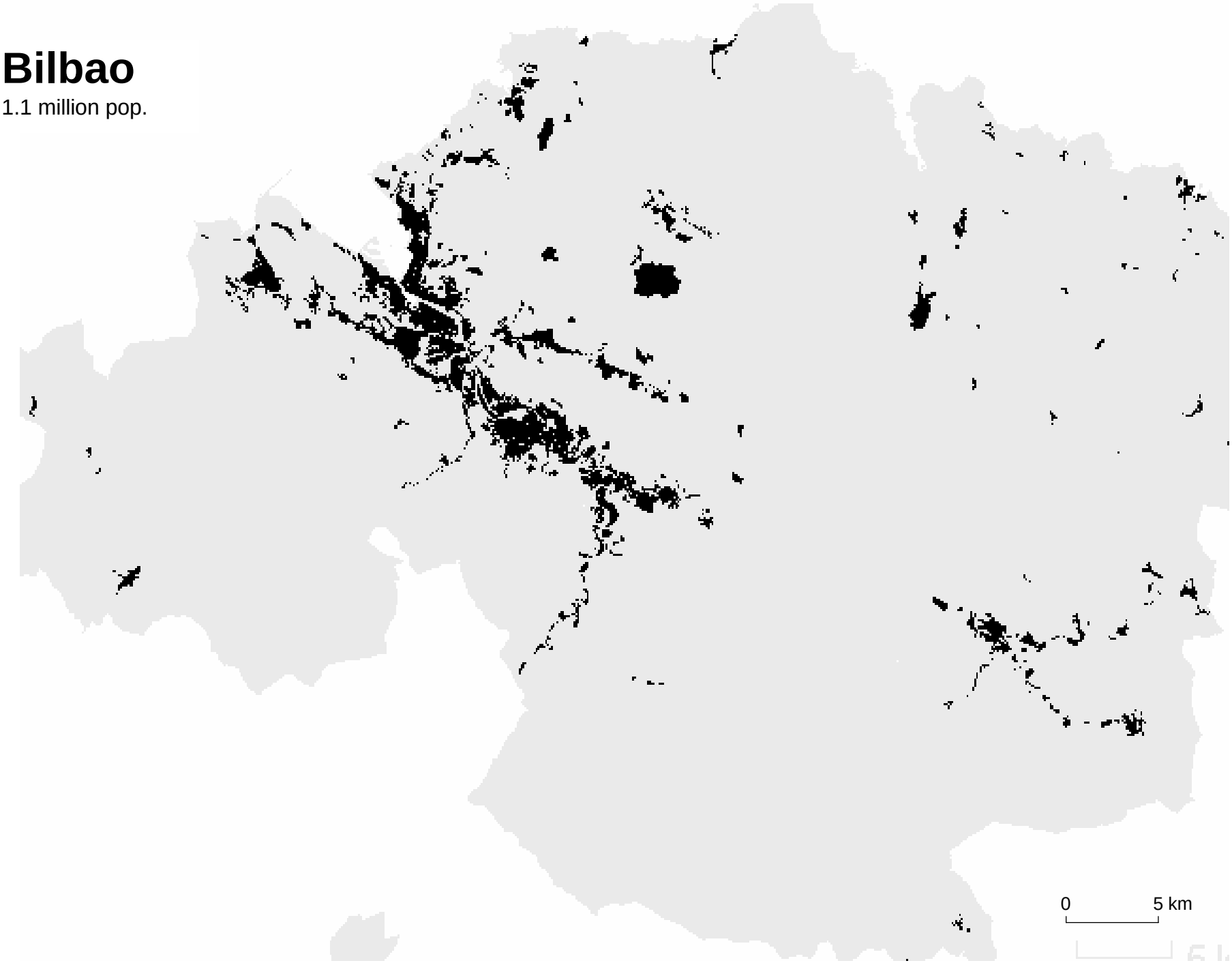
Case Cities

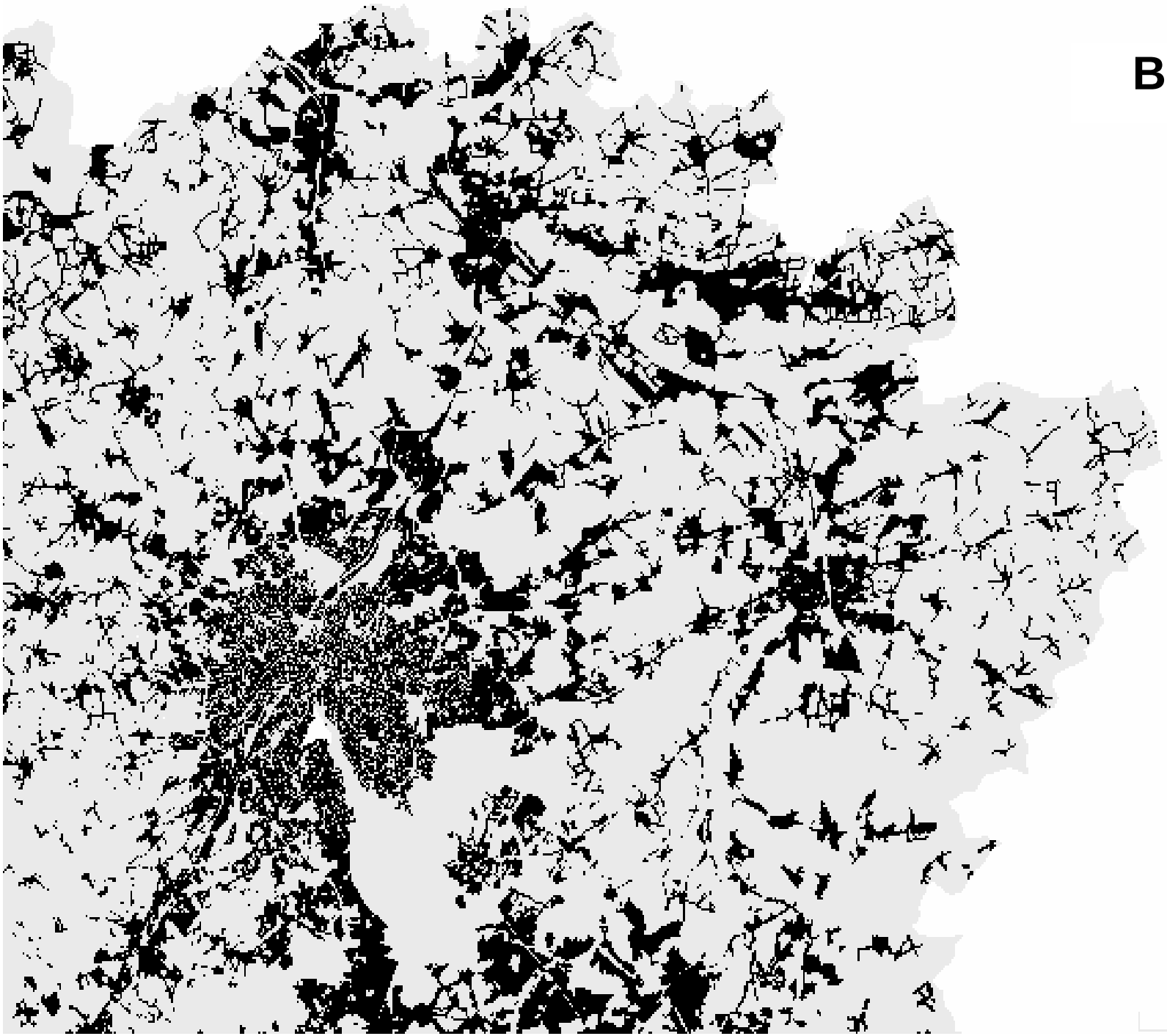
Case cities


Helsinki
Inverness
Dortmund
Brussels
Vicenza
Bilbao
Naples

Bilbao

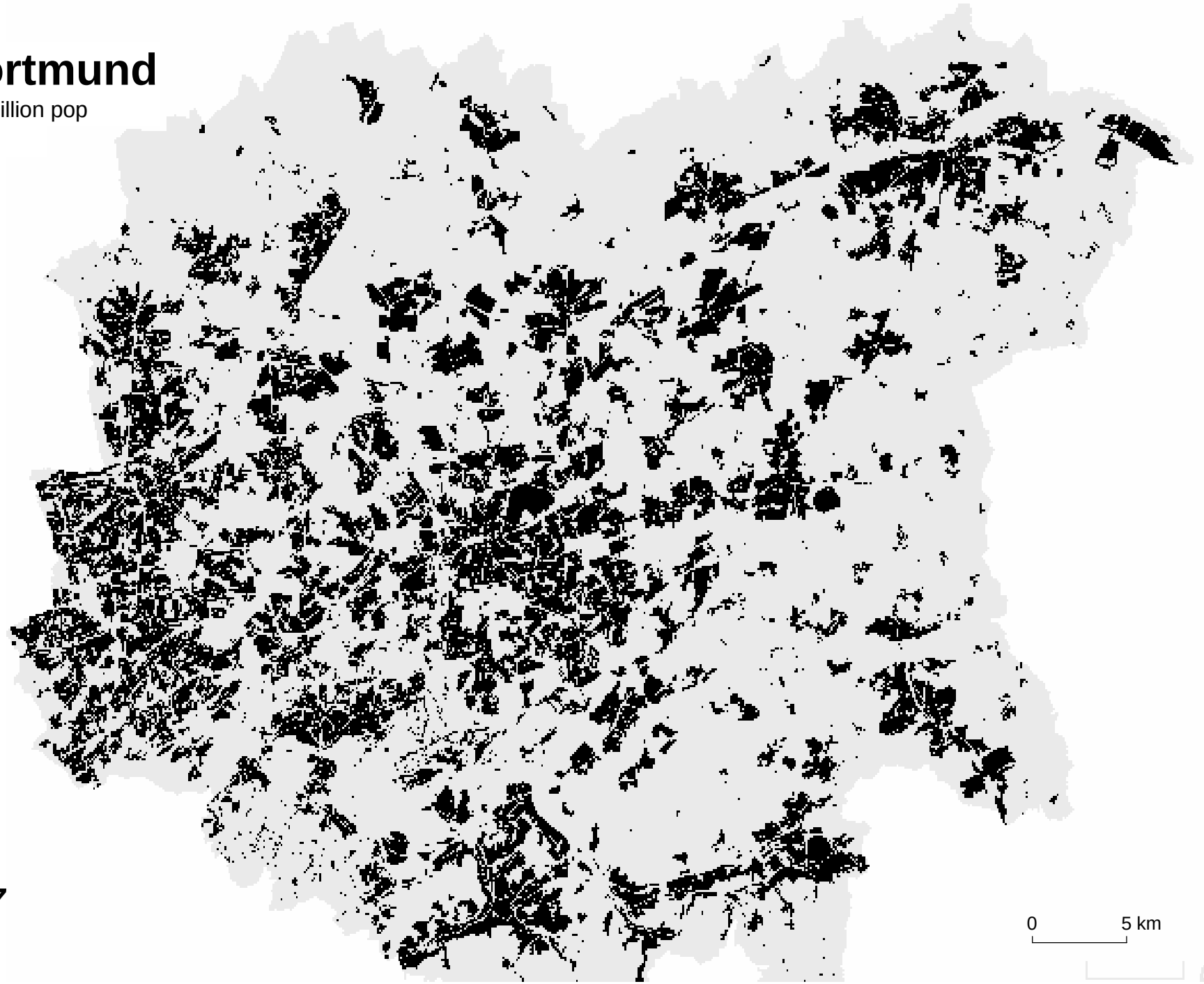
1.1 million pop.




Brussels
2.9 million pop
0
5 km

Dortmund

2.6 million pop



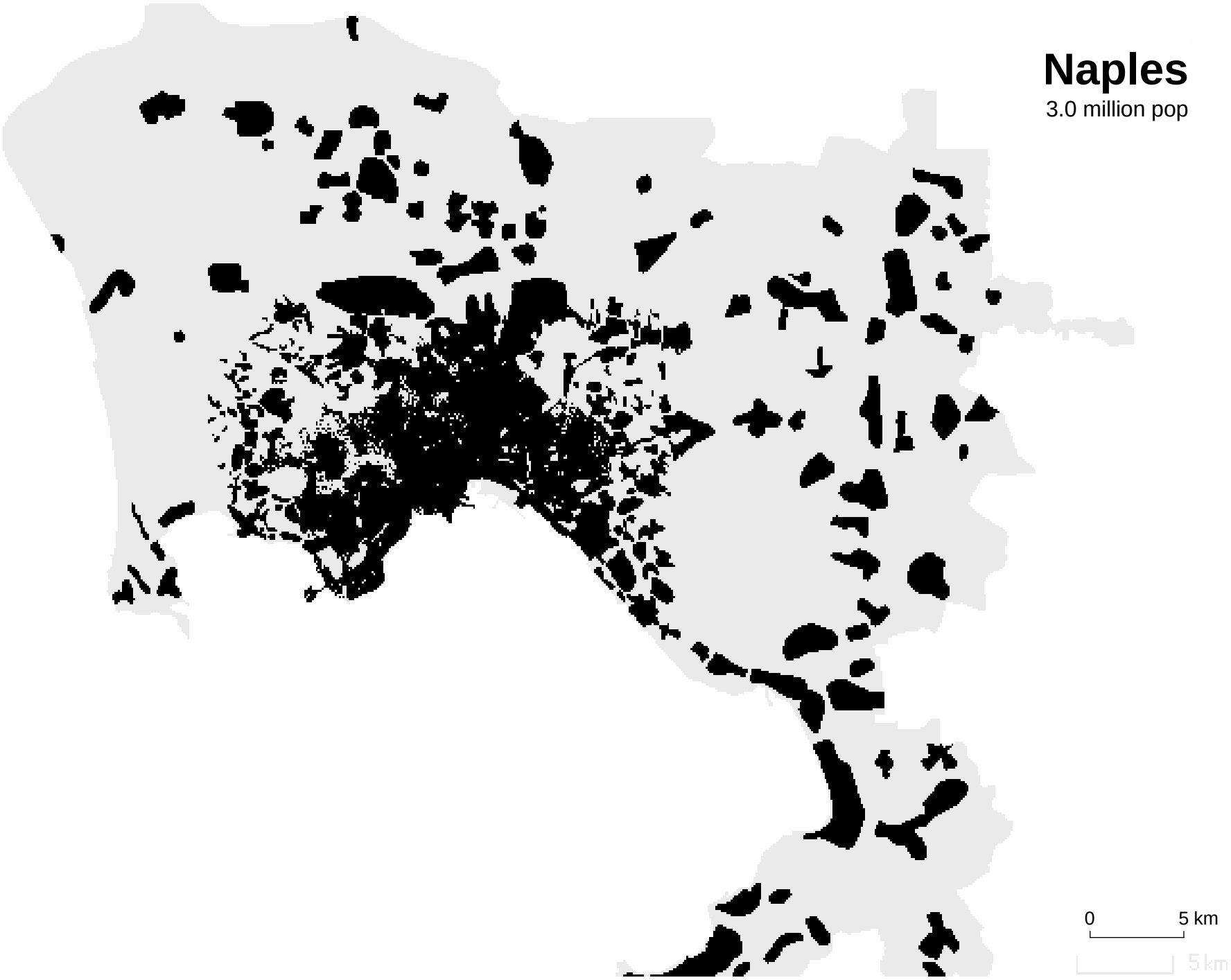
Helsinki

0.9 million pop

18

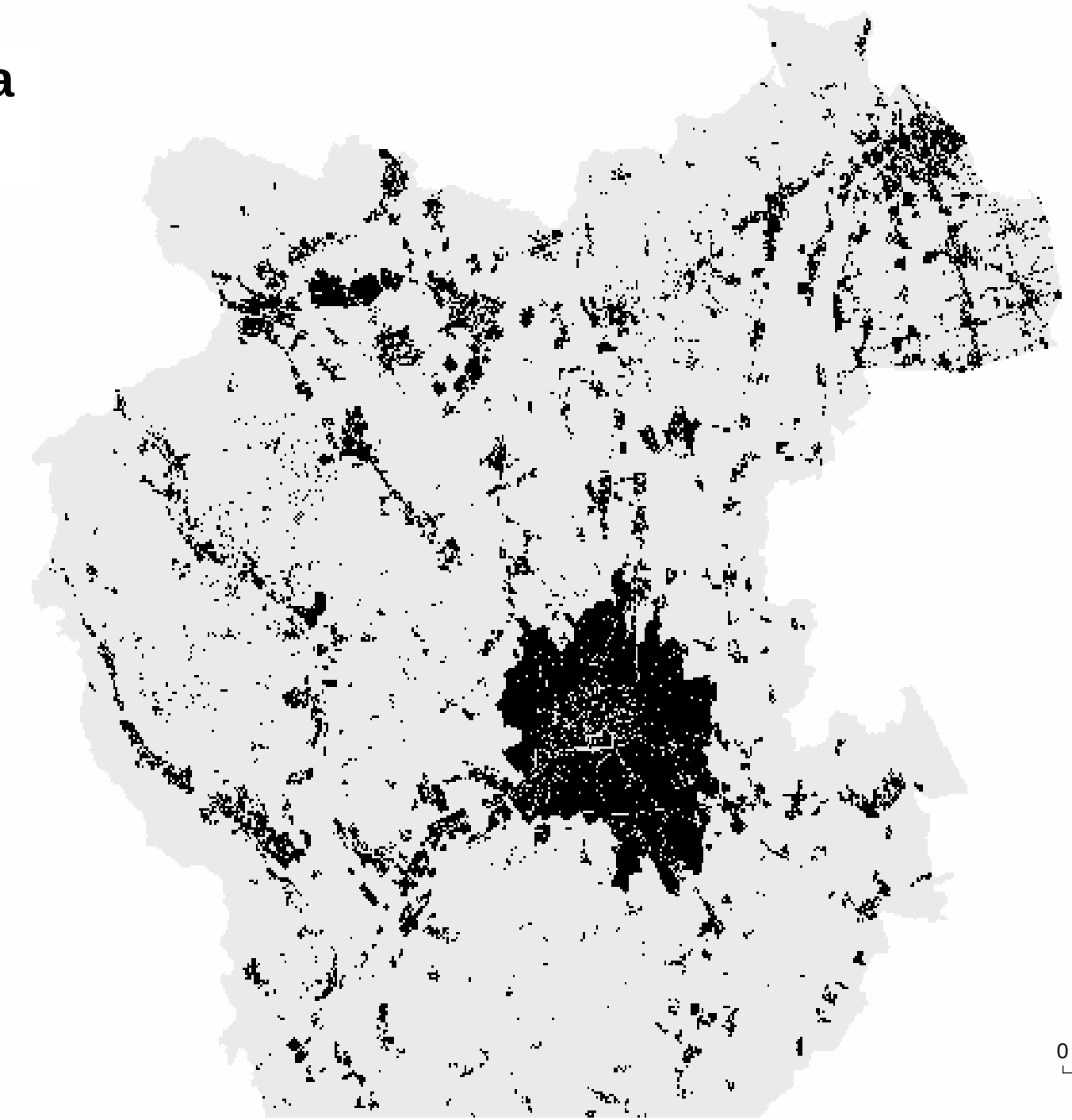
0 5 km


Inverness
0.1 million pop
0
5 km

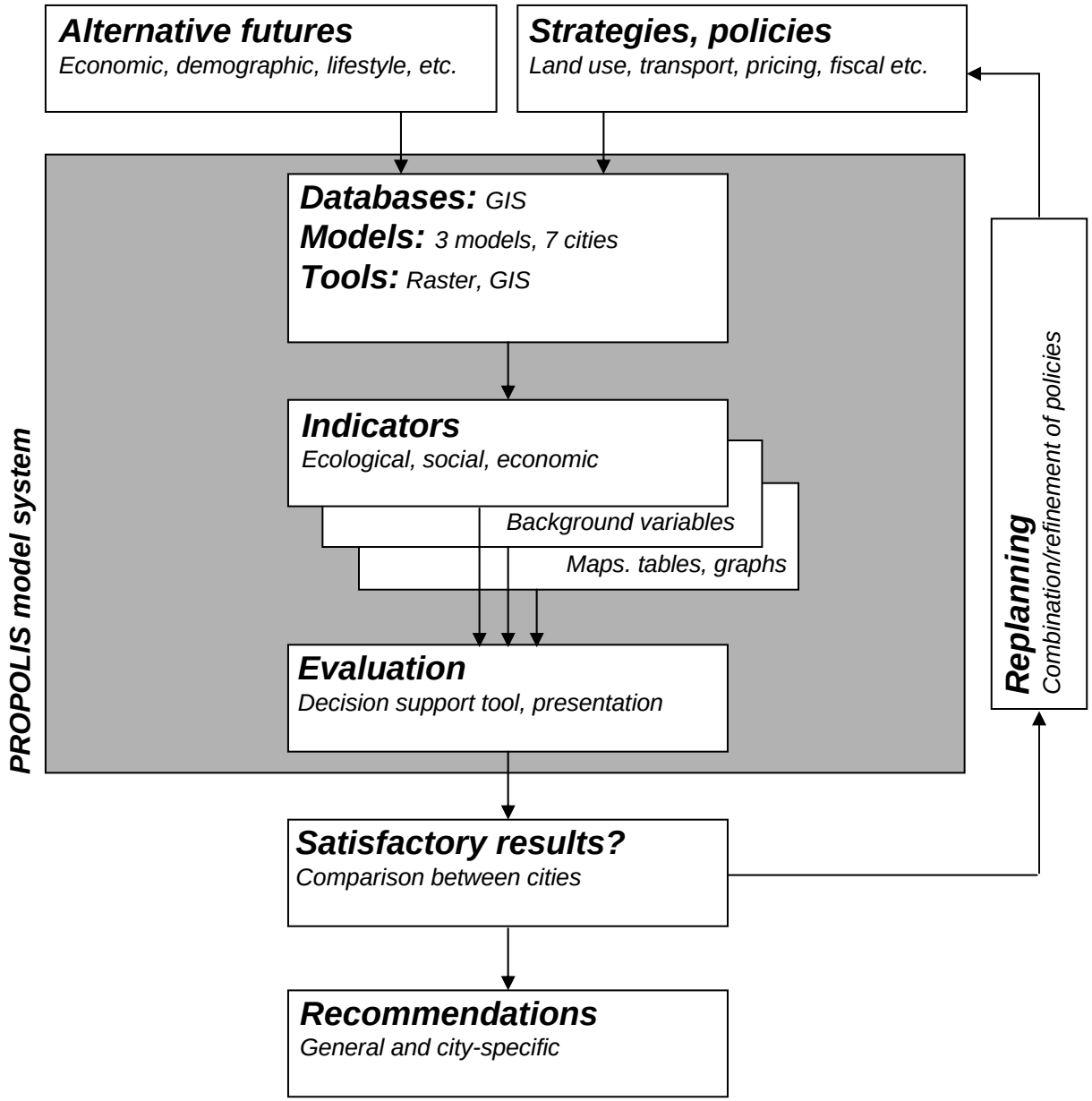

Naples
3.0 million pop
0
5 km
5 km

Vicenza

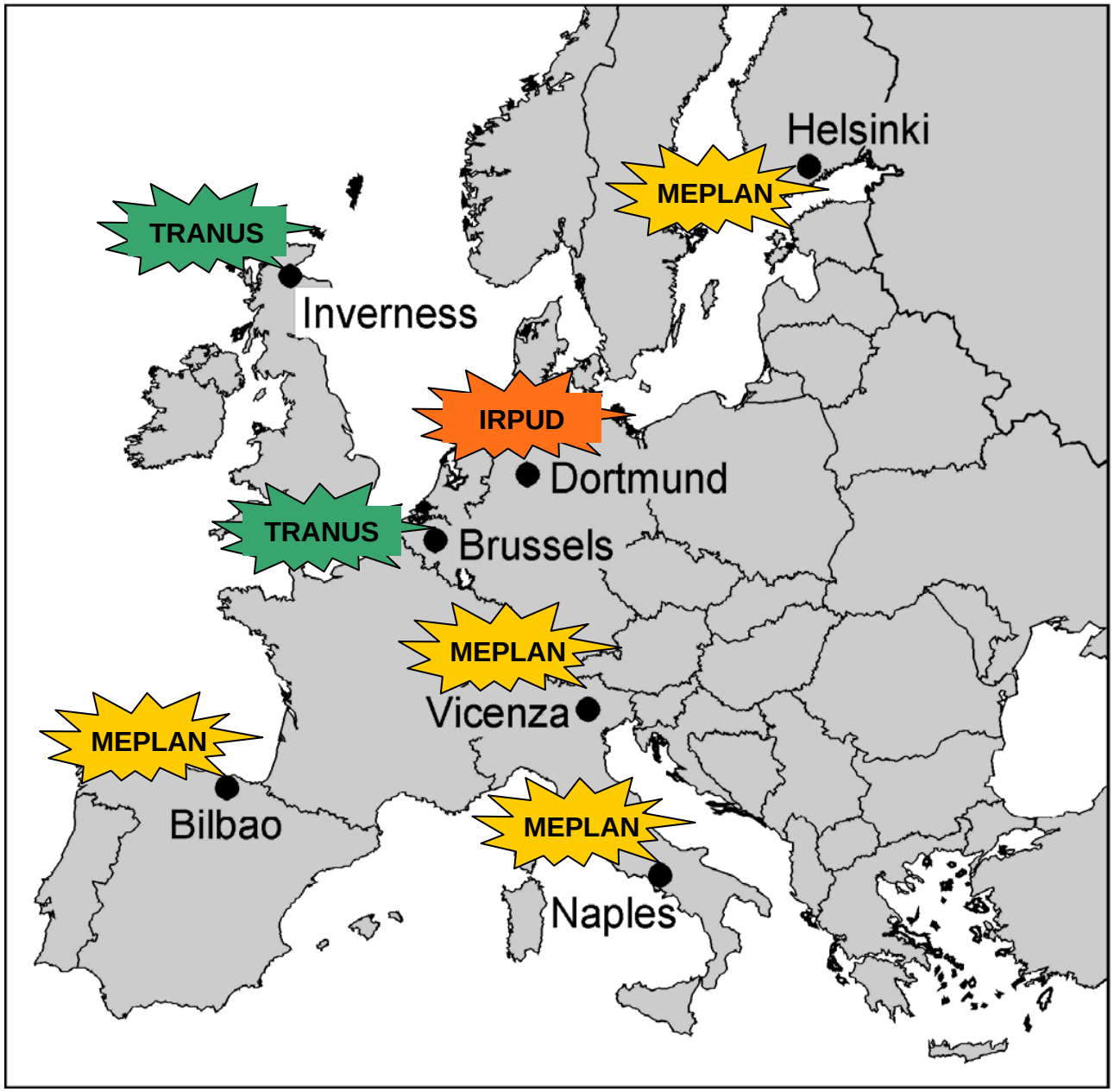
0.8 million pop



PROPOLIS approach

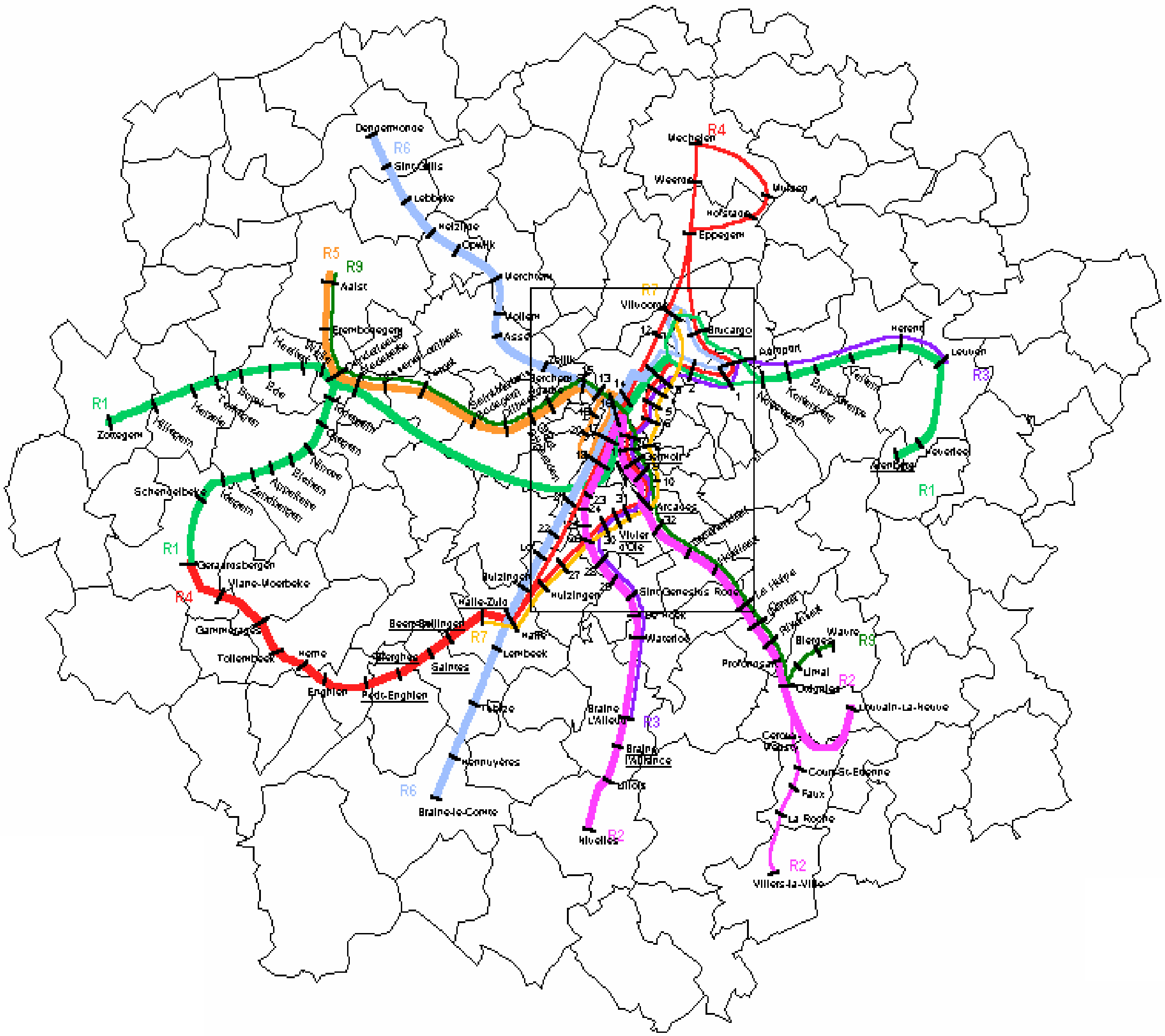


Models in case cities

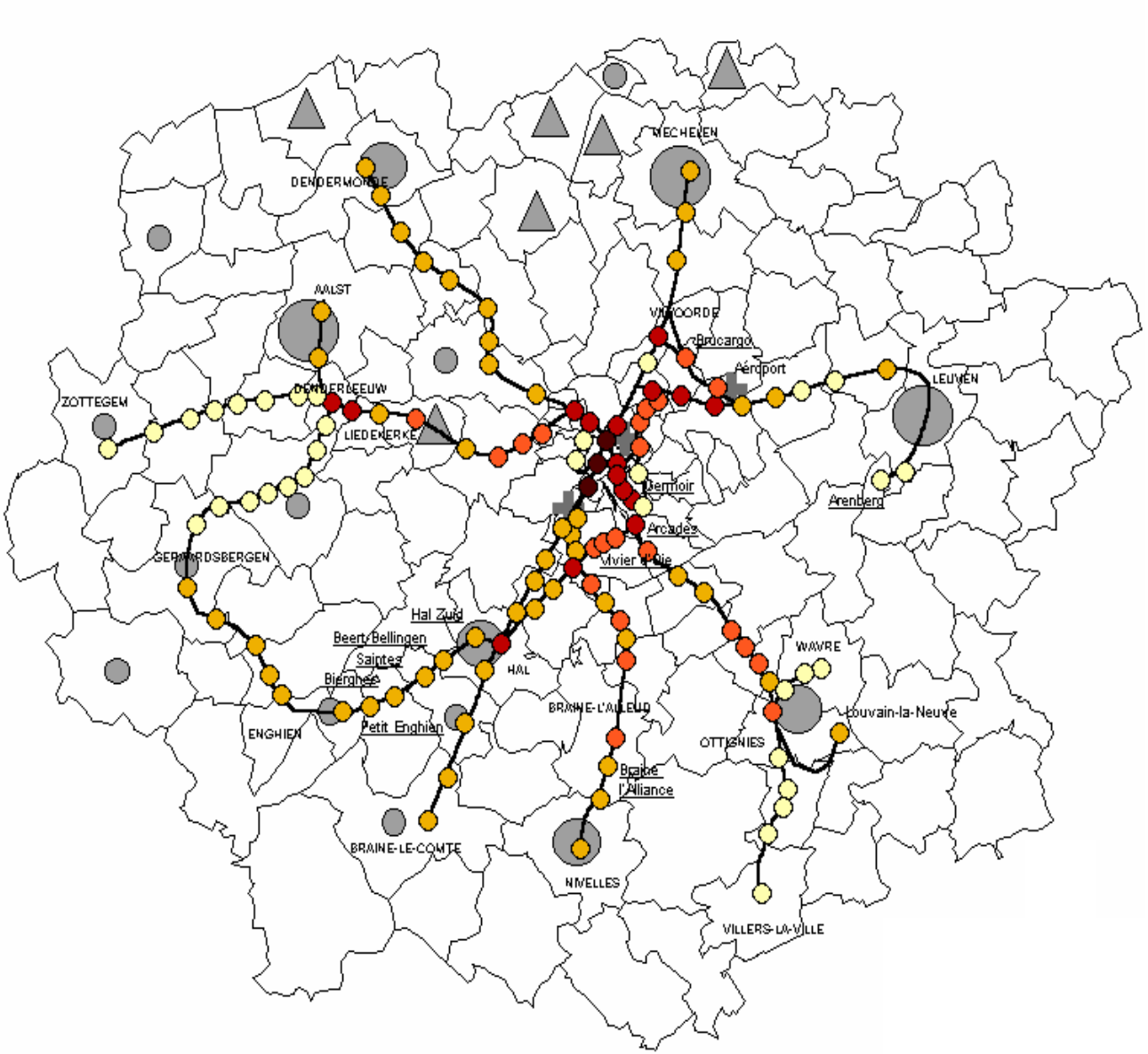


Brussels

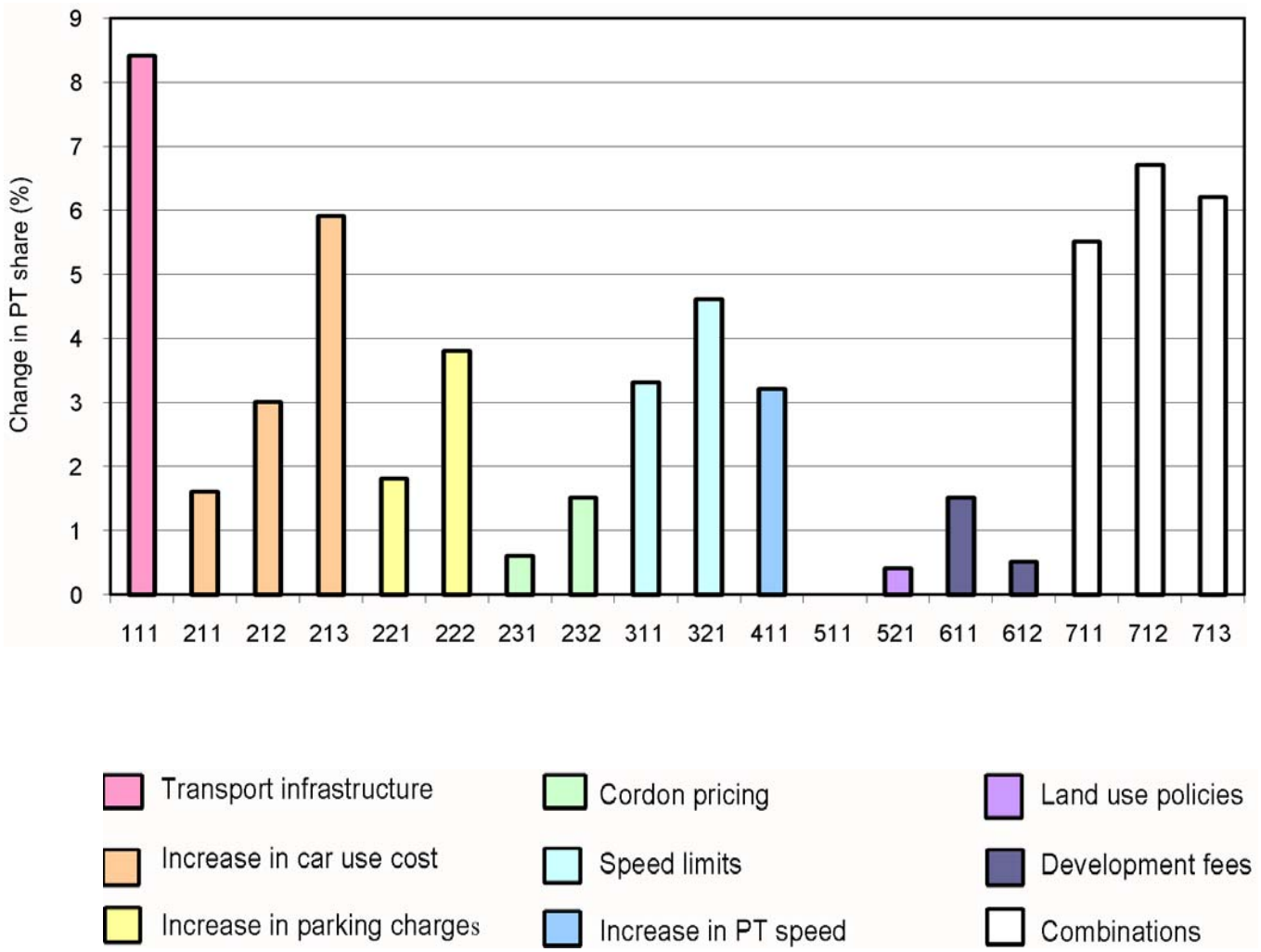
Brussels RER



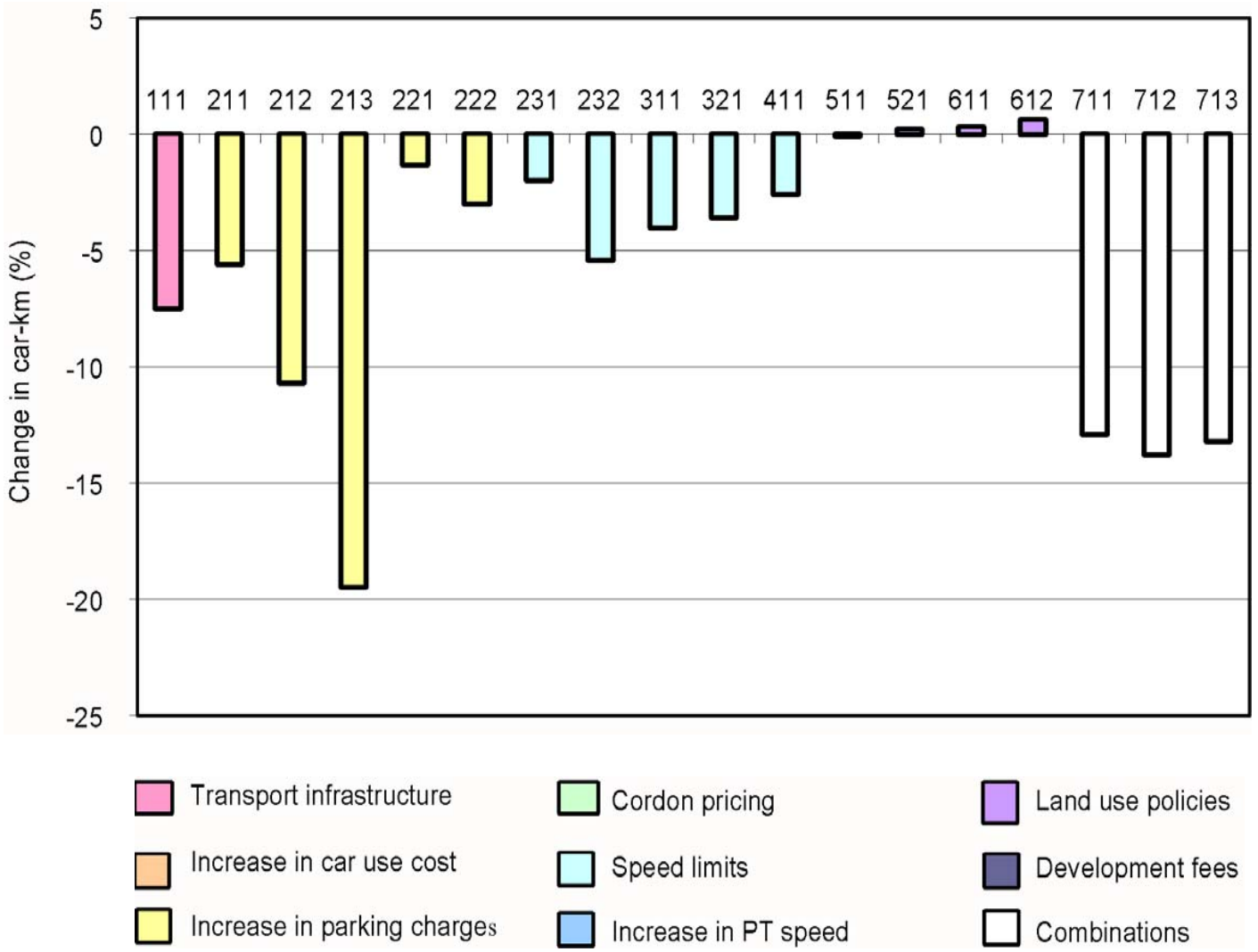
Brussels RER



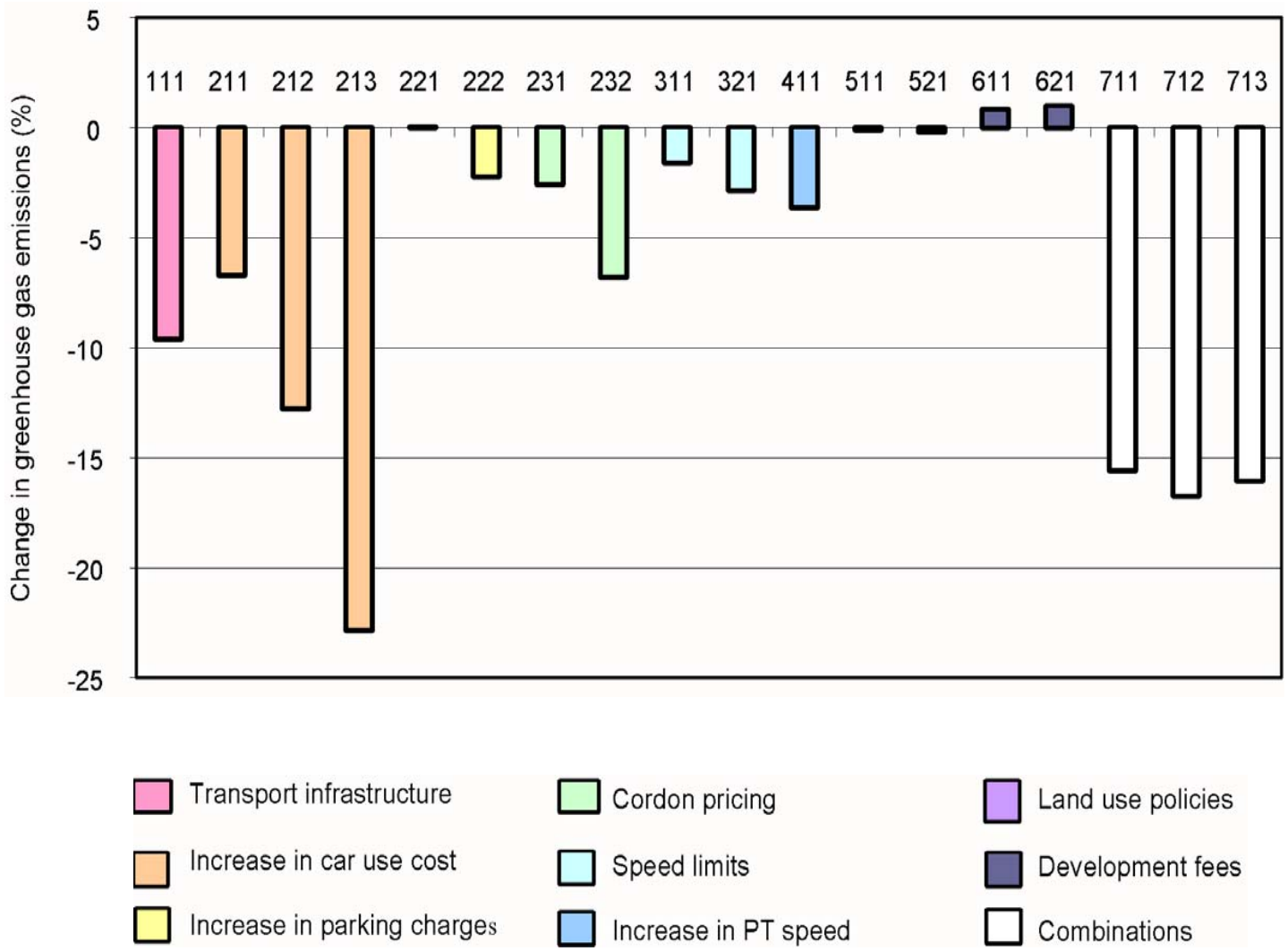
Brussels RER: change in public transport share



Brussels RER: change in car-km

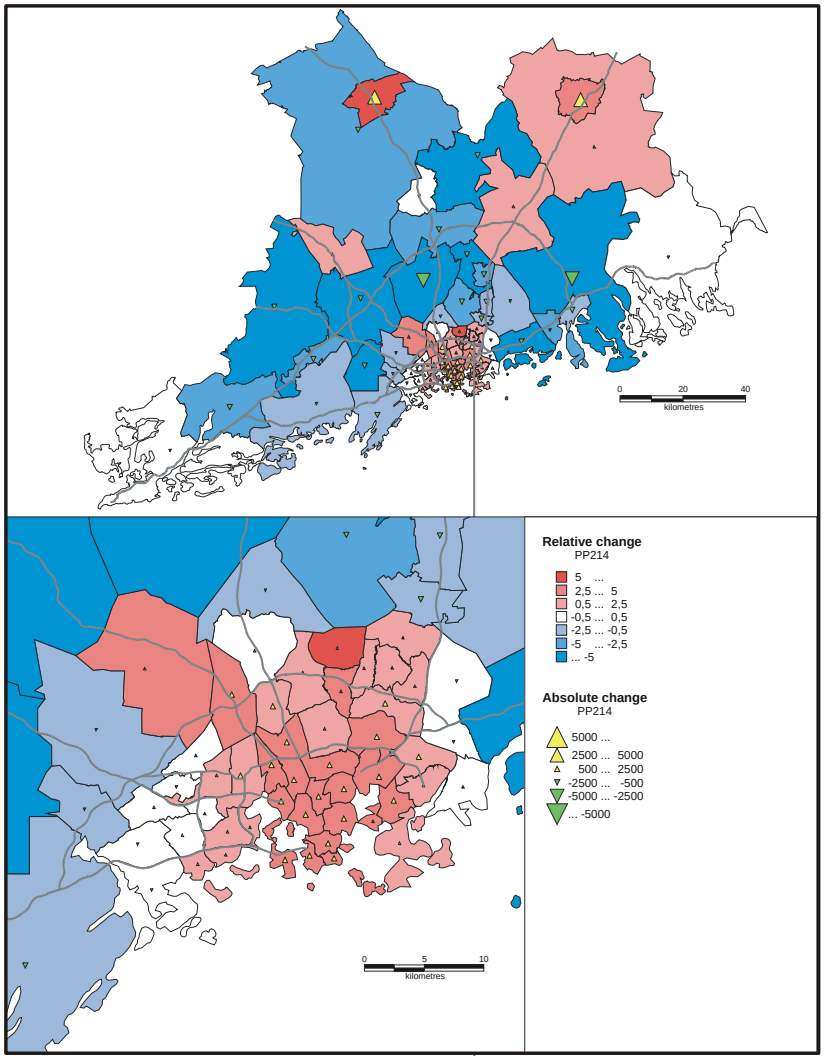


Brussels RER: change in greenhouse gas emissions

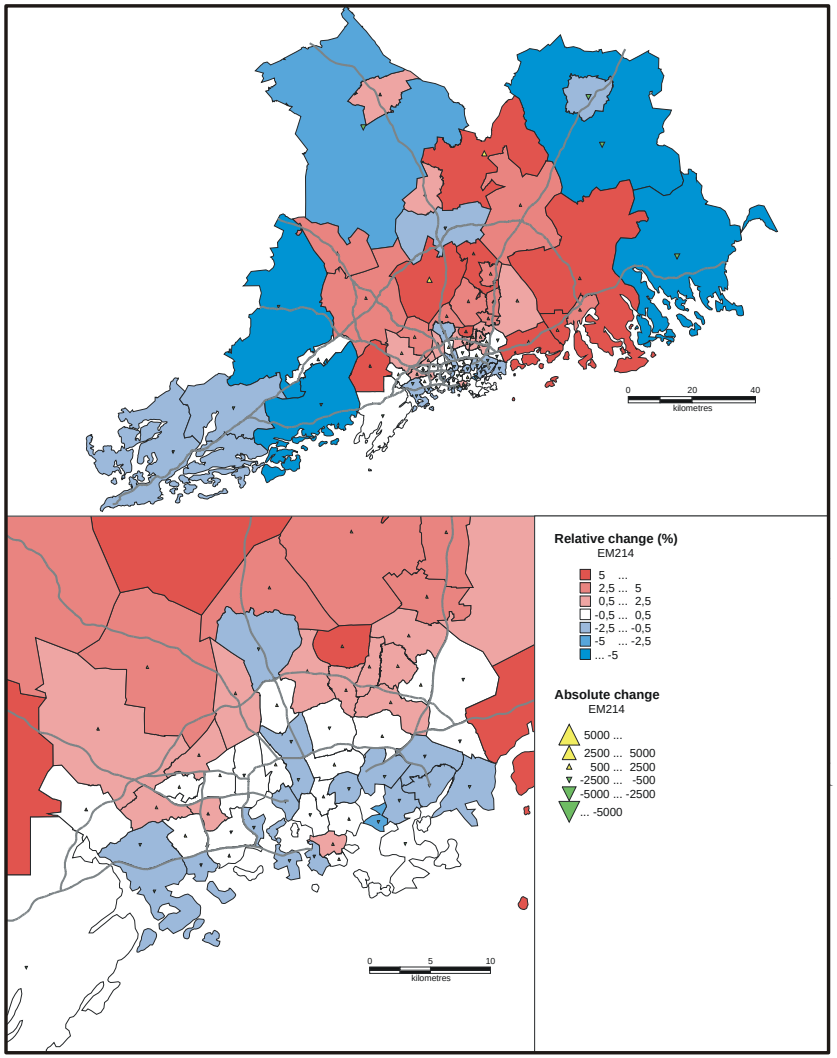


Helsinki

Helsinki: Car Operating Costs +75%

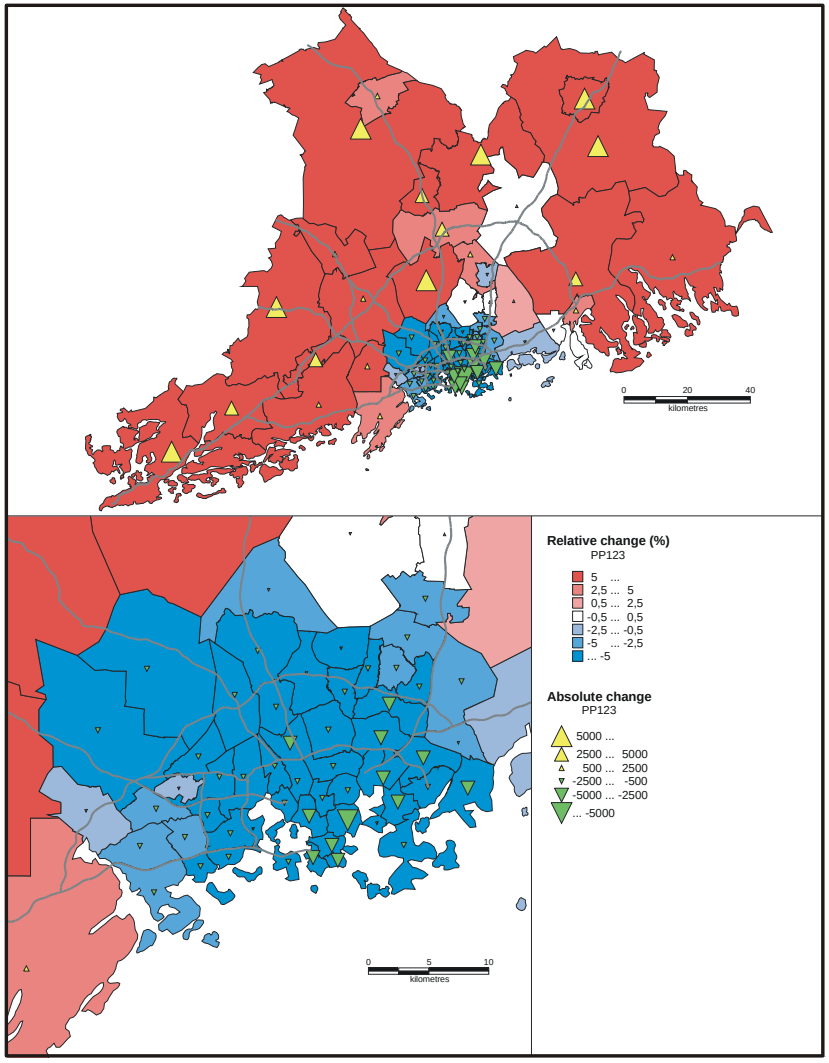


Population

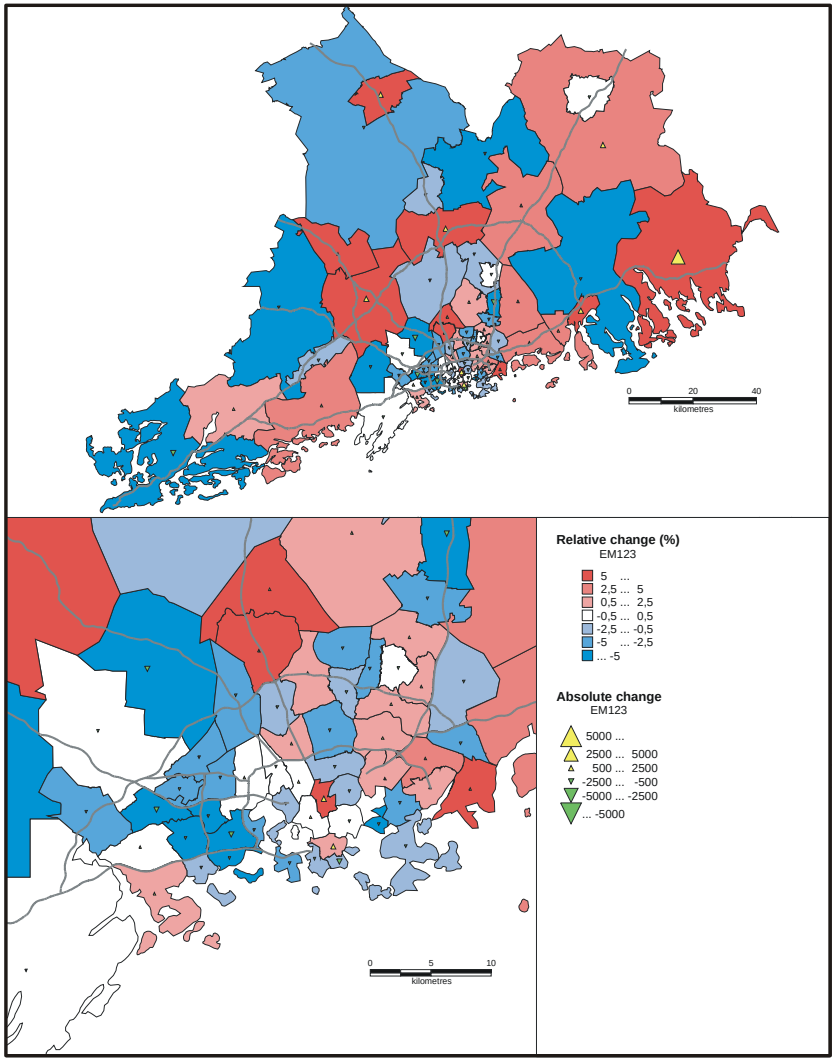


Employment

Helsinki: PT Fares -60%

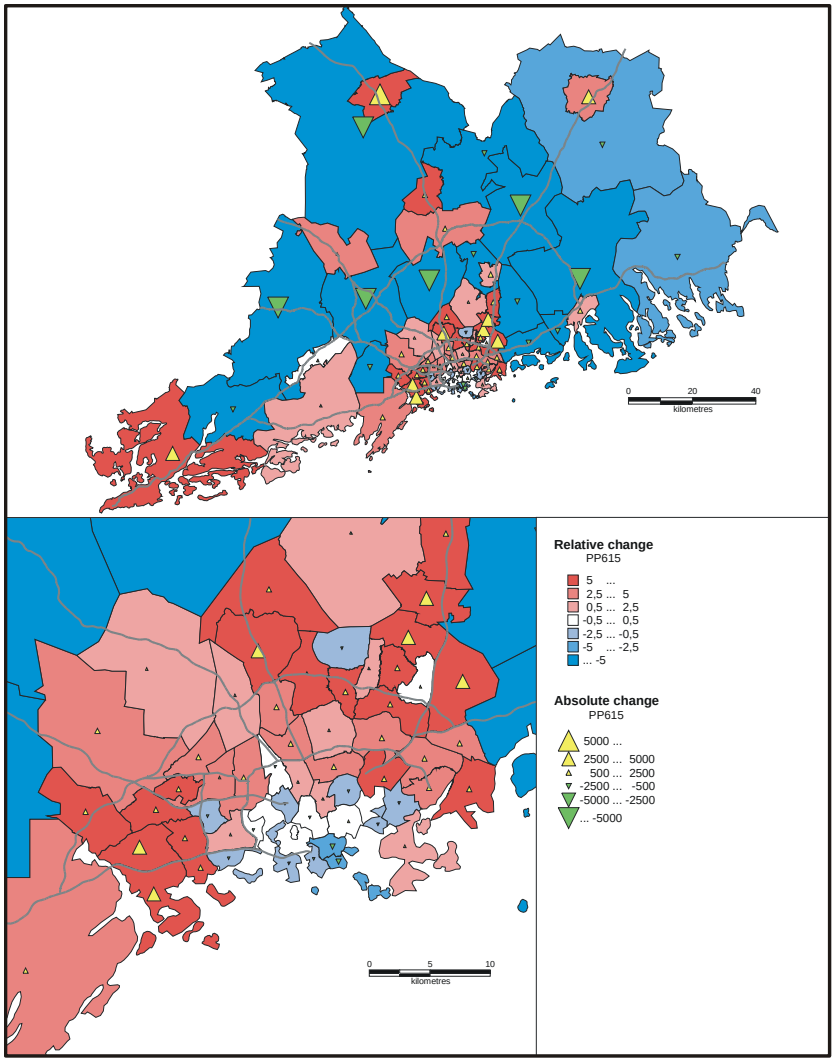


Population

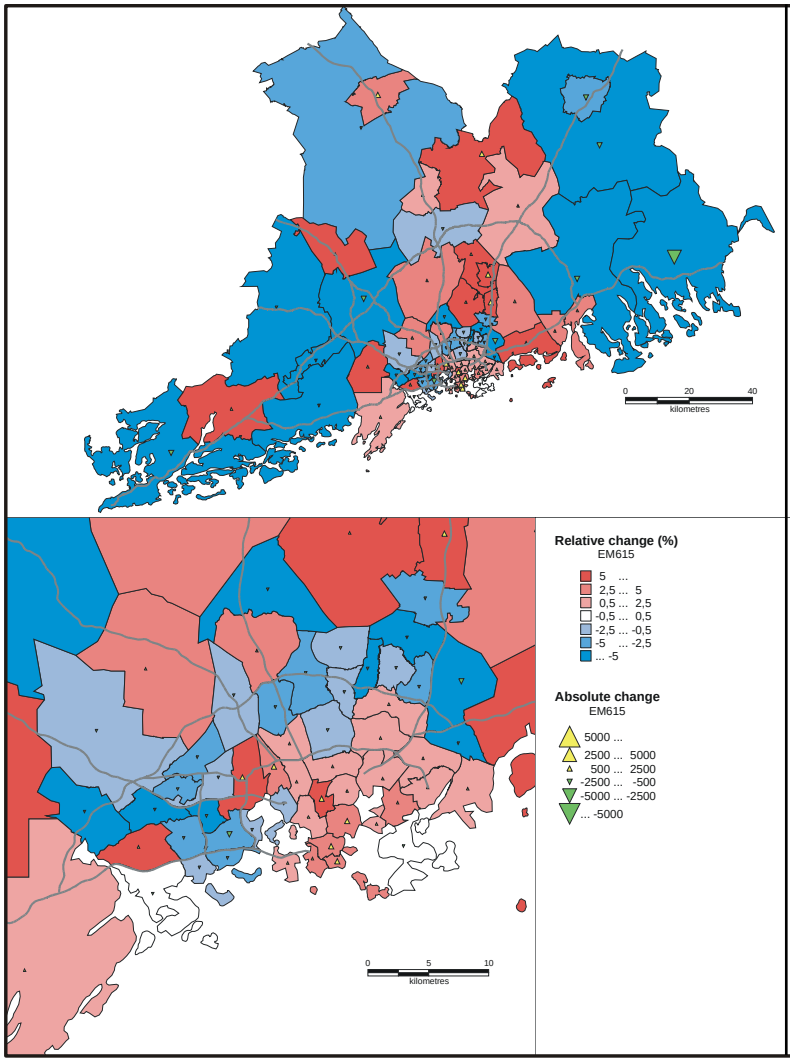


Employment

Helsinki: PT Fares -60% and land use restrictions

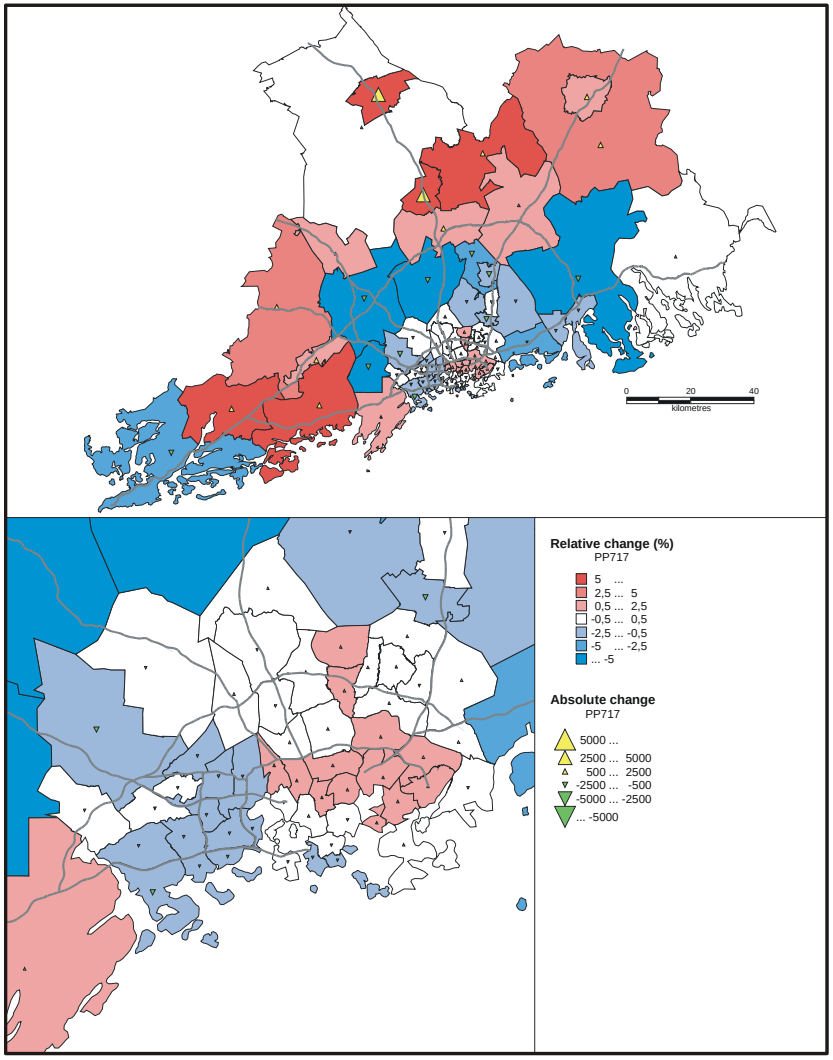


Population

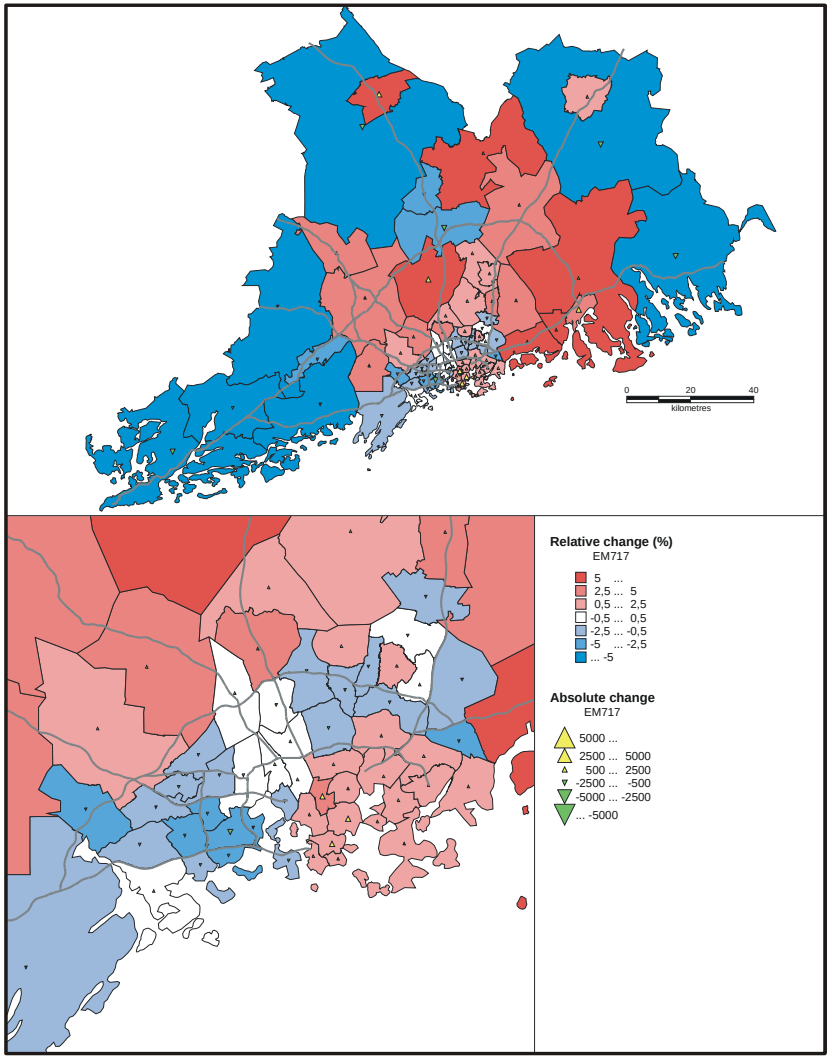


Employment

Helsinki: Car costs +75%, PT speed + 5%, PT Fares -20%

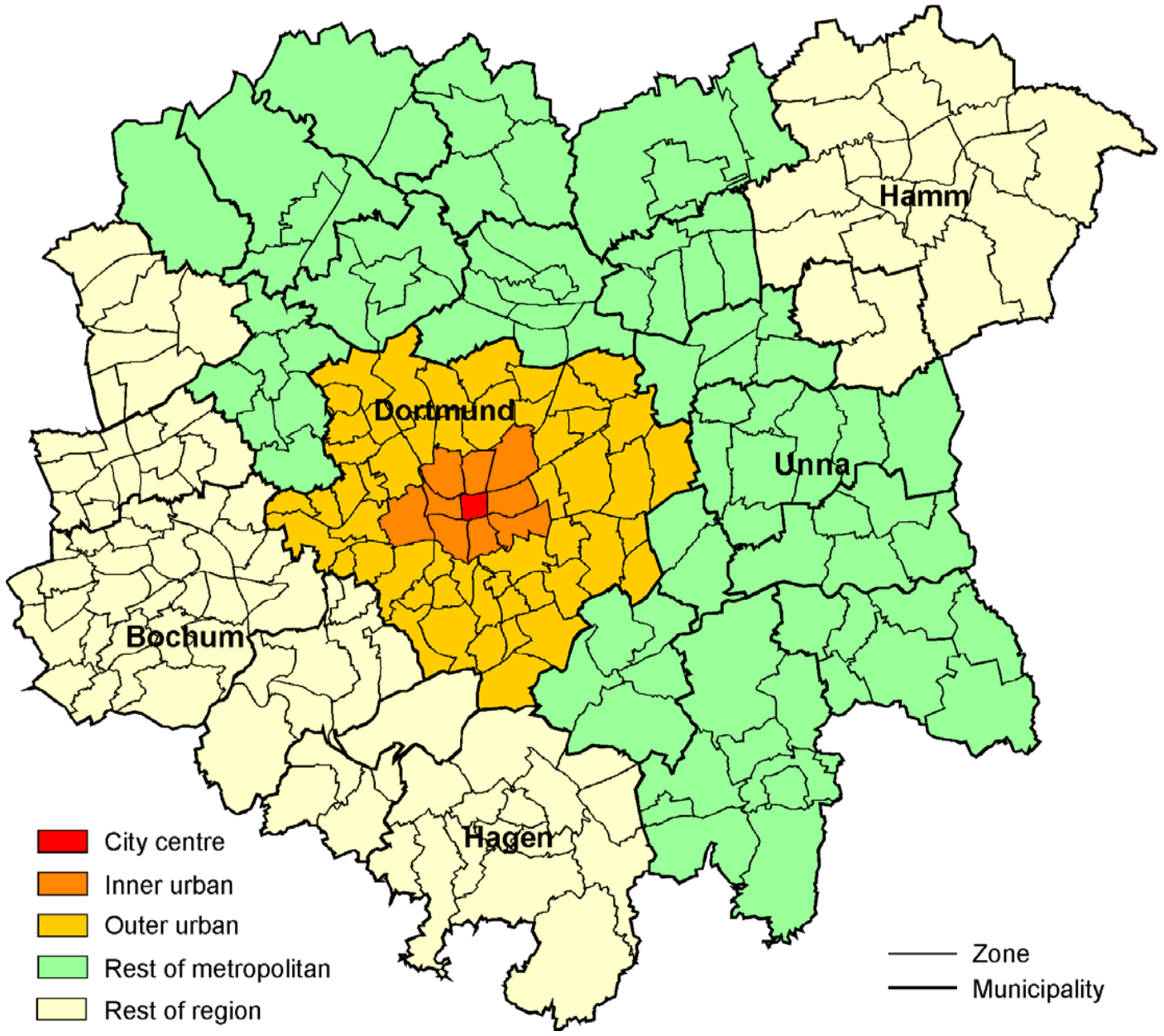


Population

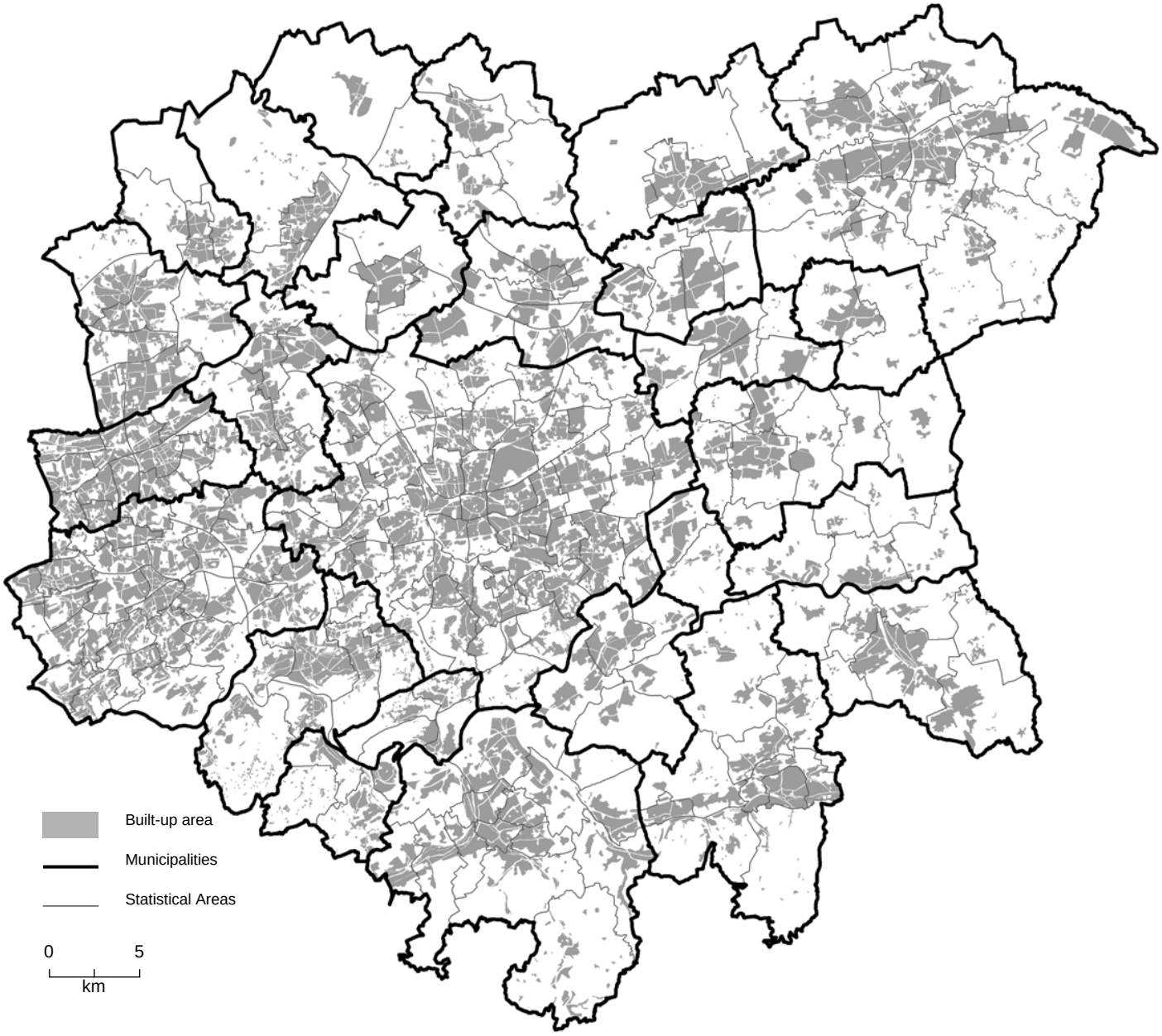


Employment

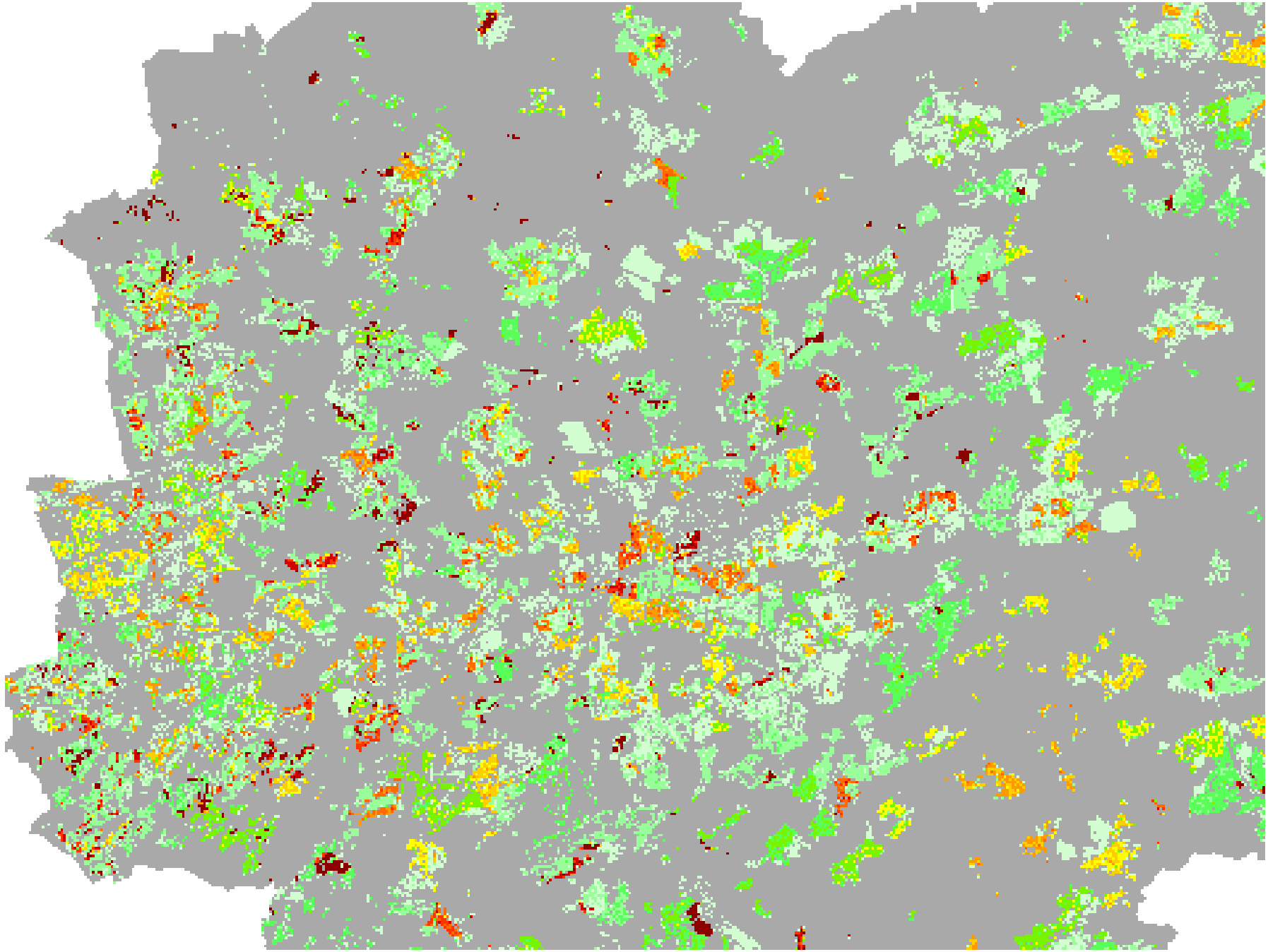
Dortmund



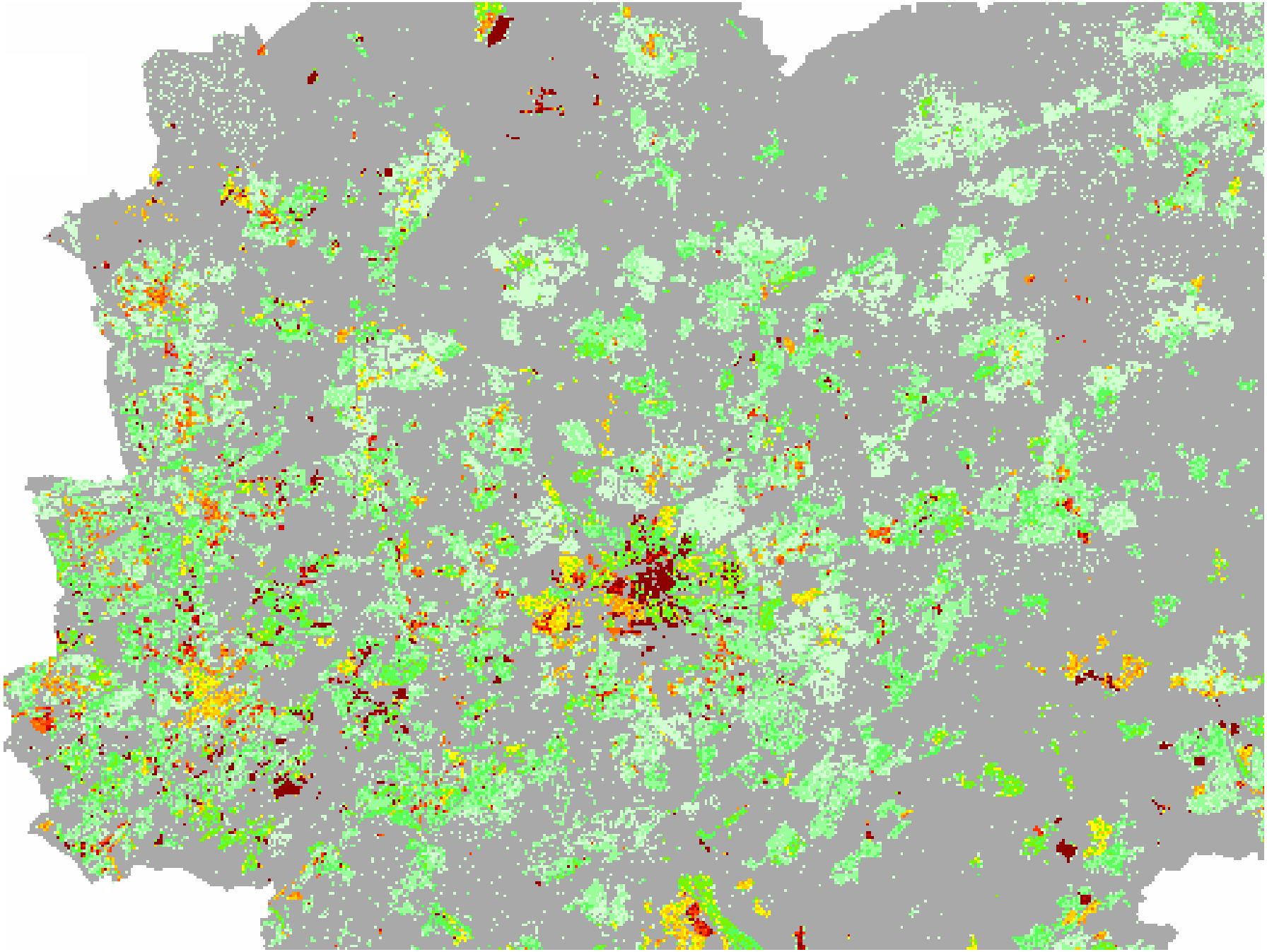
The Dortmund region



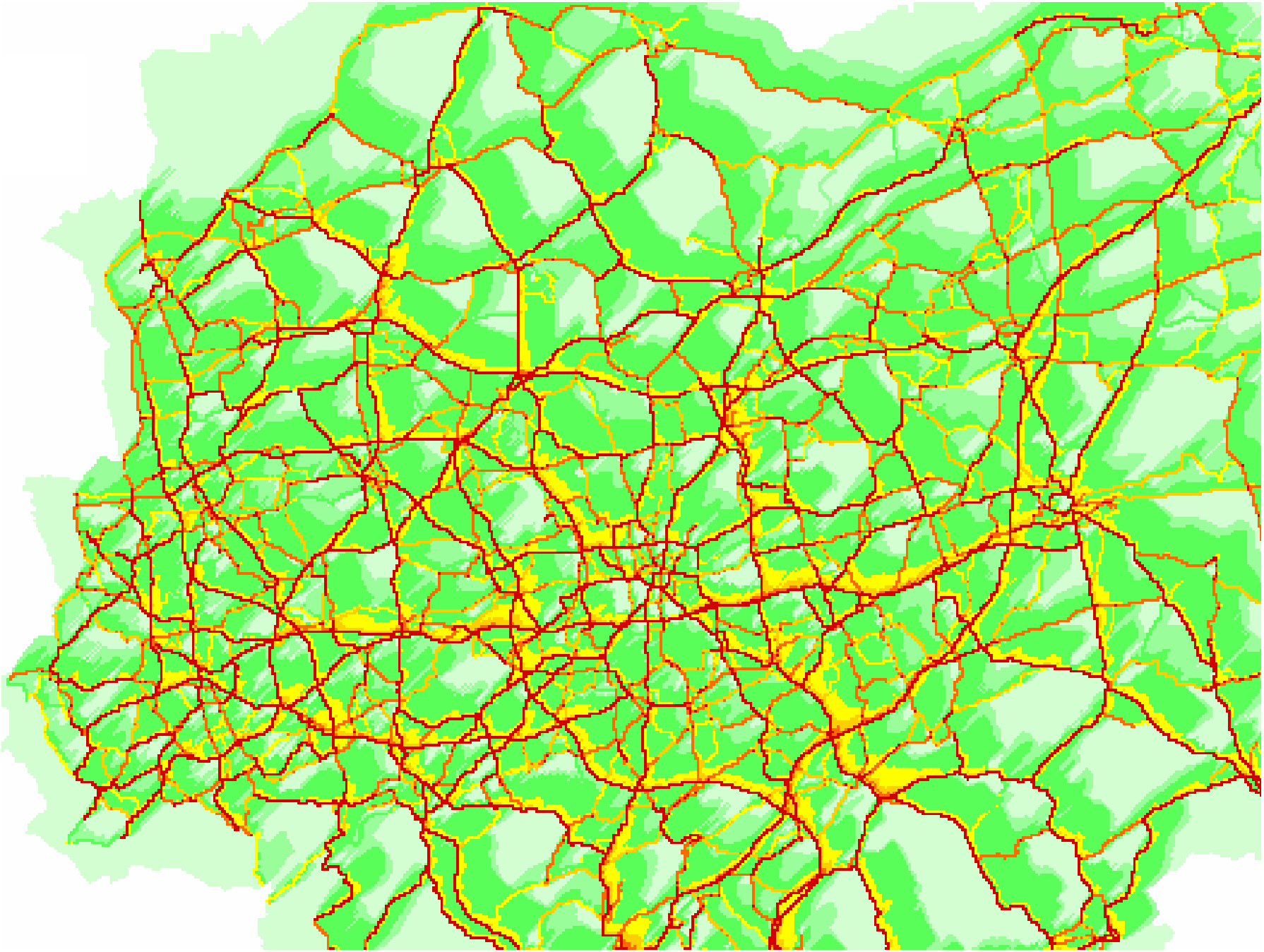
Zones and super zones



Population density



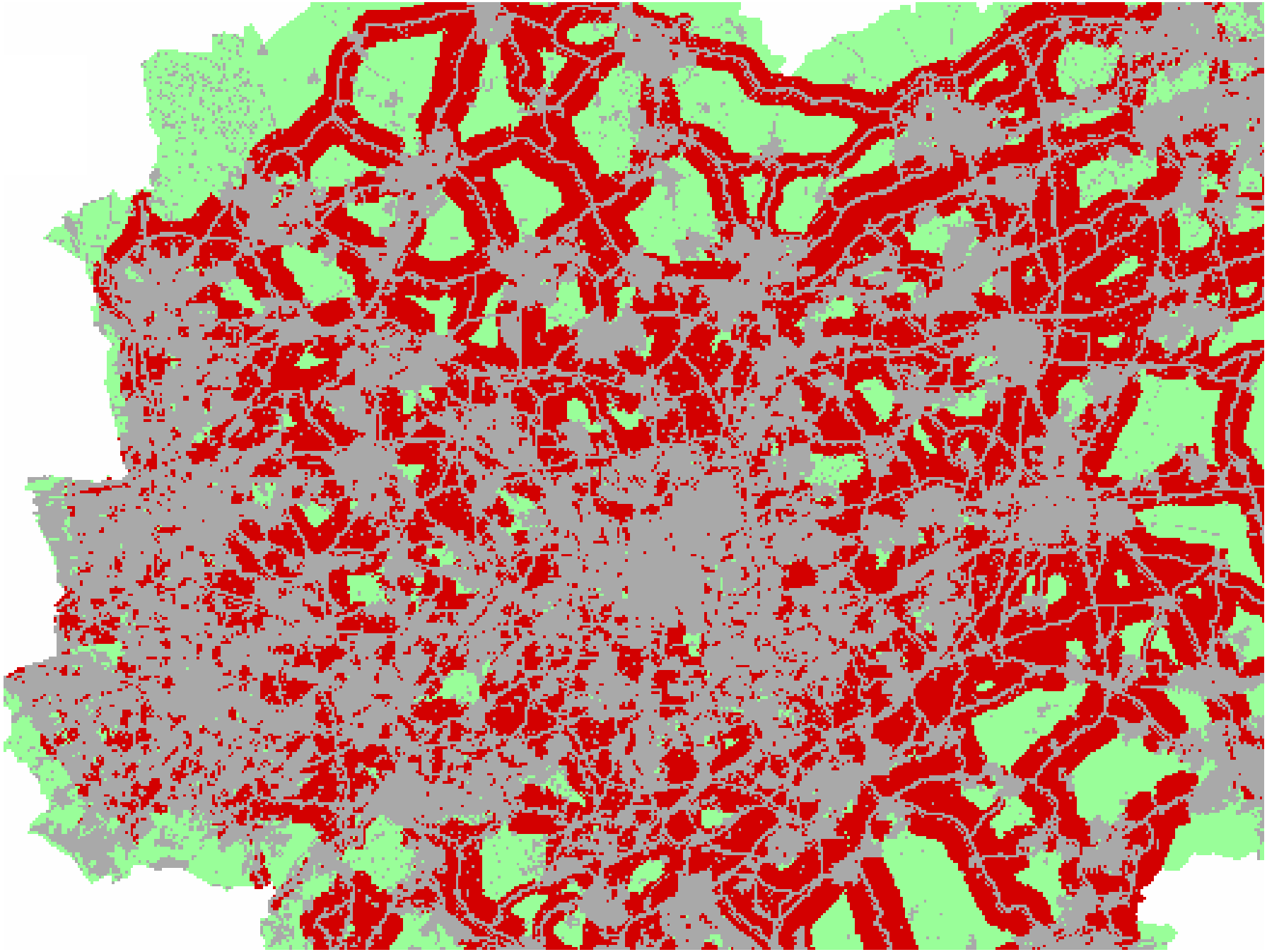
Employment density



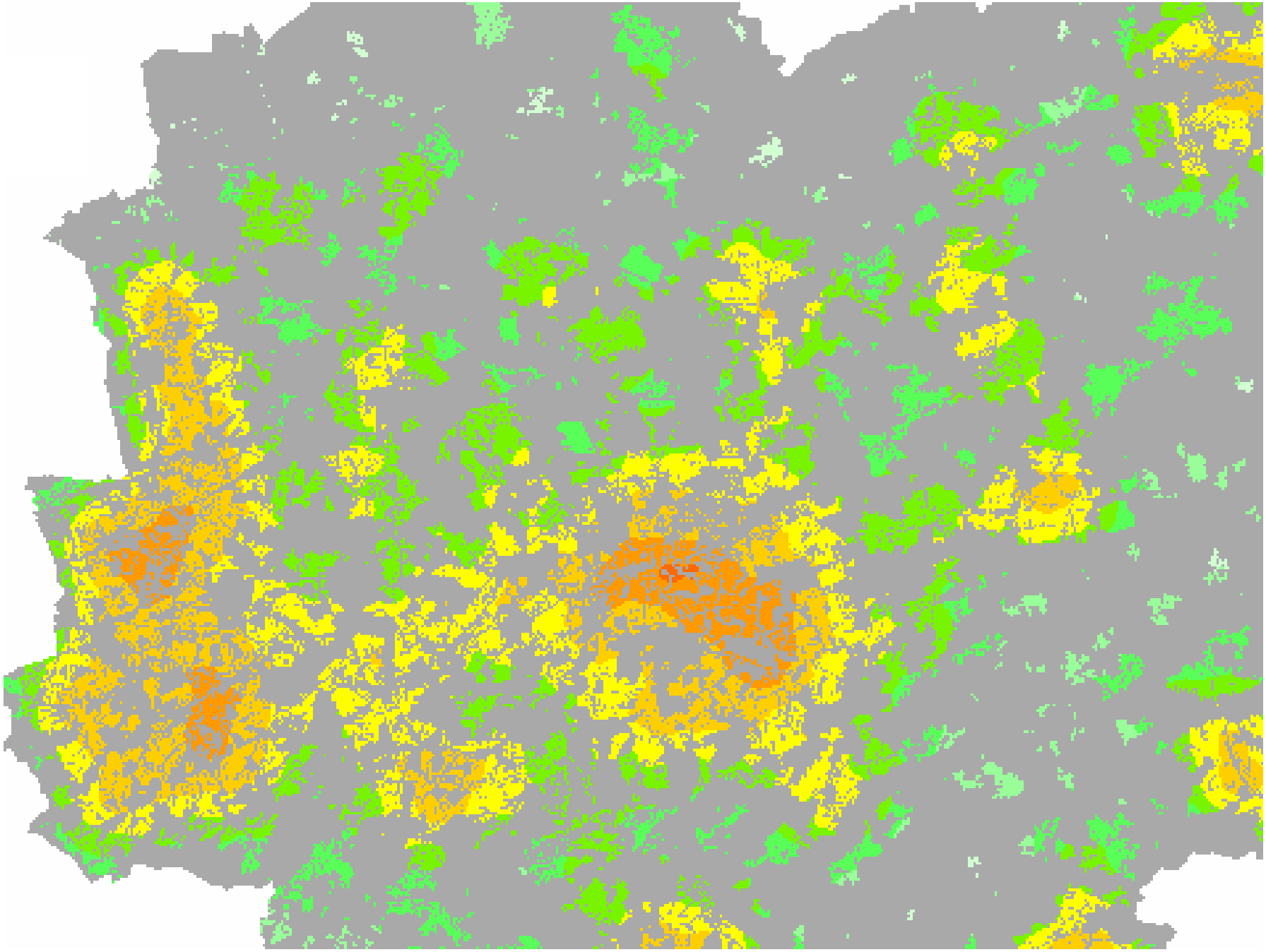
Air pollution by transport

Disturbed by traffic noise:
39.8 percent of SEG 1
34.1 percent of SEG 2
31.2 percent of SEG 3

Traffic noise

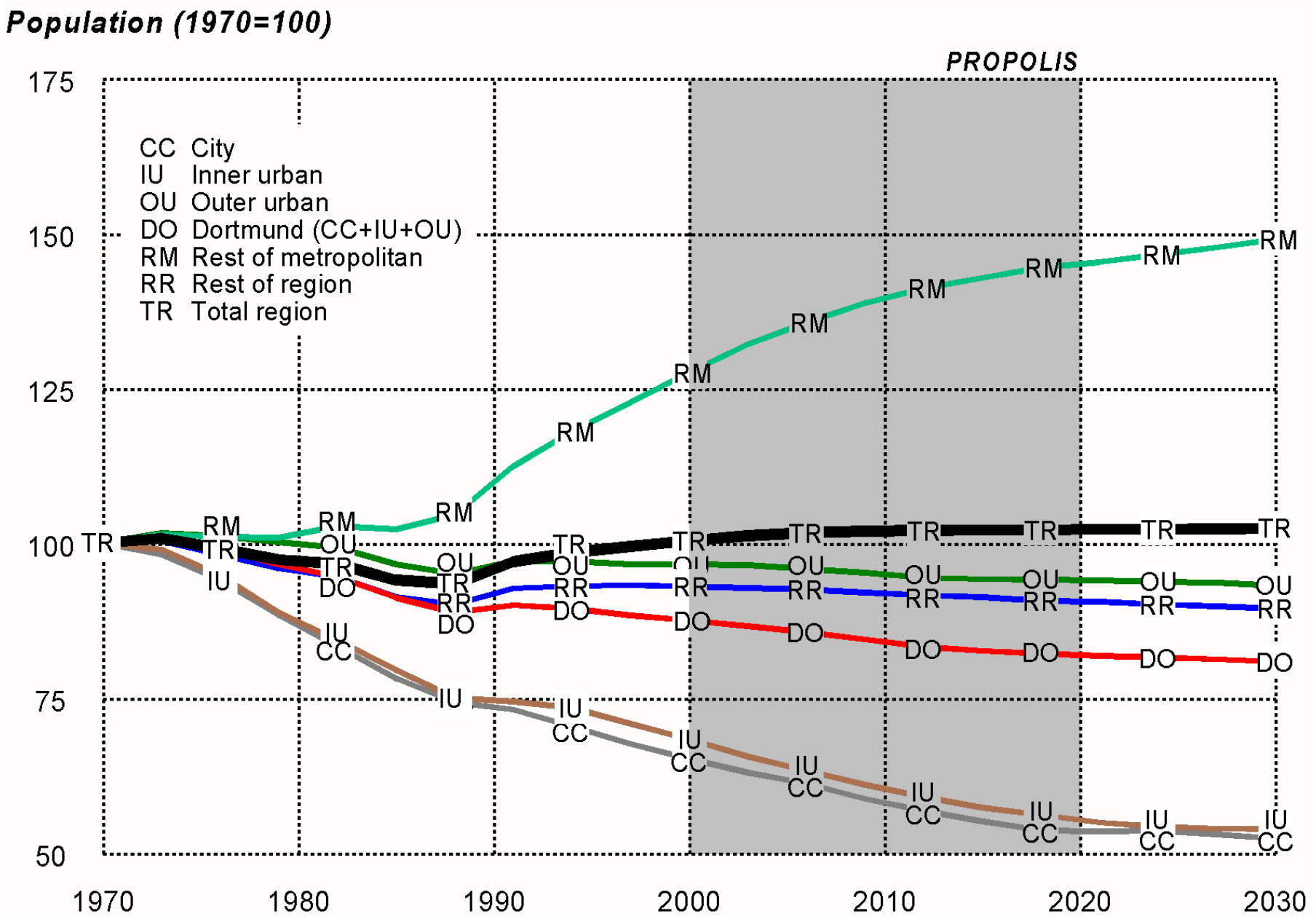


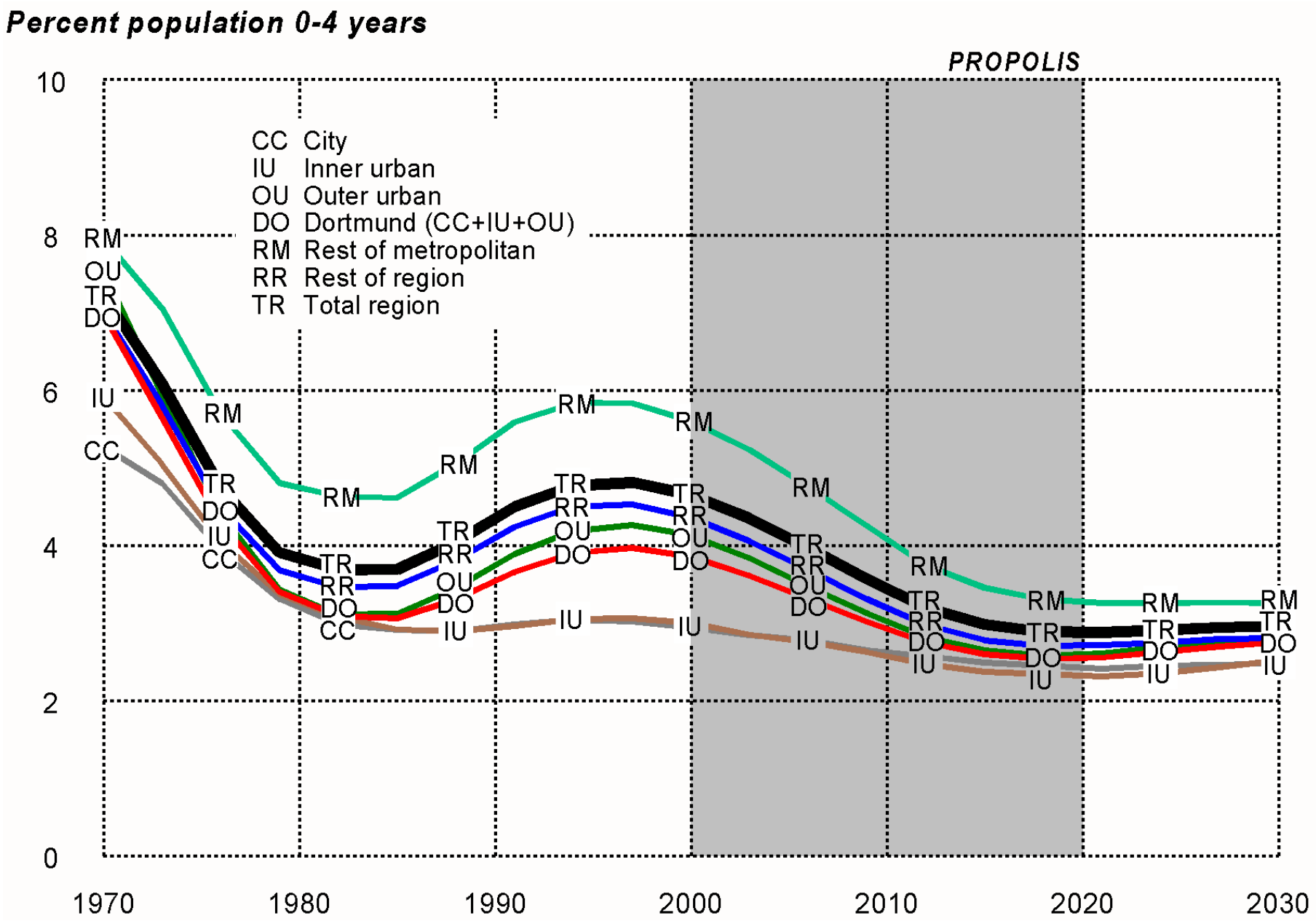
Quality of open space

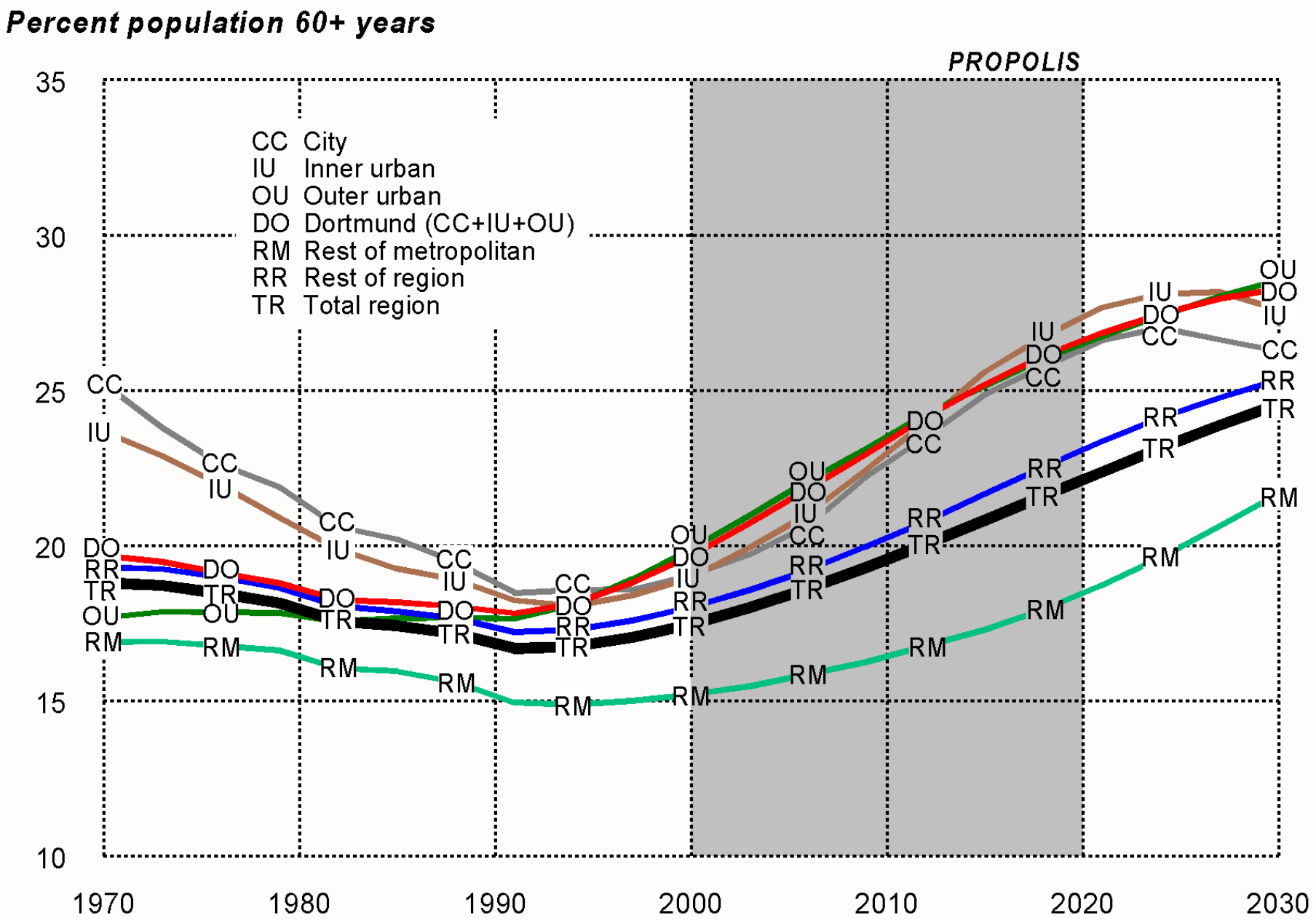


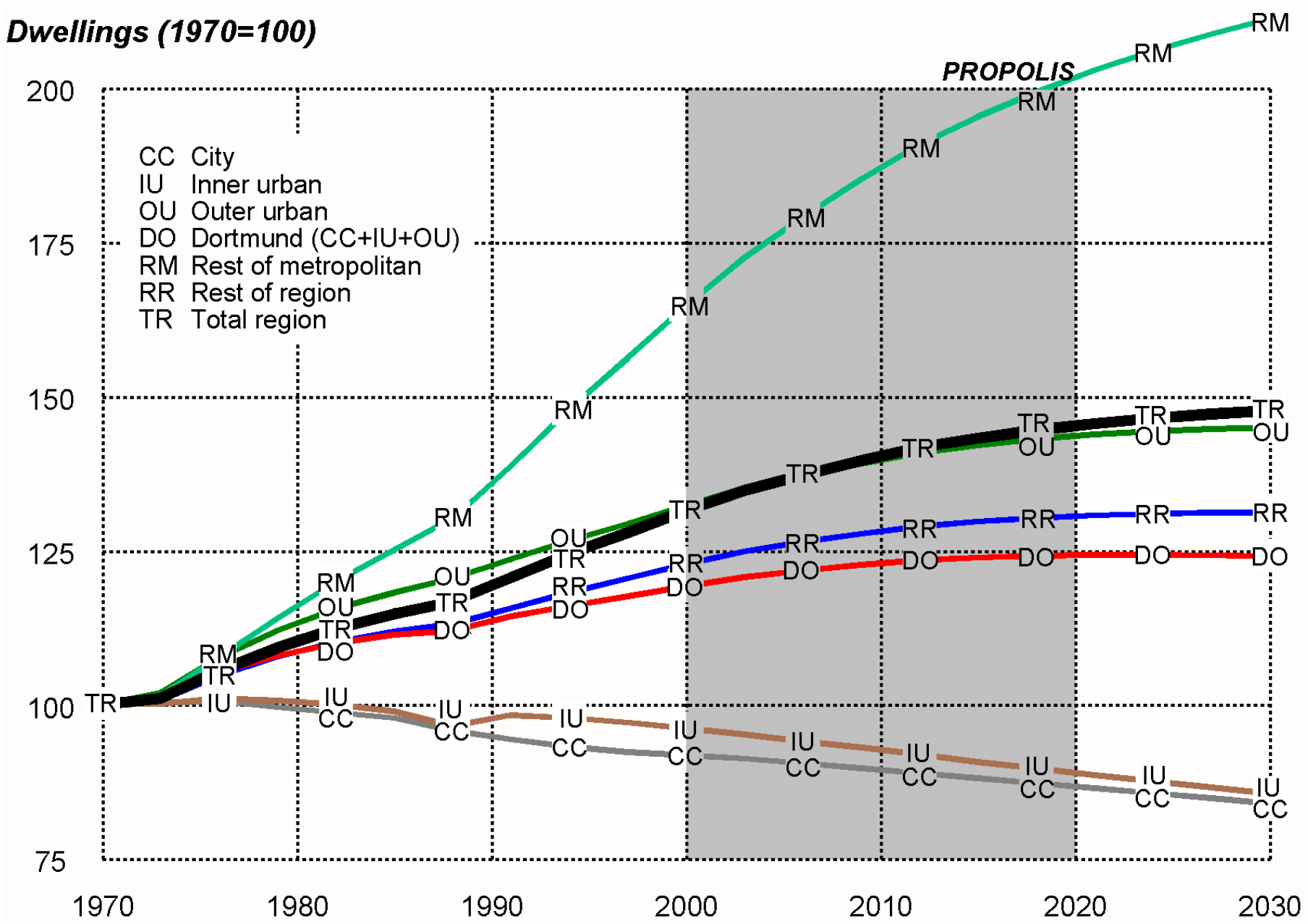
Walking accessibility to open space

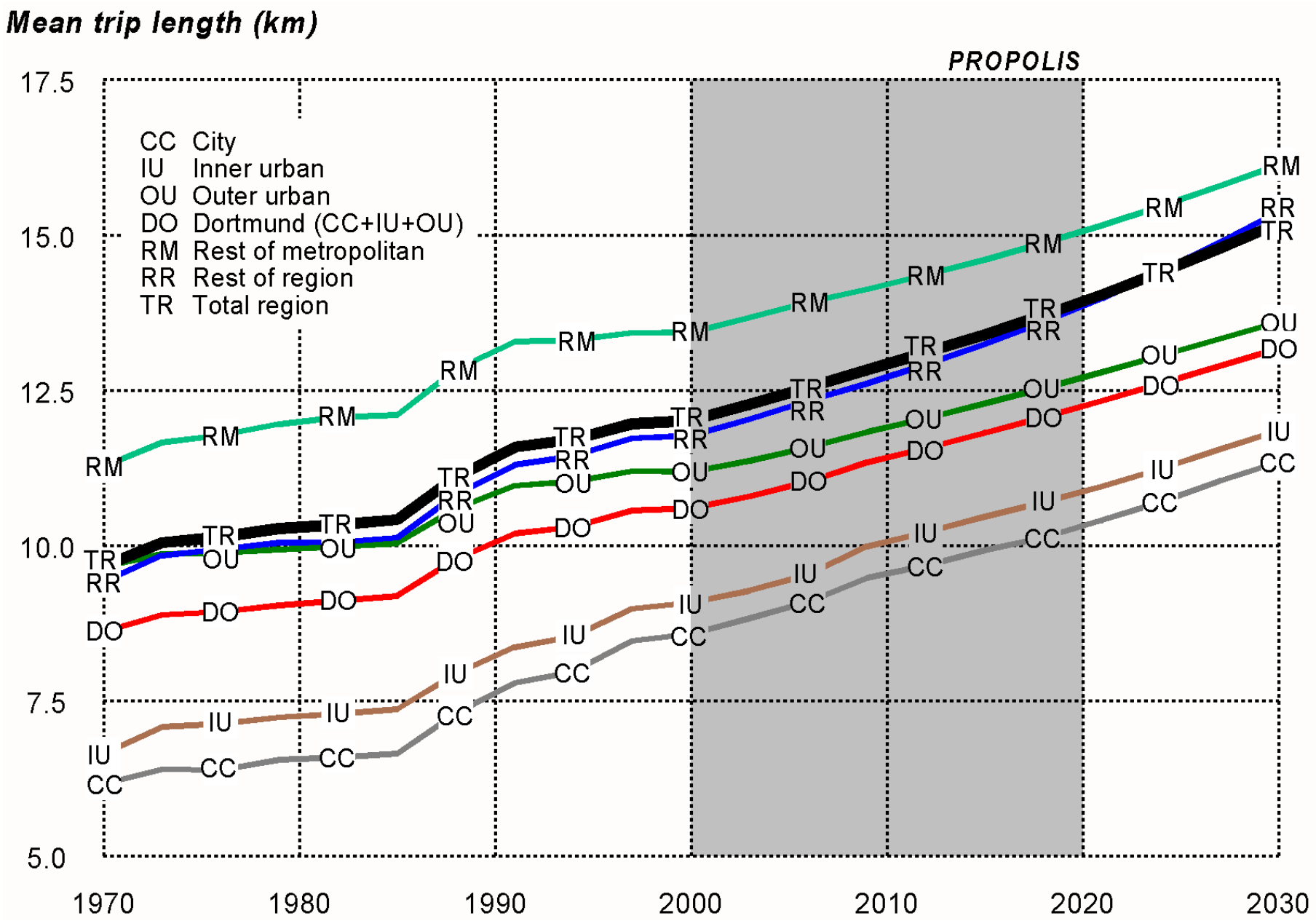
Reference Scenario

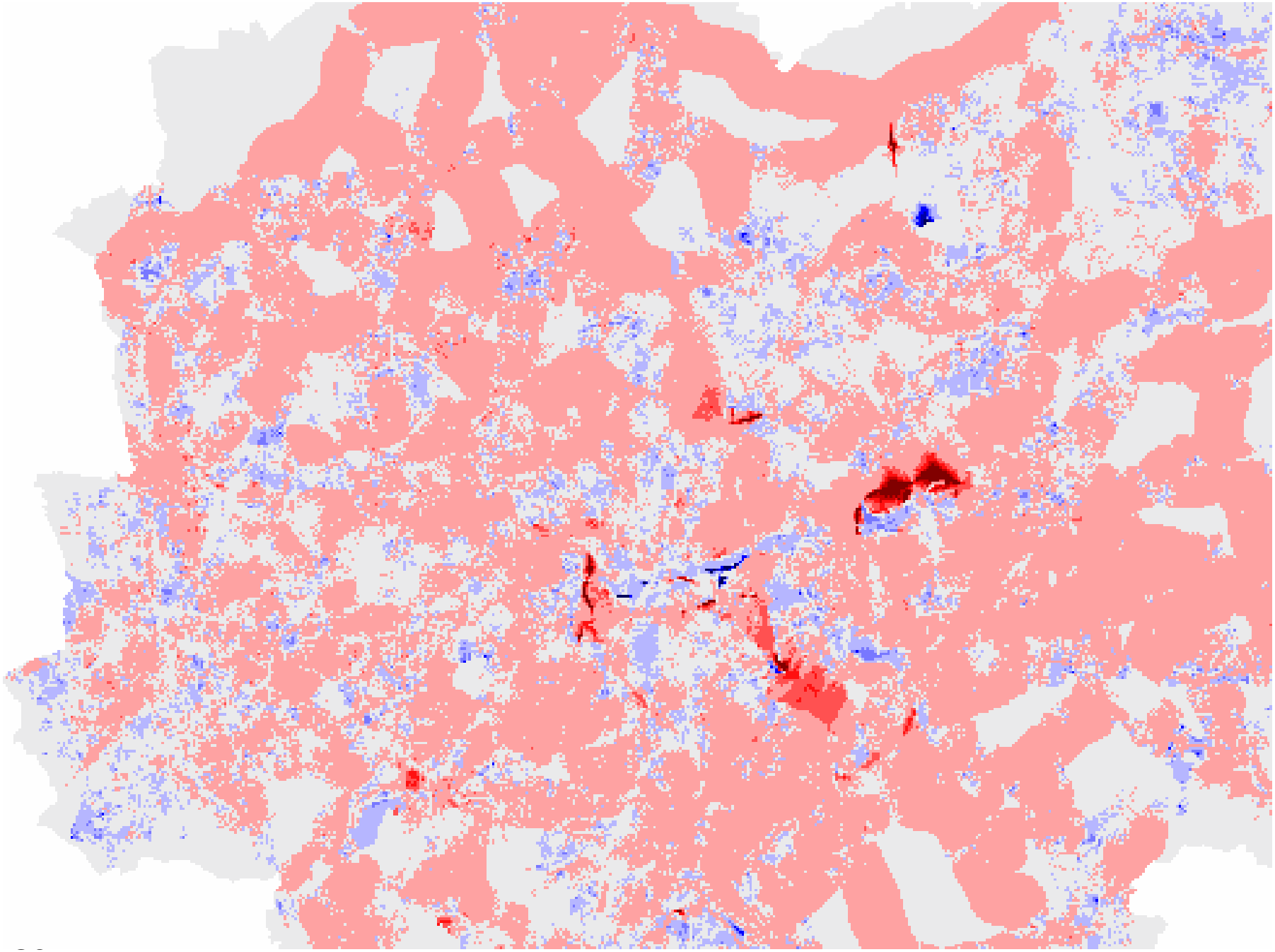

Population (1970=100)
PROPOLIS
CC City
IU Inner urban
OU Outer urban
DO Dortmund (CC+IU+OU)
RM Rest of metropolitan
RR Rest of region
TR Total region
175
150
125
100
75
50
1970
1980
1990
2000
2010
2020
2030


Percent population 0-4 years
PROPOLIS
CC City
IU Inner urban
OU Outer urban
DO Dortmund (CC+IU+OU)
RM Rest of metropolitan
RR Rest of region
TR Total region
10
8
6
4
2
0
1970
1980
1990
2000
2010
2020
2030


Percent population 60+ years
PROPOLIS
CC City
IU Inner urban
OU Outer urban
DO Dortmund (CC+IU+OU)
RM Rest of metropolitan
RR Rest of region
TR Total region
35
30
25
20
15
10
1970
1980
1990
2000
2010
2020
2030


Dwellings (1970=100)
PROPOLIS
CC City
IU Inner urban
OU Outer urban
DO Dortmund (CC+IU+OU)
RM Rest of metropolitan
RR Rest of region
TR Total region
200
175
150
125
100
75
1970
1980
1990
2000
2010
2020
2030


Mean trip length (km)
PROPOLIS
CC City
IU Inner urban
OU Outer urban
DO Dortmund (CC+IU+OU)
RM Rest of metropolitan
RR Rest of region
TR Total region
17.5
15.0
12.5
10.0
7.5
5.0
1970
1980
1990
2000
2010
2020
2030



Difference in traffic noise in Reference Scenario 2021 v. 2001

Policy Scenarios

Policy Scenarios (1)

000 Reference scenario

111-112 Local investment scenarios
- 111 Public transport investments
- 112 ‘Dortmund project’

211-219 Car operating costs
- 211 Car operating costs +25%
- 212 Car operating costs +50%
- 213 Car operating costs +100%
- 214 Car operating costs +75%
- 219 Car operating costs +300%

221-222 Parking costs
- 221 Parking costs +50%
- 222 Parking costs +100%

231-232 Cordon pricing
- 231 Cordon pricing 2 €
- 232 Cordon pricing 6 €

Policy Scenarios (2)

311-321 Speed limits

- 311 Maximum speed -10% on all roads
- 321 Maximum speed -20% on local roads

411-421 PT speed and fares

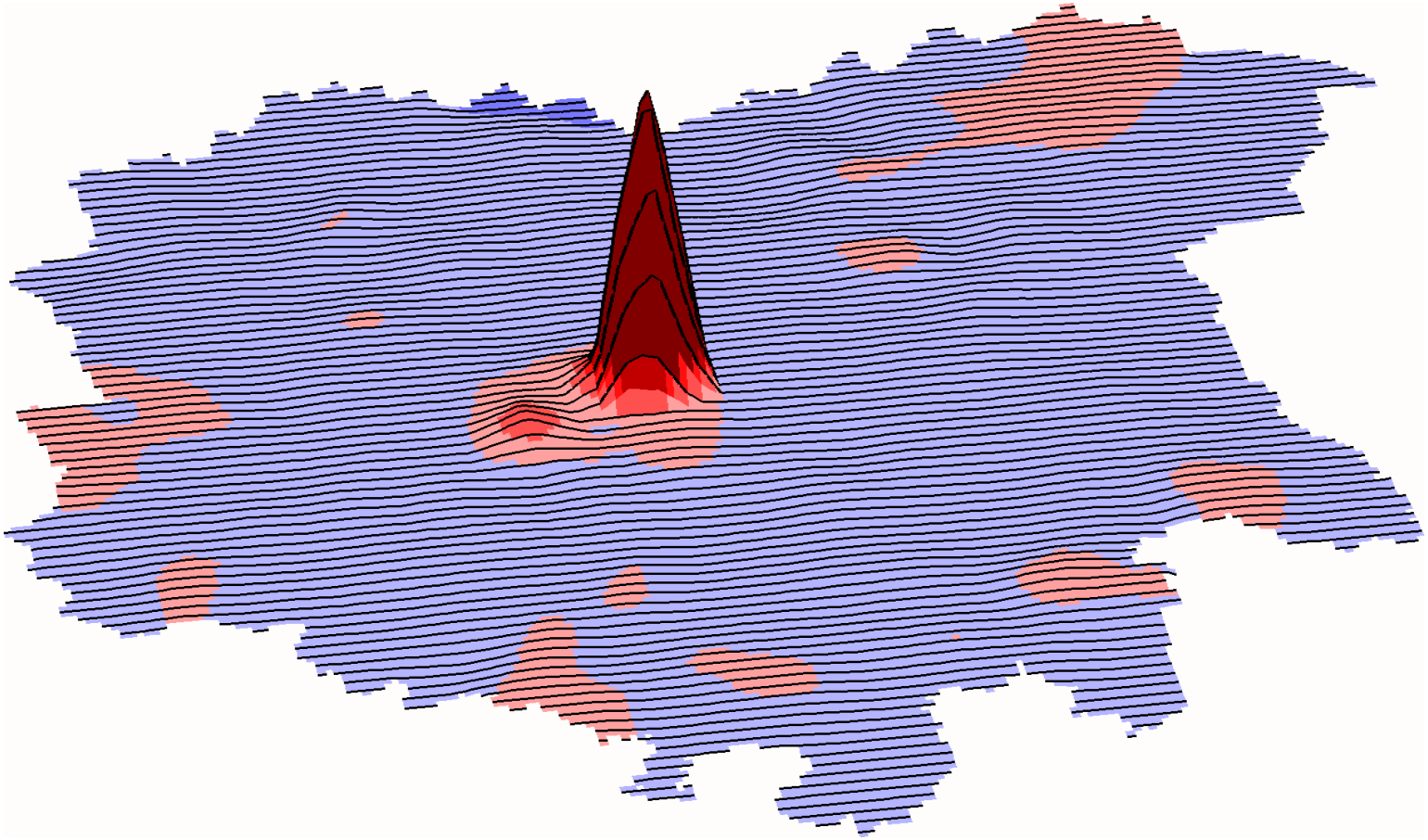
- 411 PT travel time -10%
- 412 PT travel time -5%
- 421 PT travel time -50%

511-541 Land use

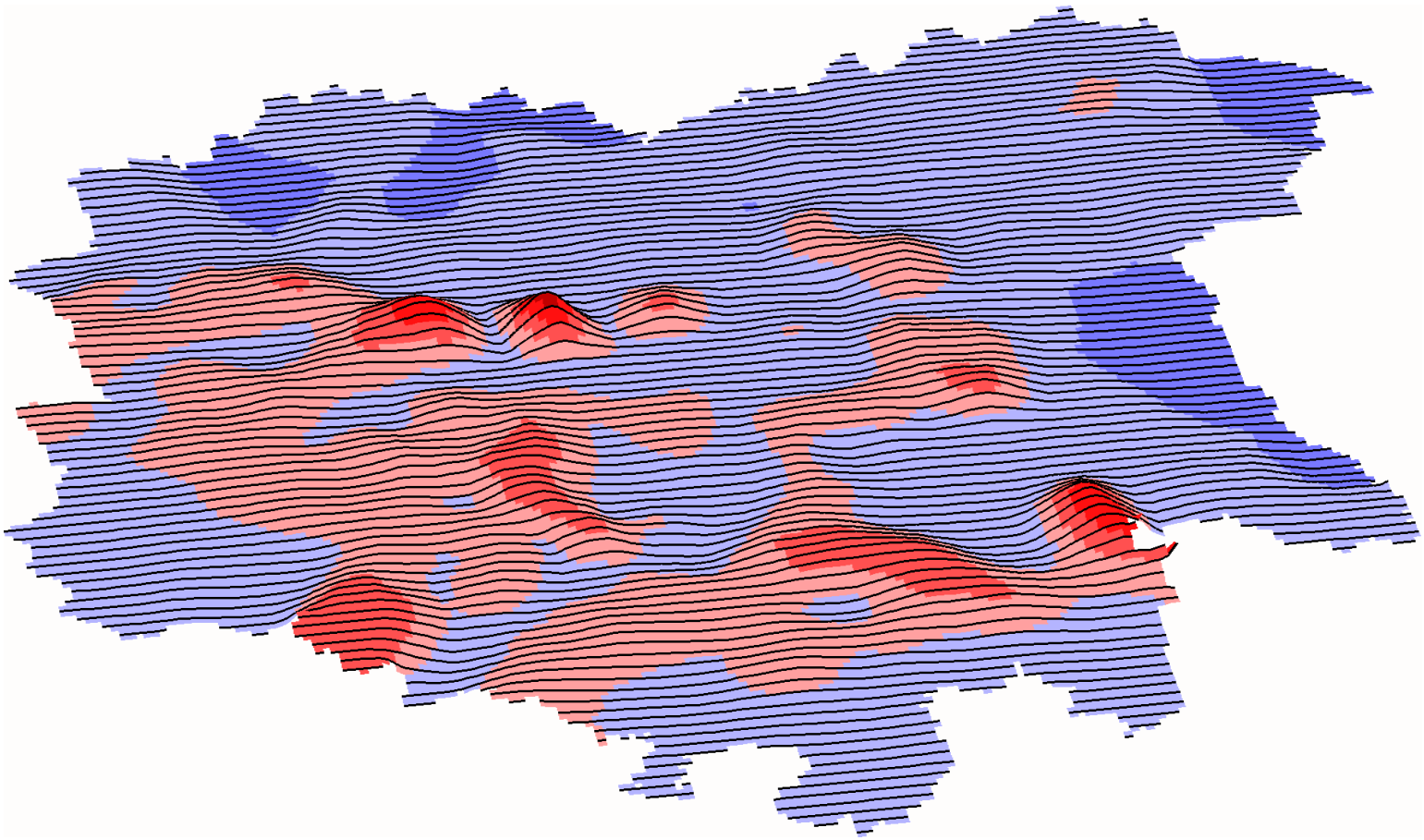
- 511 Compact city scenario
- 521 Polycentric development
- 541 Urban growth boundary

711-719 Combination scenarios

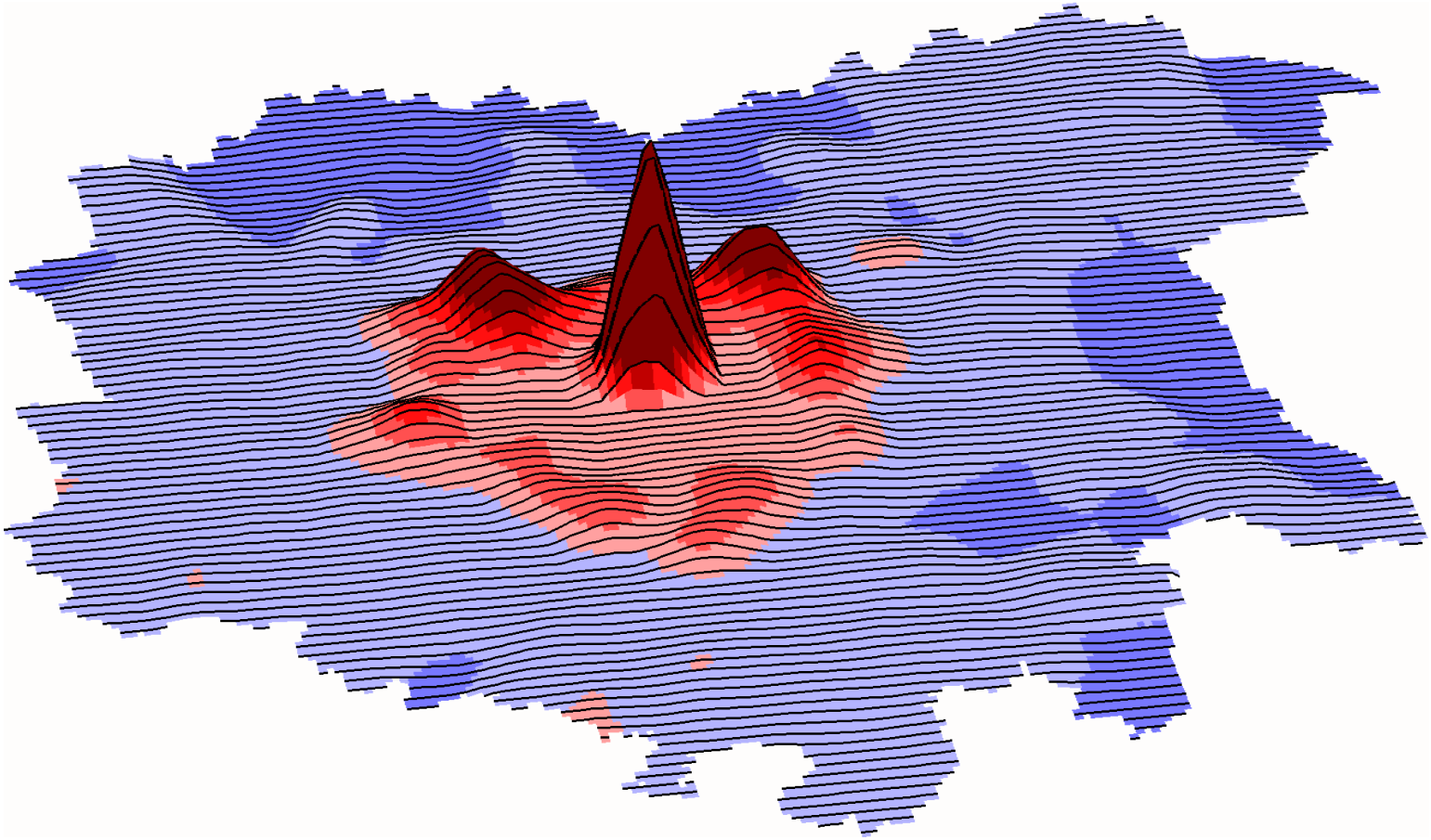
- 711 Scenarios 214+421
- 712 Scenarios 214+412+421
- 713 Scenarios 214+412+421+521
- 719 Scenarios 219+412+421+541



Compact city scenario

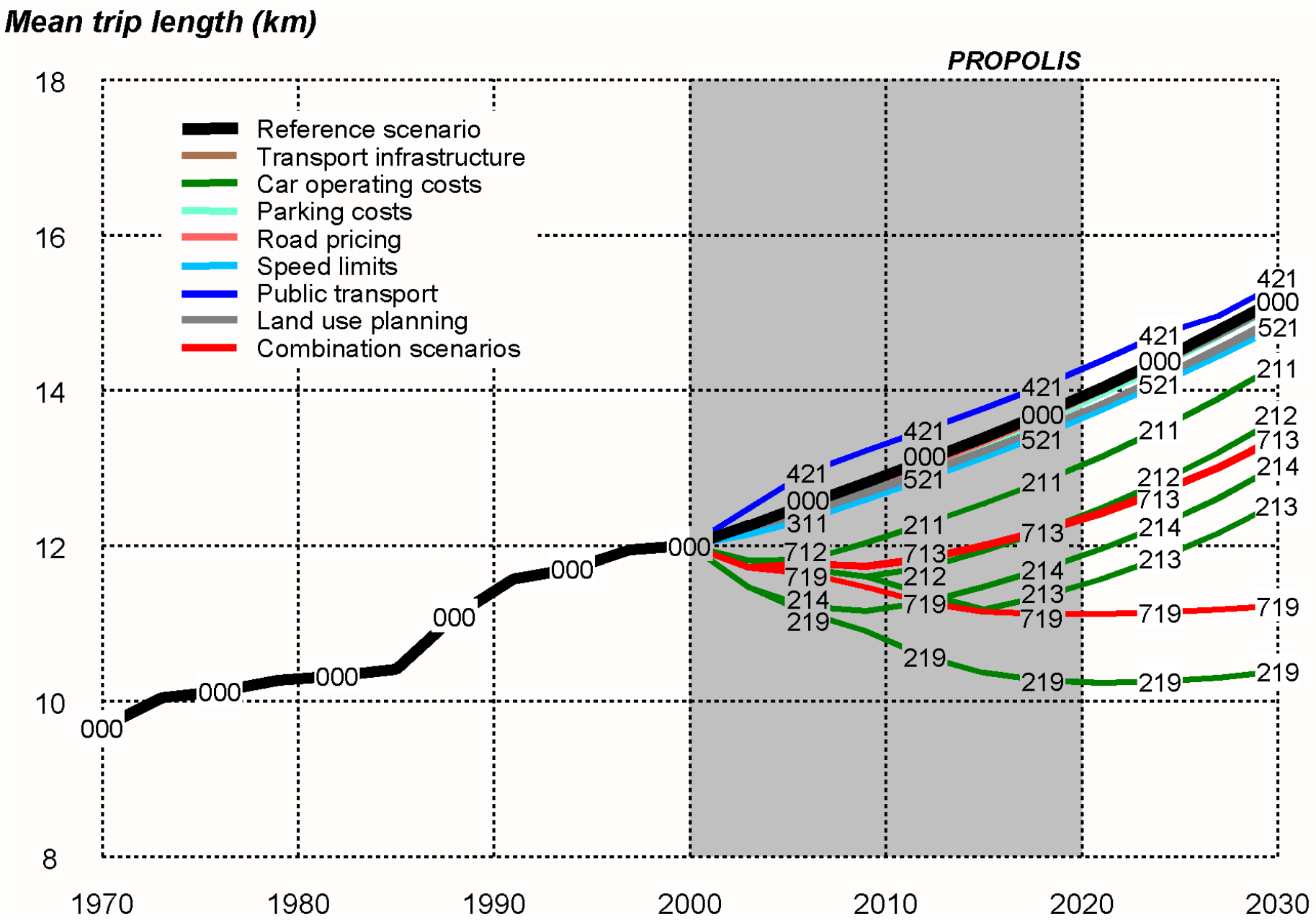


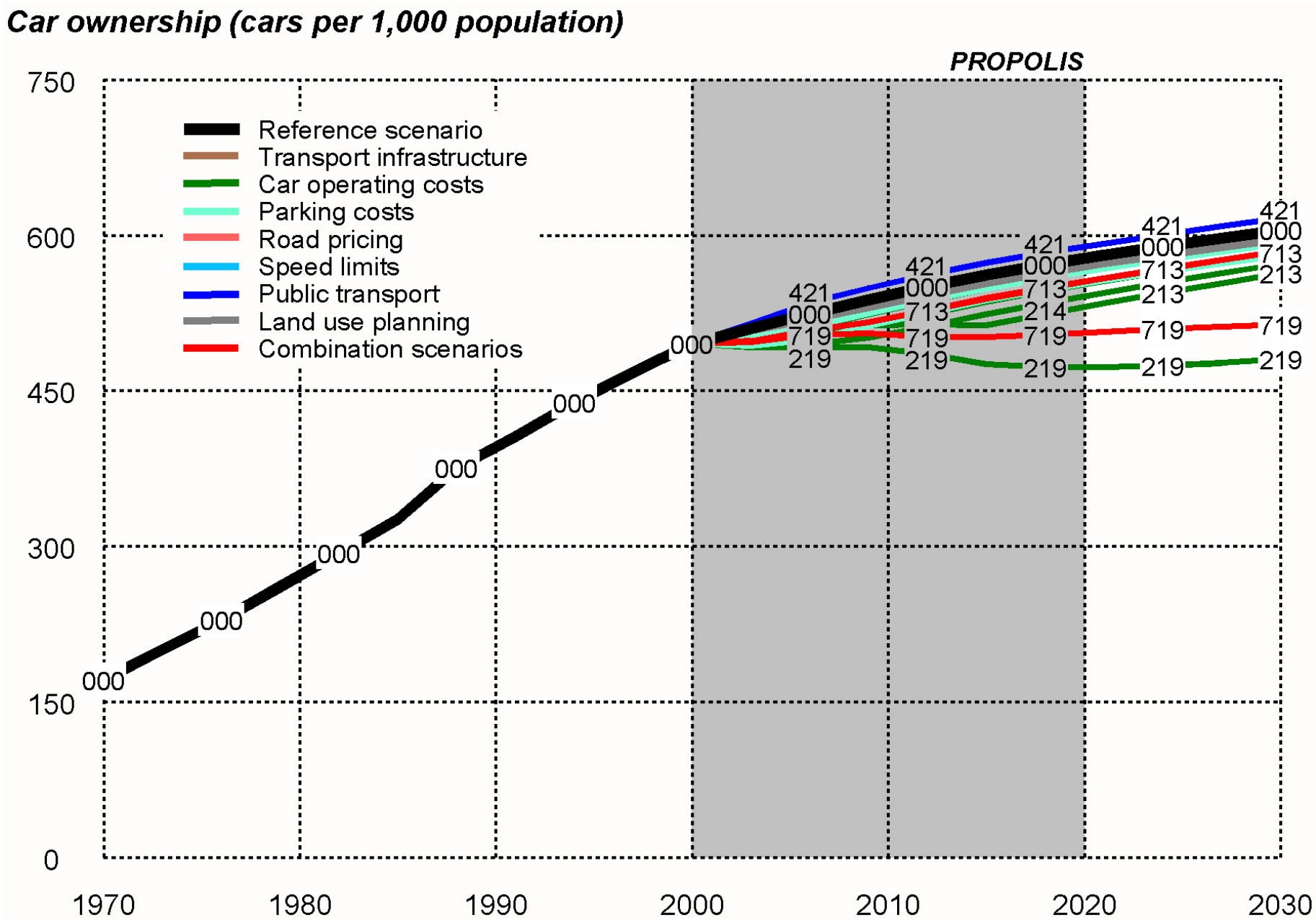
Polycentric scenario

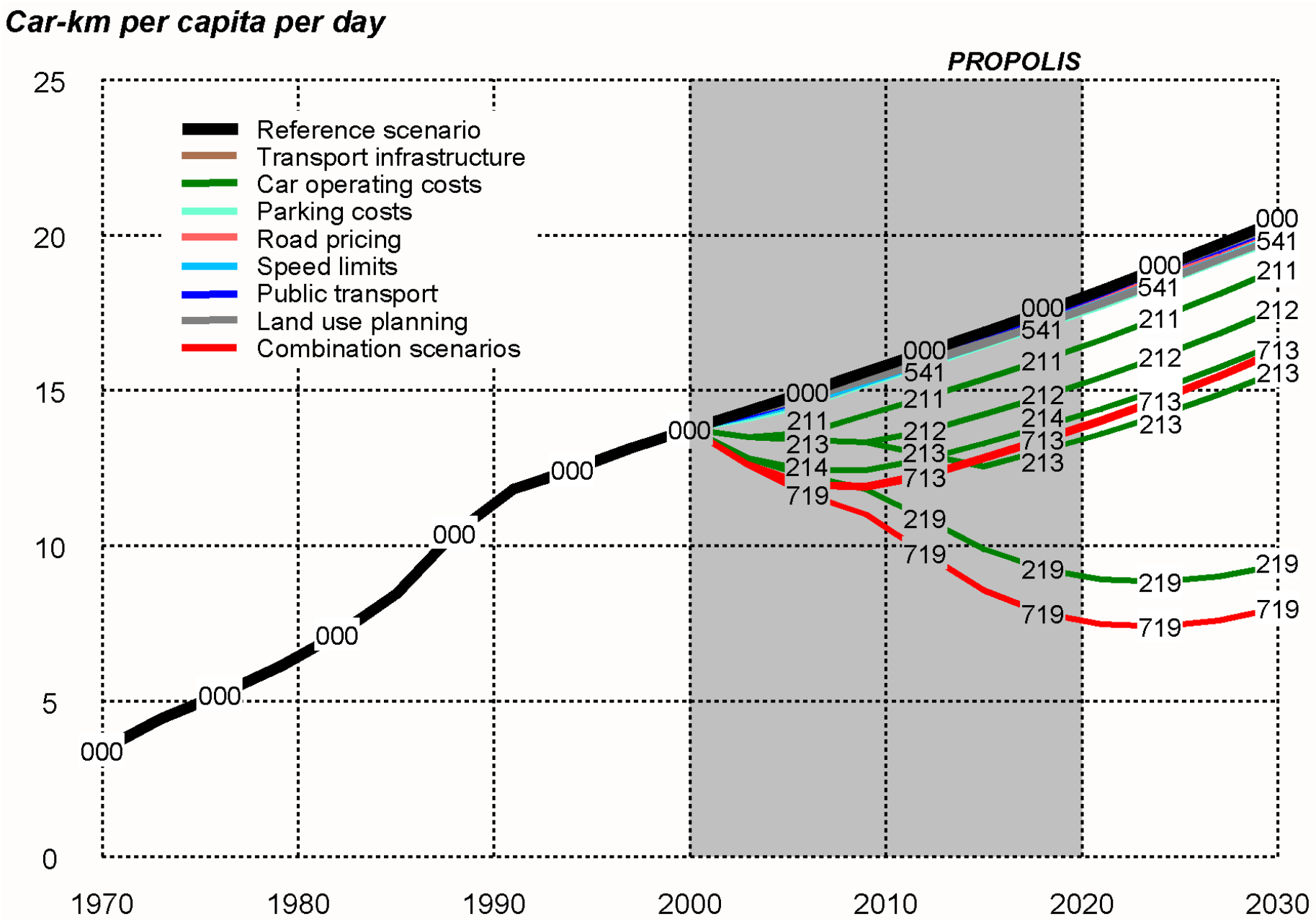


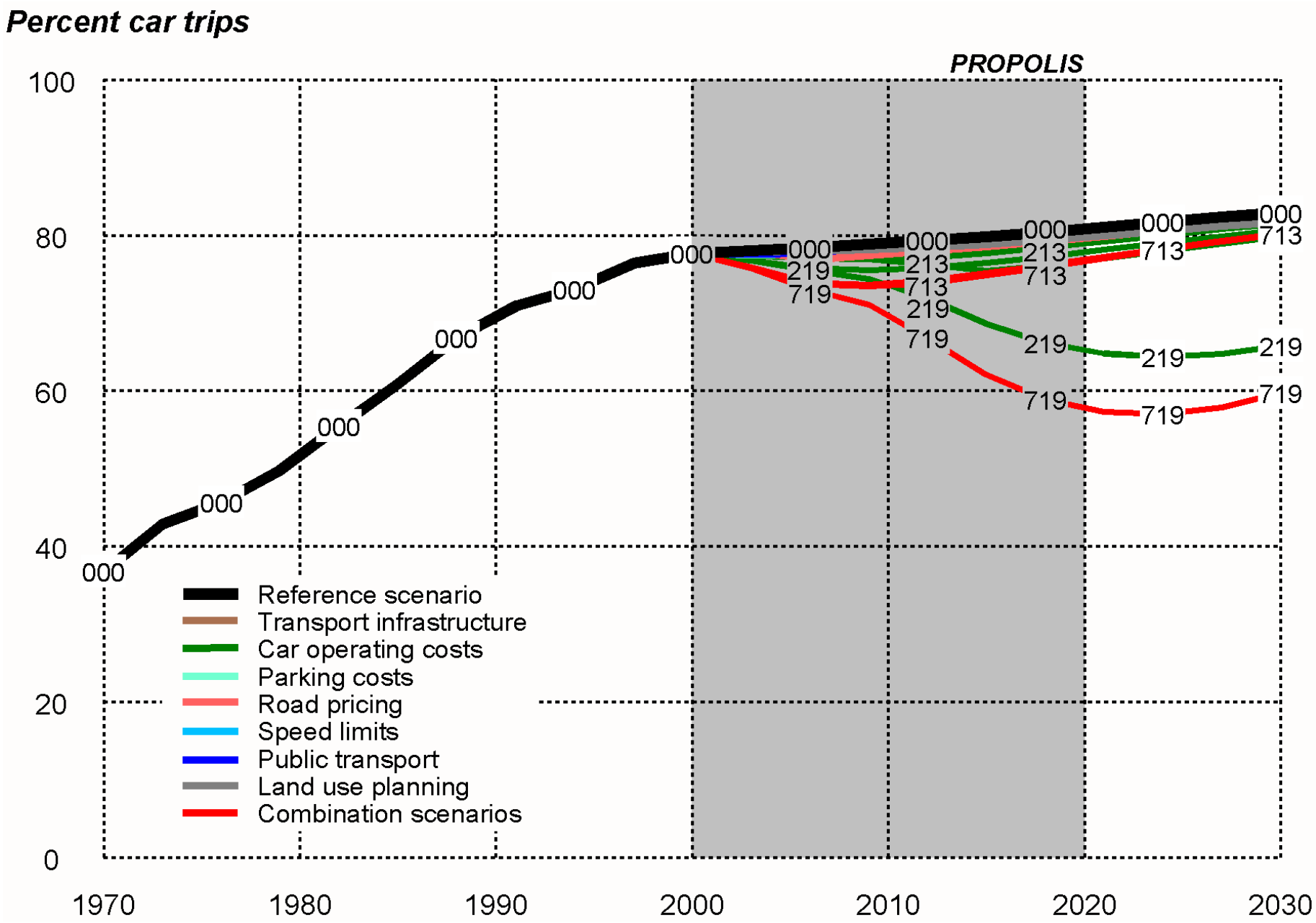
Urban growth boundary scenario

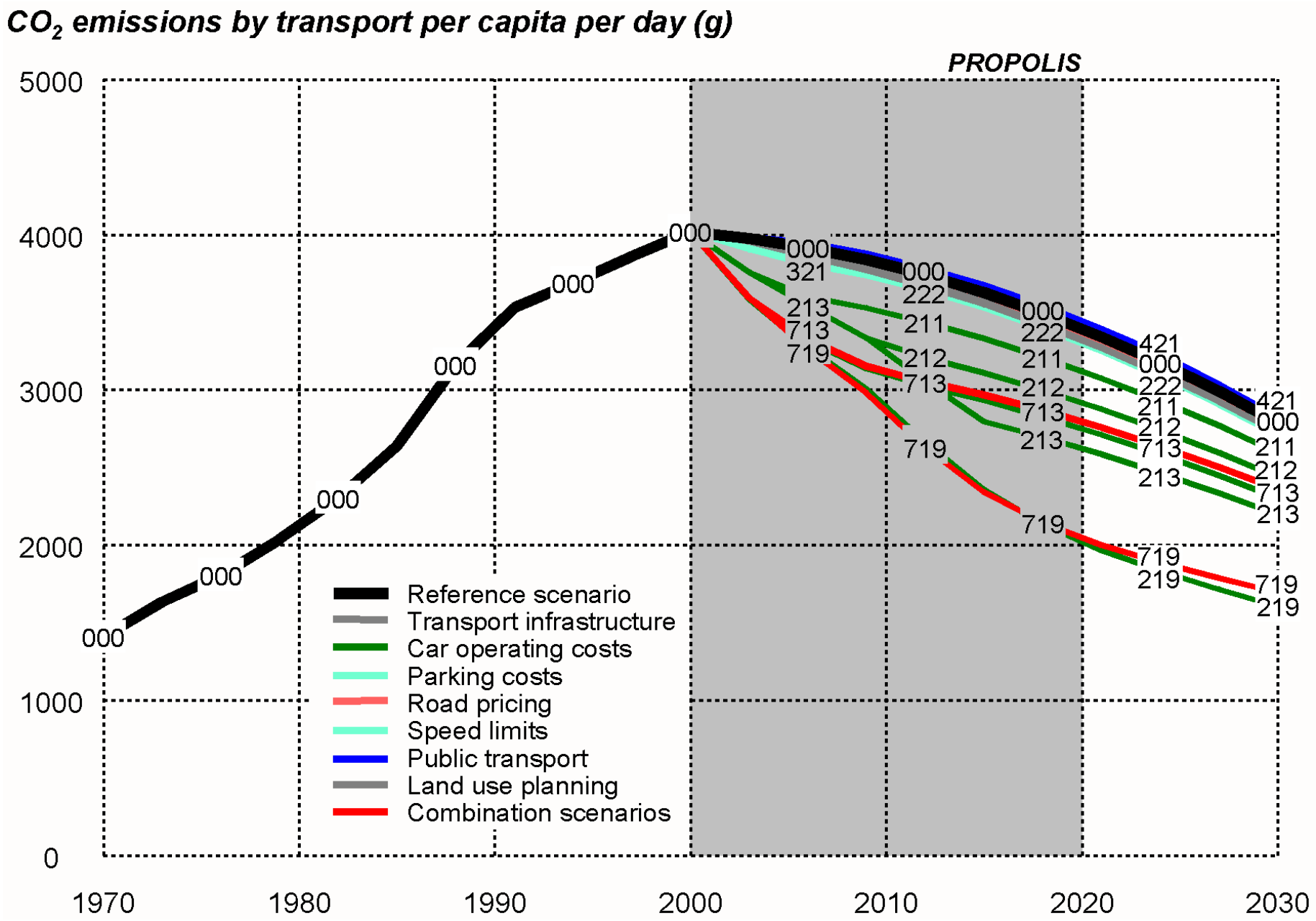
Scenario Comparison

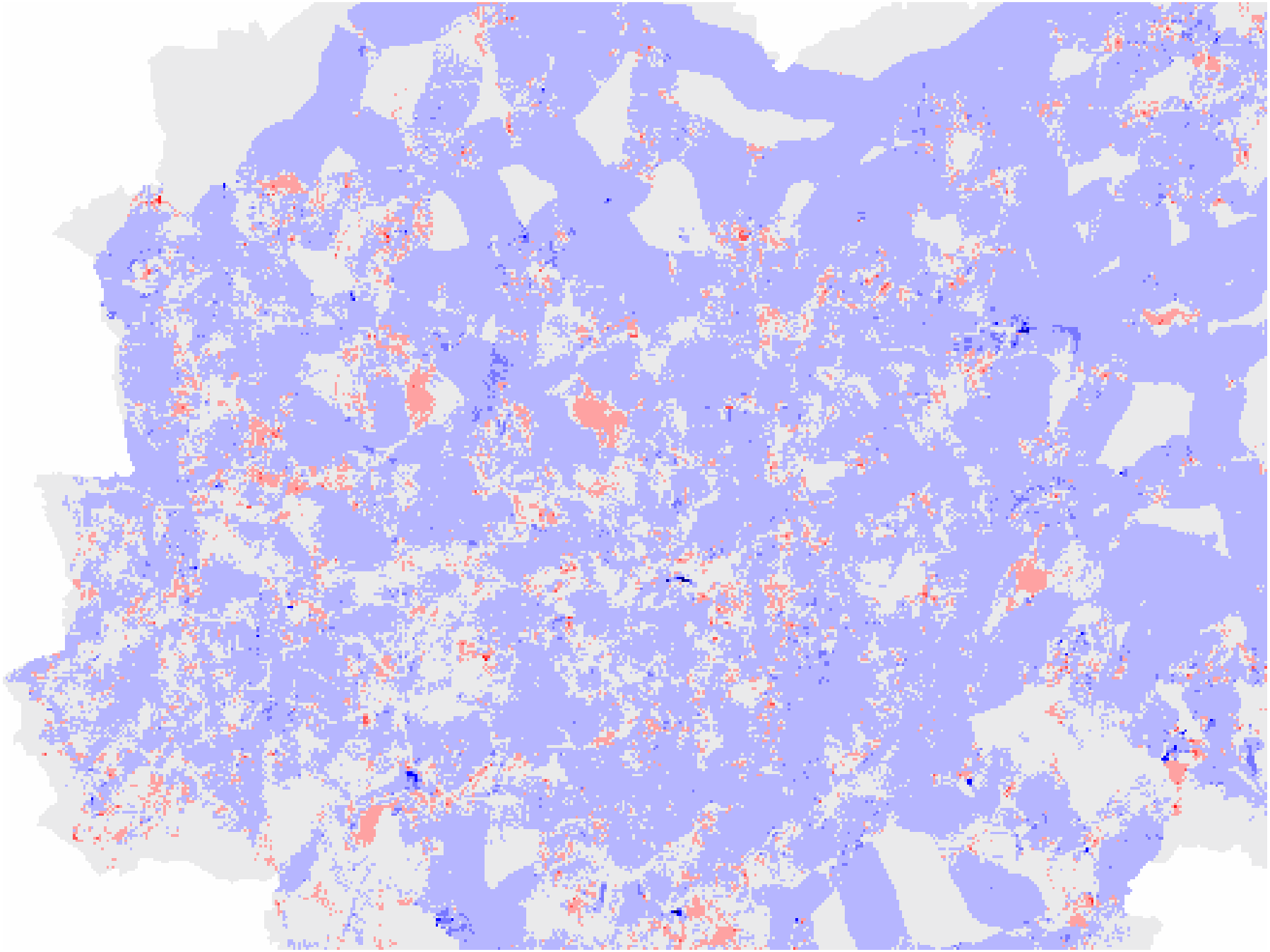

Mean trip length (km)
PROPOLIS
18
16
14
12
10
8
1970
1980
1990
2000
2010
2020
2030
Reference scenario
Transport infrastructure
Car operating costs
Parking costs
Road pricing
Speed limits
Public transport
Land use planning
Combination scenarios
000
421
521
311
211
212
213
214
219
712
713
719


Car ownership (cars per 1,000 population)
PROPOLIS
750
600
450
300
150
0
1970
1980
1990
2000
2010
2020
2030
Reference scenario
Transport infrastructure
Car operating costs
Parking costs
Road pricing
Speed limits
Public transport
Land use planning
Combination scenarios
000
421
713
719
219
214
213


Car-km per capita per day
PROPOLIS
Reference scenario
Transport infrastructure
Car operating costs
Parking costs
Road pricing
Speed limits
Public transport
Land use planning
Combination scenarios
25
20
15
10
5
0
1970
1980
1990
2000
2010
2020
2030
000
541
211
212
213
214
713
719
219


Percent car trips
PROPOLIS
100
80
60
40
20
0
1970
1980
1990
2000
2010
2020
2030
000
219
713
719
Reference scenario
Transport infrastructure
Car operating costs
Parking costs
Road pricing
Speed limits
Public transport
Land use planning
Combination scenarios


CO2 emissions by transport per capita per day (g)
PROPOLIS
5000
4000
3000
2000
1000
0
1970
1980
1990
2000
2010
2020
2030
Reference scenario
Transport infrastructure
Car operating costs
Parking costs
Road pricing
Speed limits
Public transport
Land use planning
Combination scenarios



Difference in traffic noise in Scenario 713 v. Reference Scenario in 2021

Synergies between Policies

Synergies

Synergies between policies occur if the total effect of all policies is larger or smaller than the total of the effects of the individual policies applied separately:

- ***Positive synergies:*** the policies reinforce each other.
- ***Negative synergies:*** the policies achieve the same objective by different means, i.e. are substitutable.

There are ***positive*** and ***negative*** synergies between ***land use*** and ***transport*** policies.

Synergies between land use and transport policies

	Difference to Reference Scenario in 2021 (%)						
	Trips	Trip length	% public	% car	Car-km	Cars	CO_2
214 Car operating costs +75%	–2.78	–14.77	+6.49	–3.61	–20.98	–6.24	–18.89
412 Public transport travel time –5%	0.00	+0.02	+1.15	–0.06	–0.12	–0.05	–0.04
421 Public transport fares –50%	+0.75	+2.49	+11.84	–0.42	–0.68	+1.95	+1.62
521 Development at rail stations	+0.01	–1.43	+1.01	–0.01	–0.46	+0.01	–0.35
Total	–2.02	–13.69	+20.19	–4.10	–21.32	–4.33	–17.66
713 (214+412+421+521)	–1.93	–11.56	+27.45	–4.96	–23.28	–3.81	–17.61
Synergies	+0.09	+2.13	+7.26	–0.86	–1.96	+0.52	+0.05

Positive synergies Negative synergies

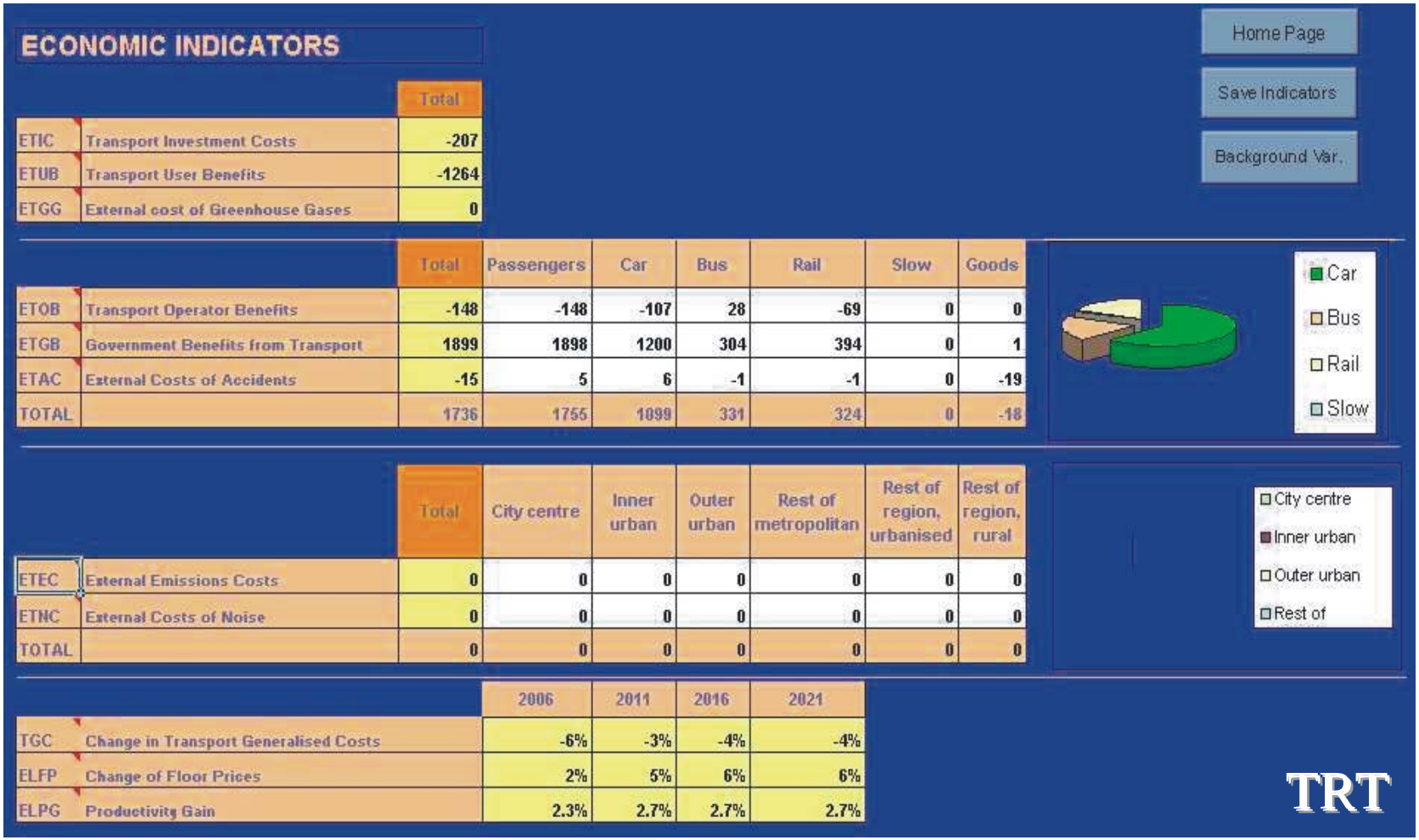
Evaluation

Problems of evaluation of policies

- What are the ***socio-economic footprints***?
- Conflicting ***short- and long-term effects***
- ***Policy combinations*** - accumulative or neutralising effects
- ***Mitigation of negative side effect***s
- ***Conflicting goals*** - is there an optimum?

Economic evaluation

Economic evaluations are made in a special module



		Total
ETIC	Transport Investment Costs	-207
ETUB	Transport User Benefits	-1264
ETGG	External cost of Greenhouse Gases	0

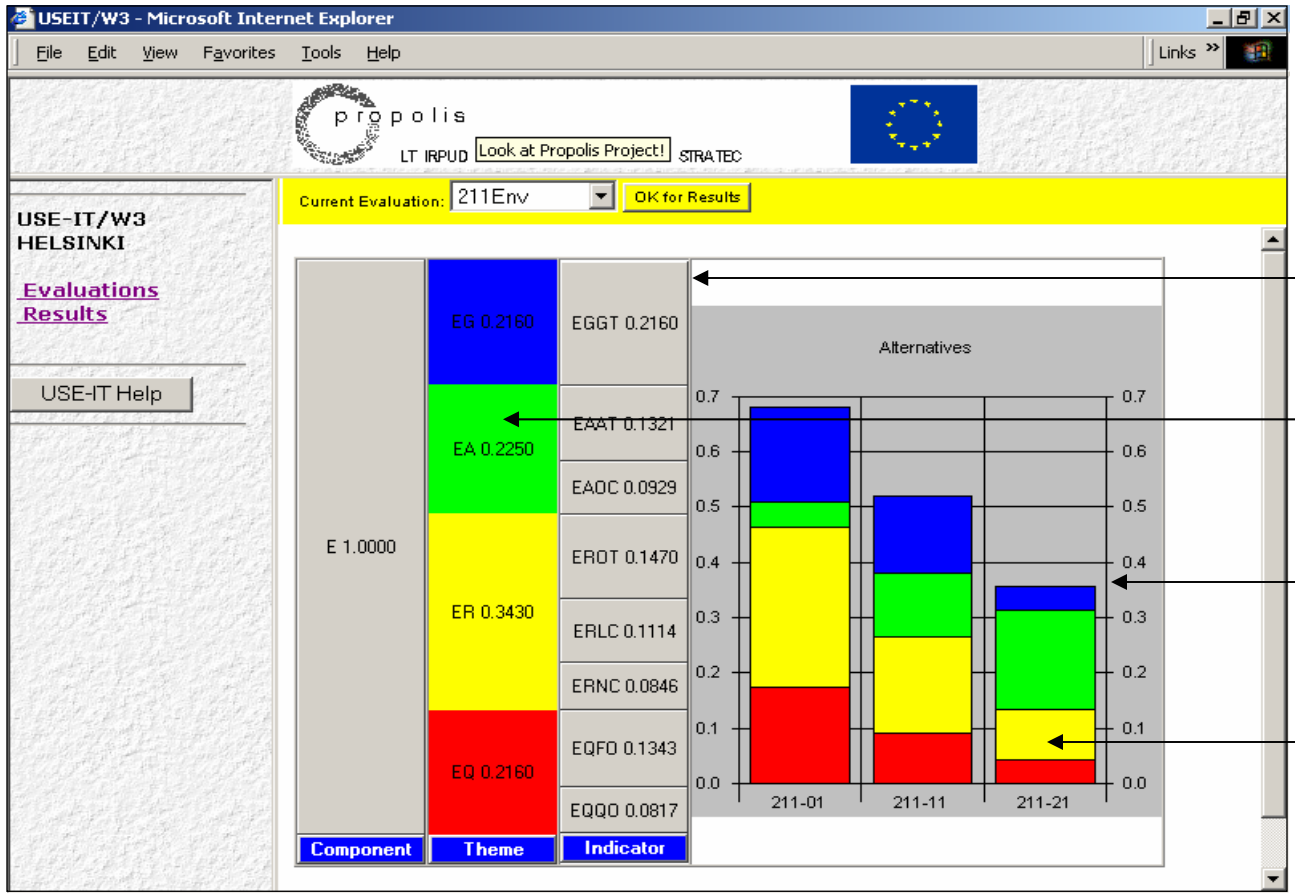
		Total	Passengers	Car	Bus	Rail	Slow	Goods
ETOB	Transport Operator Benefits	-148	-148	-107	28	-69	0	0
ETGB	Government Benefits from Transport	1899	1898	1200	304	394	0	1
ETAC	External Costs of Accidents	-15	5	6	-1	-1	0	-19
TOTAL		1736	1755	1099	331	324	0	-18

		Total	City centre	Inner urban	Outer urban	Rest of metropolitan	Rest of region, urbanised	Rest of region, rural
ETEC	External Emissions Costs	0	0	0	0	0	0	0
ETNC	External Costs of Noise	0	0	0	0	0	0	0
TOTAL		0	0	0	0	0	0	0

		2006	2011	2016	2021
TGC	Change in Transport Generalised Costs	-6%	-3%	-4%	-4%
ELFP	Change of Floor Prices	2%	5%	6%	6%
ELPG	Productivity Gain	2.3%	2.7%	2.7%	2.7%

Overall assessment

The indicators are evaluated in the USE-IT module



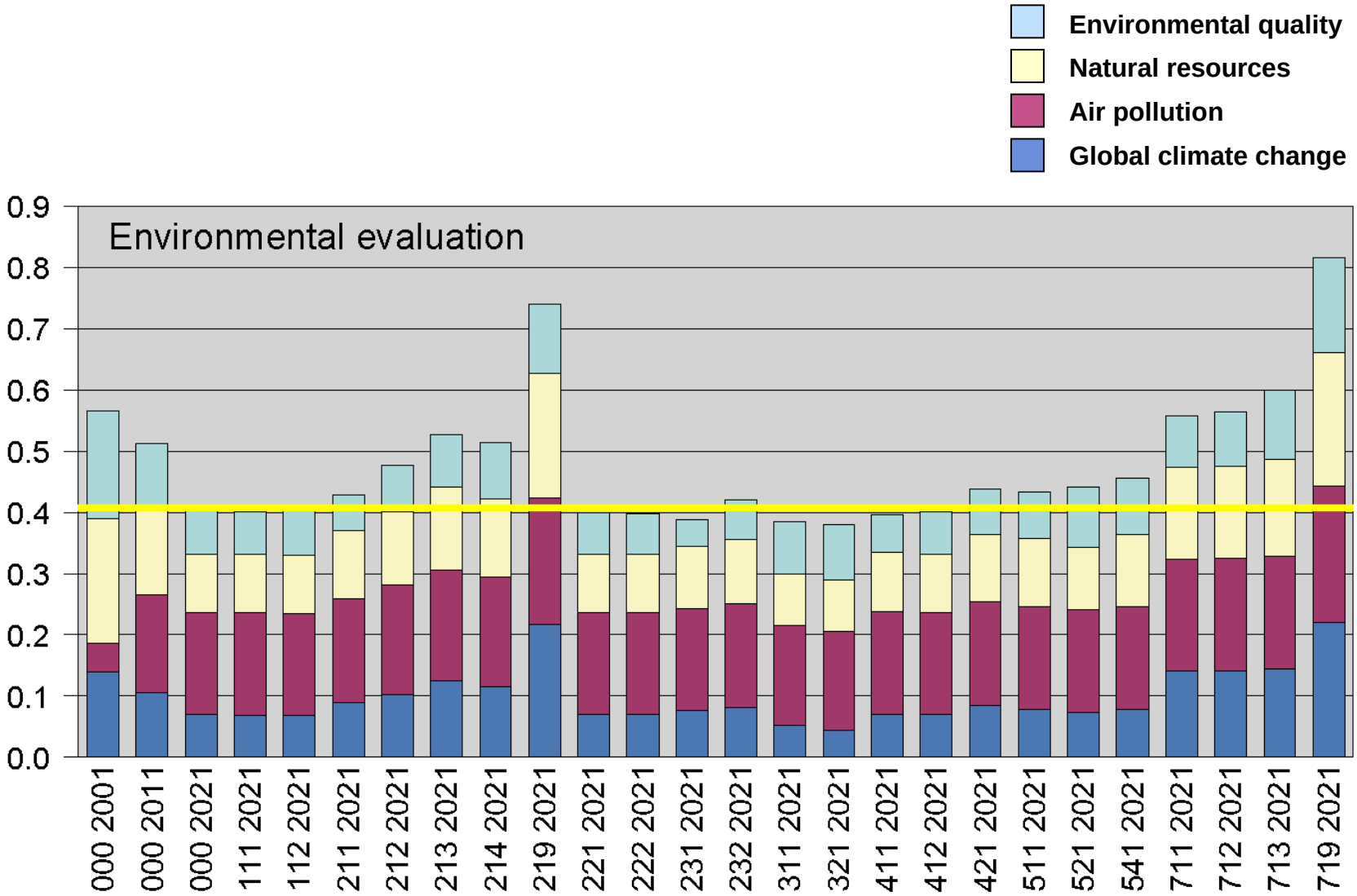
Indicator weights

Theme weights

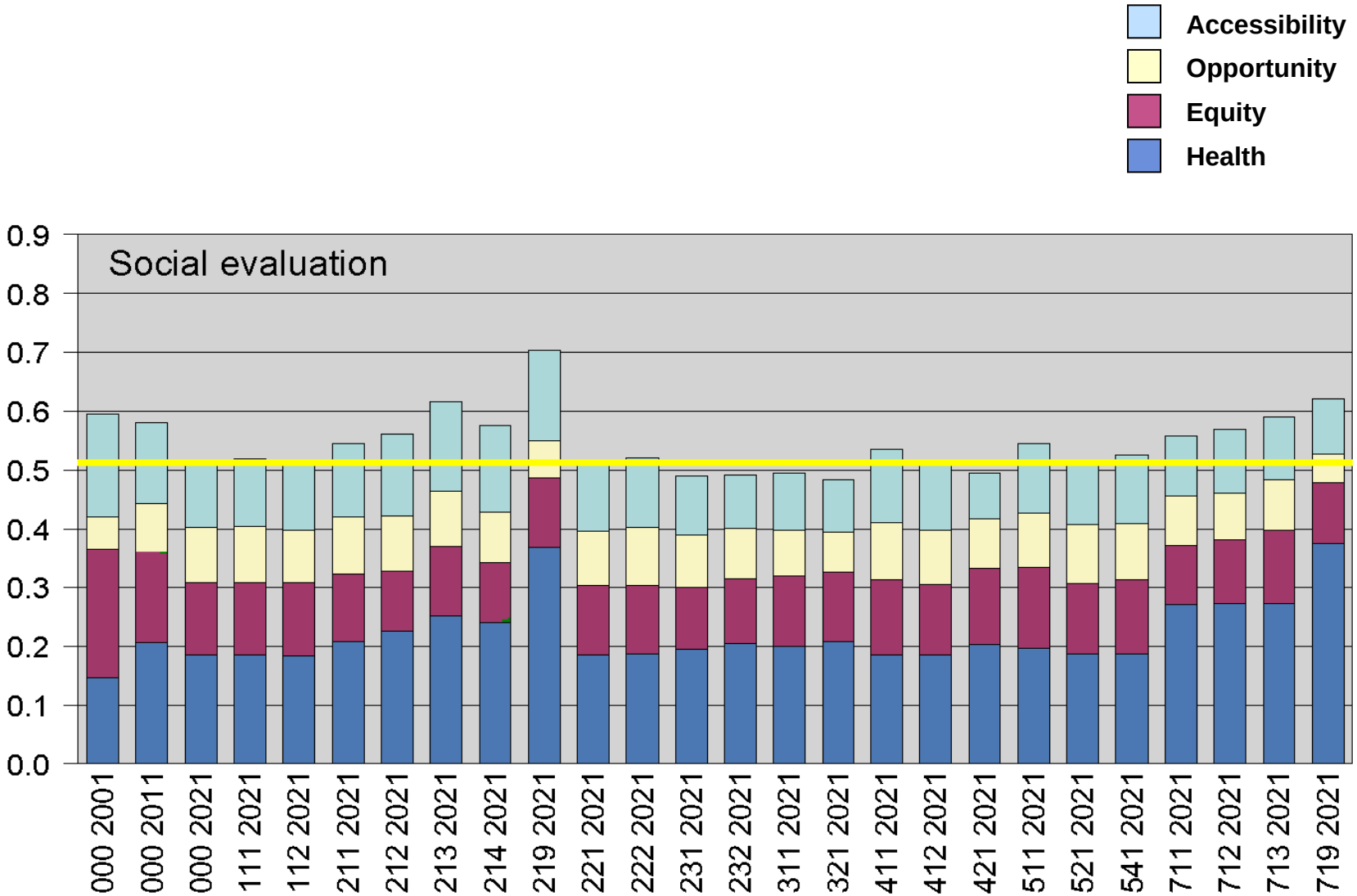
Environmen-tal index

Policy alternatives

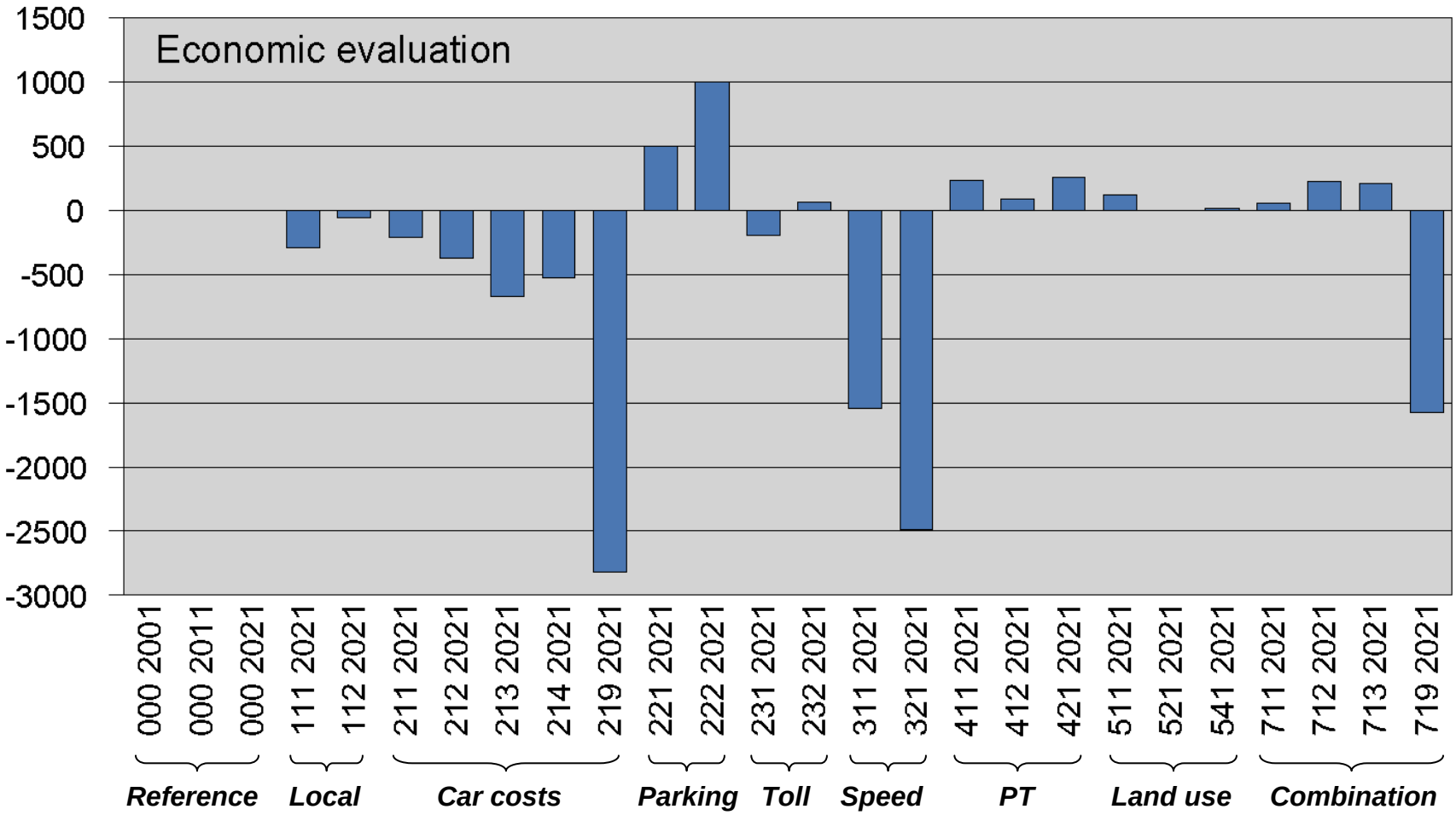
Environmental evaluation



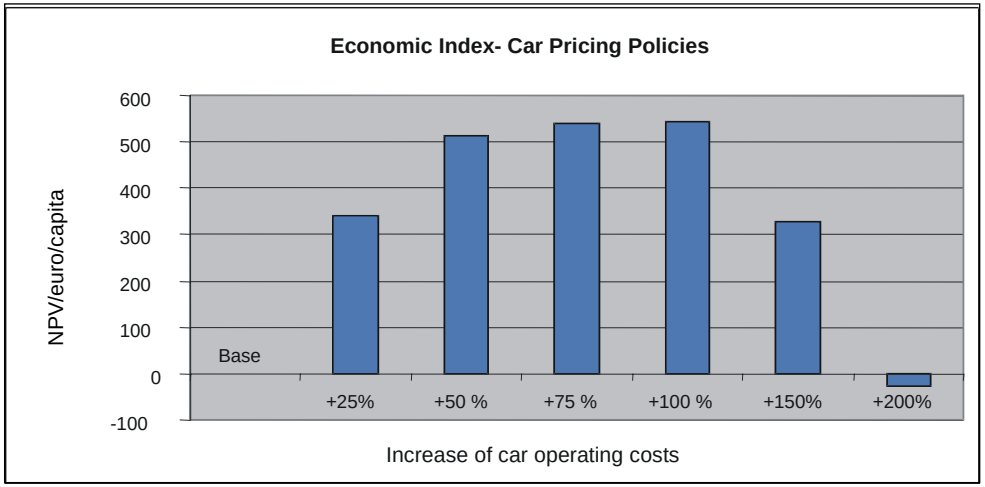
Social evaluation



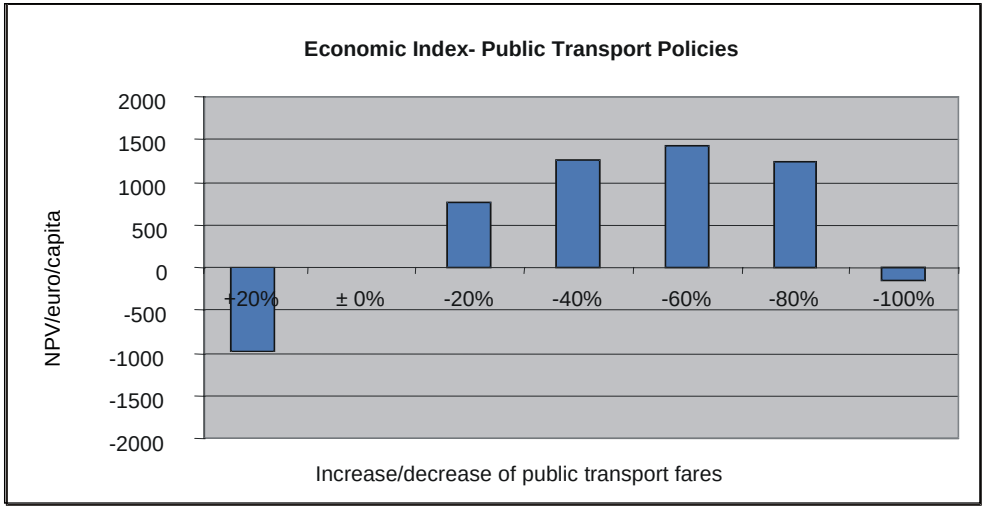
Economic evaluation



There is an optimum for car pricing and PT fares

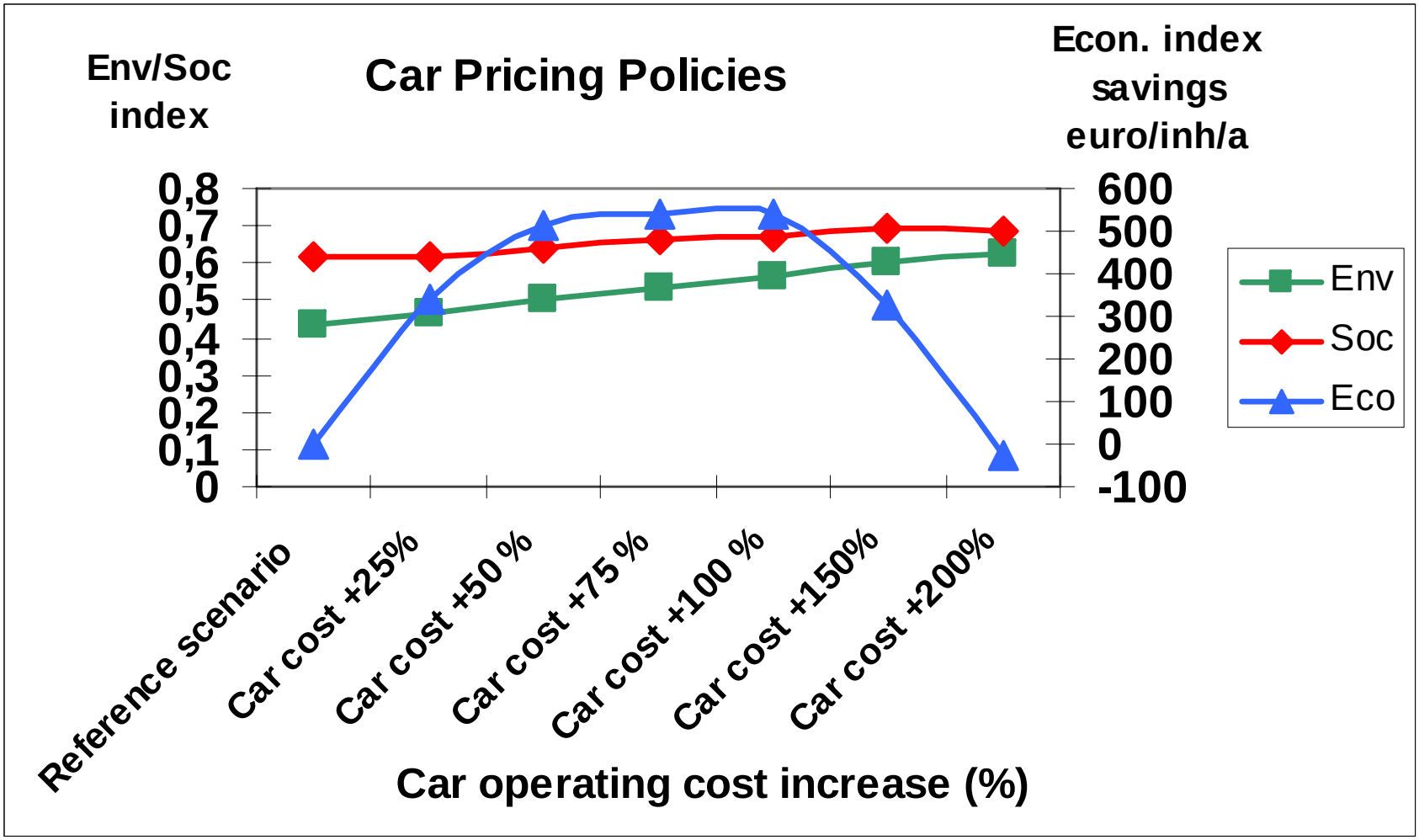


The Economic Index in different car pricing policies

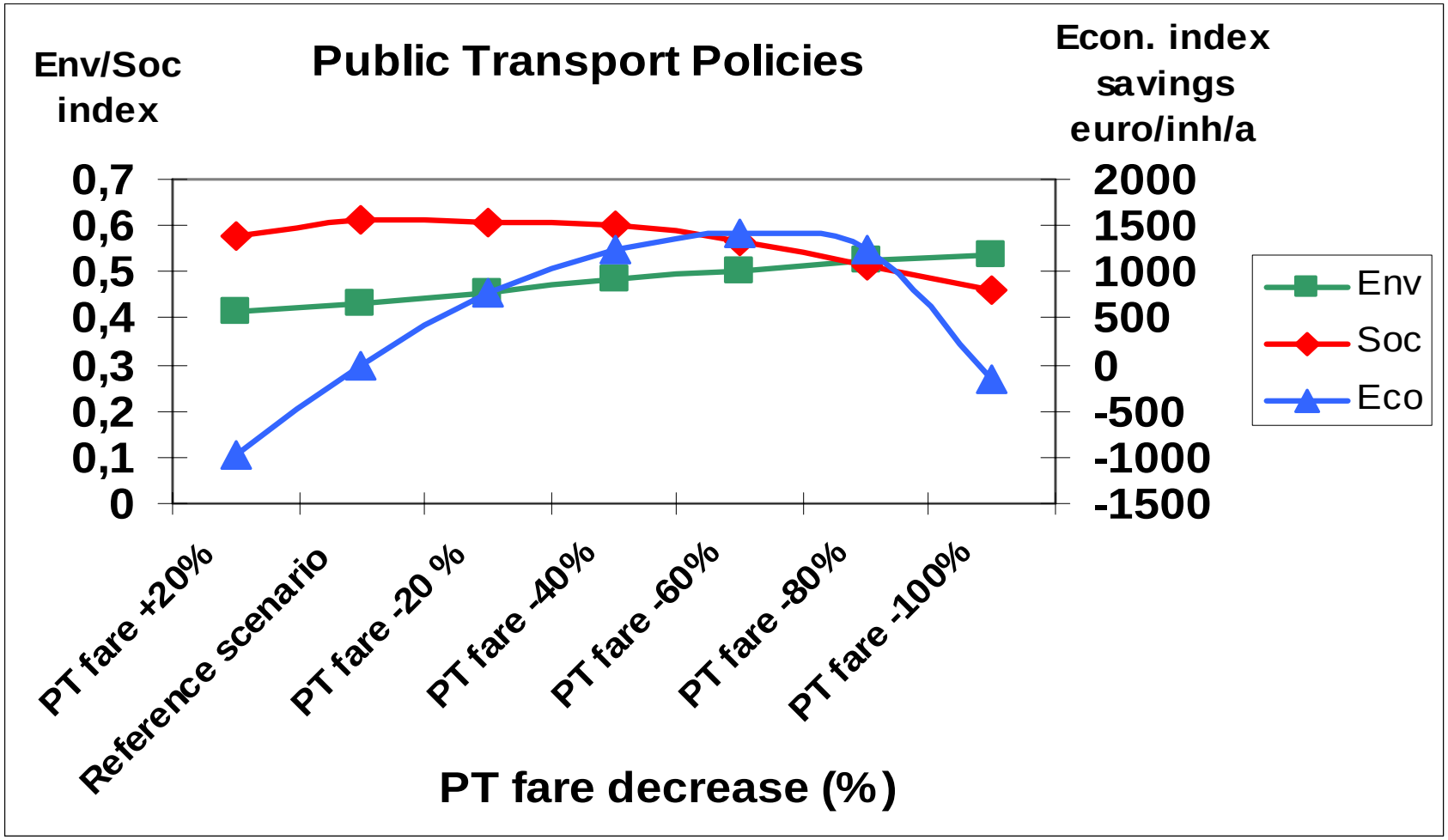


The Economic Index in different public transport pricing policies

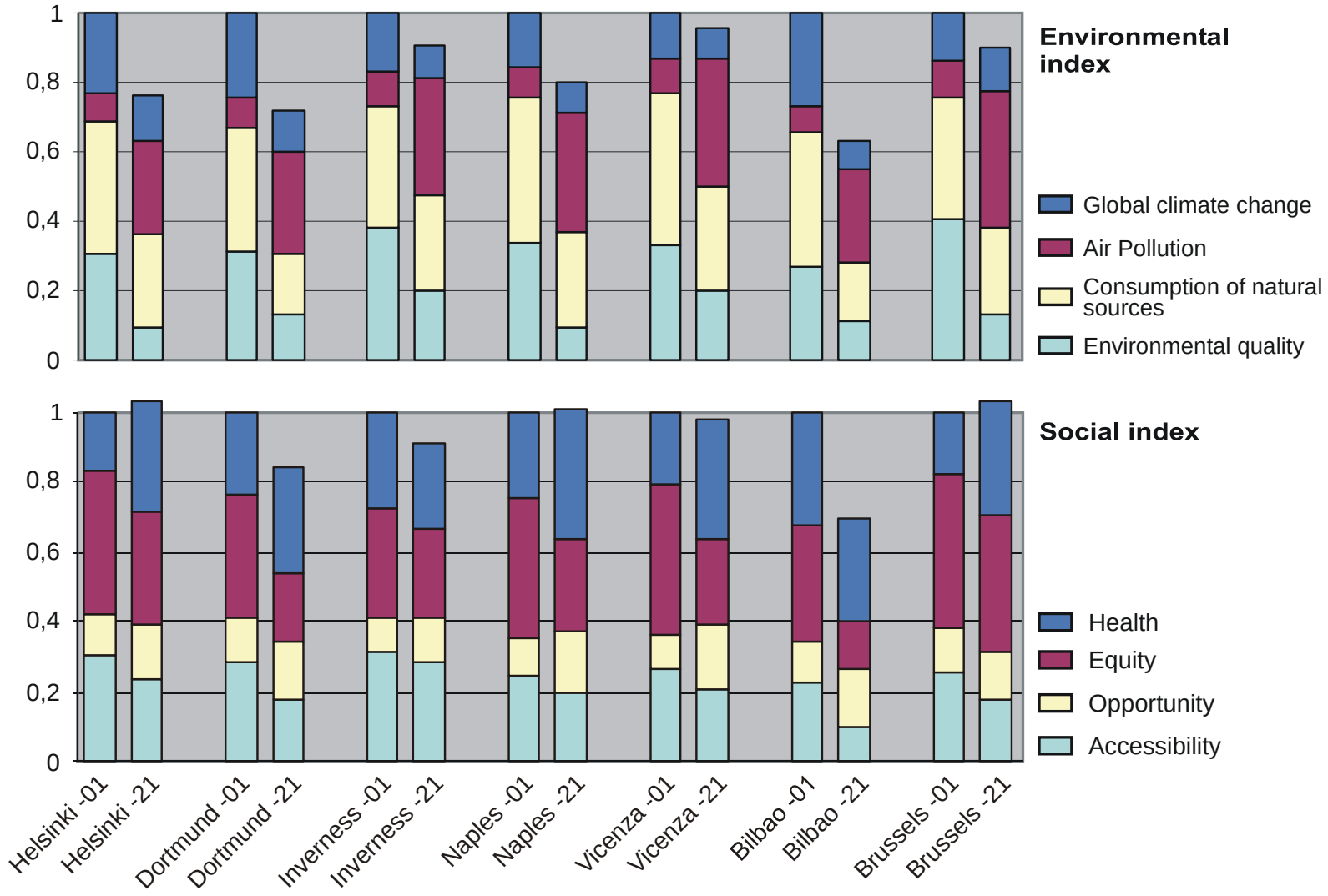
Sustainability indices in car pricing scenarios



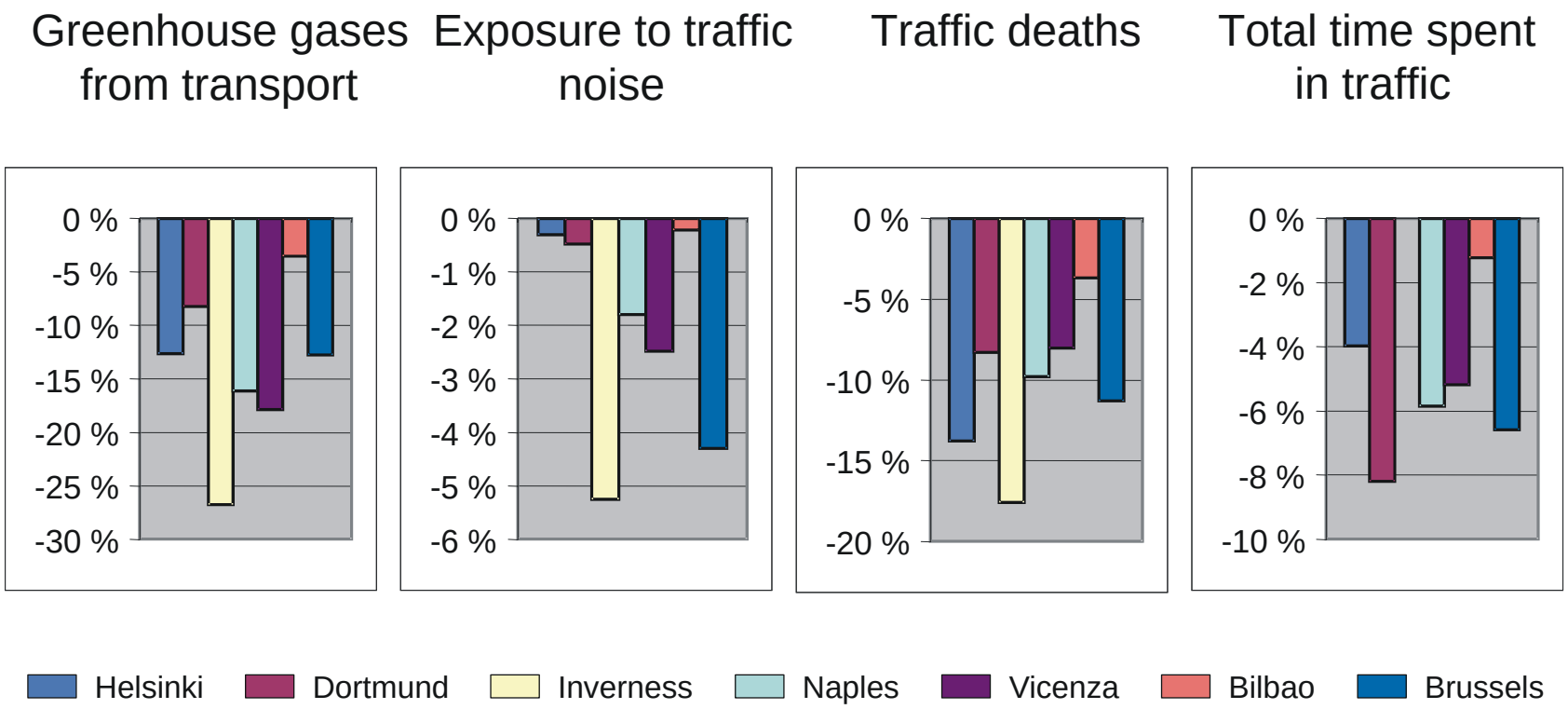
Sustainability indices in public transport pricing scenarios



Environmental and Social Index in Reference Scenario



*Scenario 212: car operating costs +50 % **



* *Policy scenario in 2021 v. Reference scenario in 2021*

Conclusions

Conclusions (1)

Without integrated urban land-use and transport planning the existing level of sustainability will ***not*** be maintained.

Further growth in ***income*** will result in

- further ***spatial decentralisation*** of residences and workplaces,
- higher ***car ownership***,
- more and longer ***trips***,
- more ***energy*** consumption and ***greenhouse gases***,
- more ***traffic noise*** and ***air pollution***,
- less ***open space*** and ***natural habitats***.

Conclusions (2)

Transport policies making ***public transport*** more attractive (i.e. faster or less expensive) have only ***little*** effect on car mobility.

However, they contribute to further spatial decentralisation of residences and workplaces.

Conclusions (3)

Land-use policies to increase urban density or mixed land-use or development near public transport stations ***without*** accompanying measures to make car travel less attractive have only ***little effect*** on car mobility.

However, these policies are important in the long run as they provide the necessary ***preconditions*** for a reduction of car mobility.

Conclusions (4)

Transport policies making ***car travel*** less attractive (more expensive or slower) are ***very effective*** in reducing car mobility and making cities more sustainable.

However, these policies depend on a ***not too dispersed*** spatial organisation.

Conclusions (5)

Policy packages combining policies making car travel less attractive ***and*** policies making public transport more attractive ***and*** land-use policies to increase urban density and mixed land use are ***very effective*** in achieving less car-dependent cities.

They may include:

- a combination of ***pricing policies*** directed at car users with moderate public transport fares,
- ***public transport infrastructure investments*** to improve public transport speed and service,
- a ***land use plan*** supporting living near central areas, in satellite cities or along public transport corridors.

Conclusions (6)

The goal of ***simultaneously improving all dimensions*** of sustainability was reached in most of the case cities using the same type of approach. This indicates that the approach could work in other ***European*** cities as well, and that the results could thus be transferable.

Conclusions (7)

For cities in other affluent regions, such as ***North America*** and ***Australia***, the results can contribute to the discussion whether soft ***pull*** measures are sufficient to achieve sustainable cities or whether politically less acceptable ***push*** measures are also needed.

However, to give up their car-dependent way of life seems presently unacceptable to these countries ... but there are also positive developments..

Conclusions (8)

For the rapidly growing cities in ***eastern Europe***, ***Asia*** and ***Latin America***, the results can be seen as a warning not to repeat the costly mistakes European cities have made.

However, the speed of growth and inefficient governance structures often prevent the implementation of integrated land use and transport policies for sustainable cities.

More information:

PROPOLIS website:
www.wspgroup.fi/lt/propolis

PROPOLIS Final Report:
Lautso, K., Spiekermann, K., Wegener, M., Sheppard, I., Steadman, P., Martino, A., Domingo, R., Gayda, S.: *PROPOLIS – Planning and Research of Policies for Land Use and Transport for Increasing Urban Sustain-ability*. LT Consultants, Helsinki, 2004.