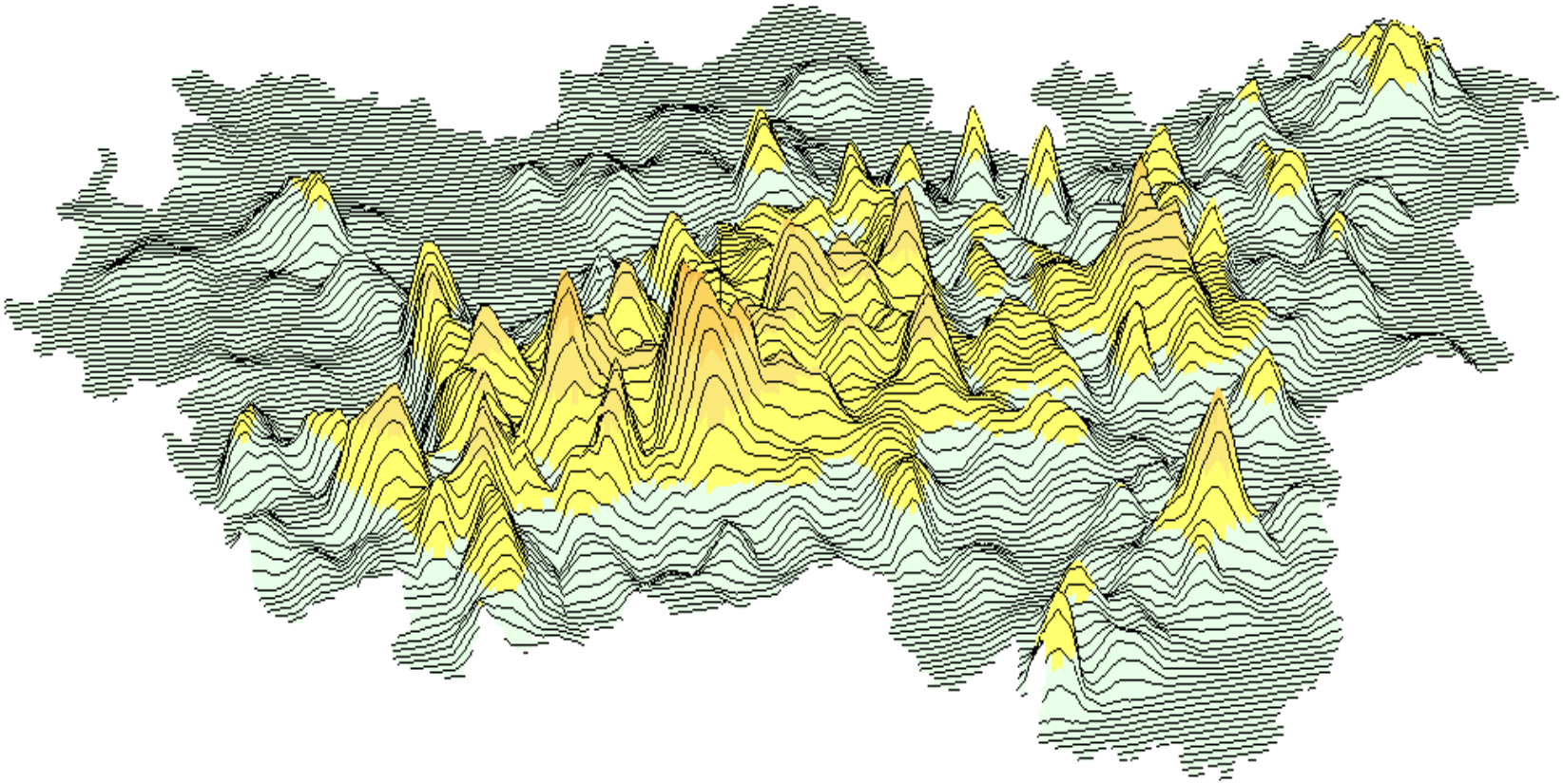
Modelling the Energy Transition in the Ruhr Area



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The Great Transformation

The Great Transformation (1)

Climate researchers agree that anthropogenic greenhouse gas emissions ***significantly contribute*** to climate change, and that ***radical measures*** to reduce them and to adapt to no longer avoidable climate change are needed.

The German Advisory Council on Global Change (WBGU) in its expertise of 2011 called for a ***societal contract*** for a ***great transformation***, a change also of ***cultural*** identities and established ***value*** perceptions and ***action*** patterns in ***politics***, ***economy*** and private ***consumption***.

In its expertise of 2016 the Council emphasised the central role of ***urban and regional planning*** for the achievement of this transformation.

The Great Transformation (2)

This ***fundamental transformation*** will affect mobility and transport in cities. Therefore urban mobility and transport constitute an ***important policy field*** of the transformation called for by the WBGU.

Mobility and transport cannot be analysed separately but have to be assessed ***together*** with urban spatial development, i.e. decisions by ***households*** and ***firms*** where to select their residences or to locate their businesses.

Urban mobility and land use planning therefore need to respond to the challenges of the ***Great Transformation*** together in an ***integrated*** way.

The Mercator Programme

The Mercator Programme

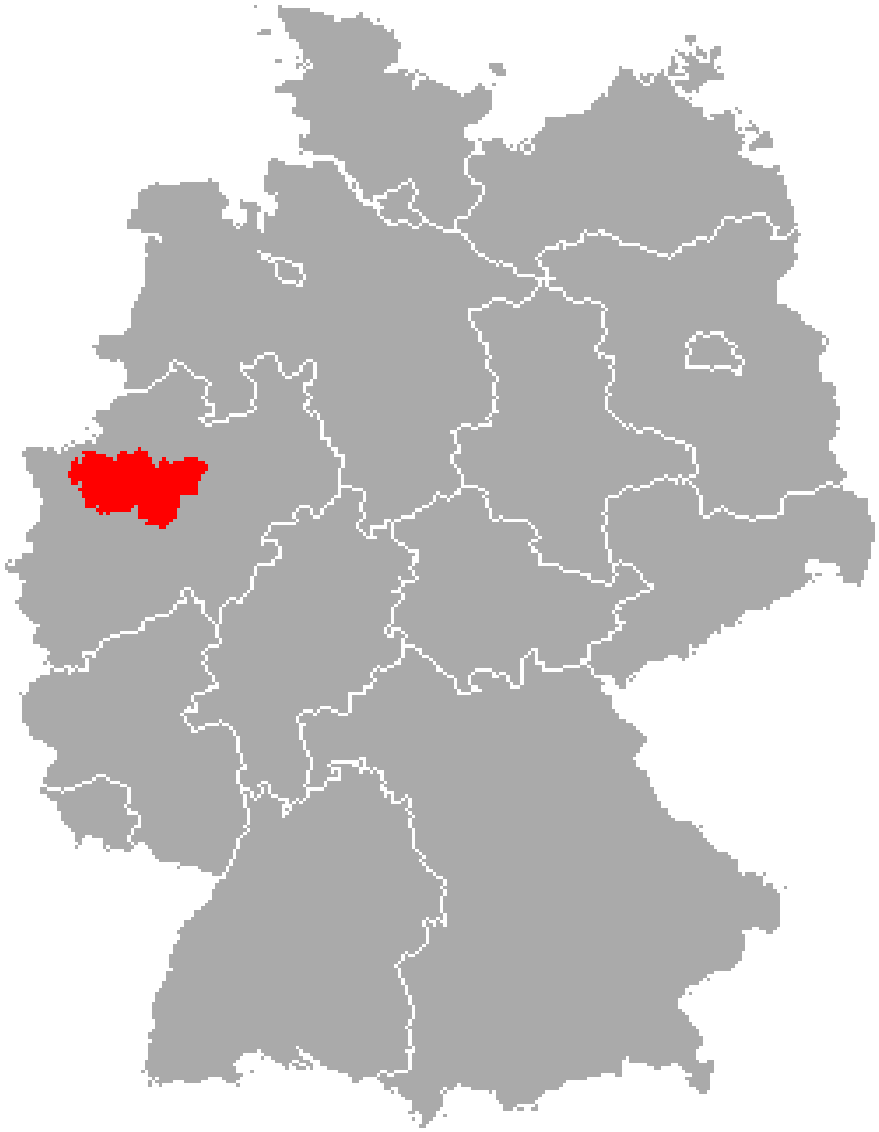
Therefore the private ***Mercator Foundation*** launched in 2013 ***research programme*** on the implementation of the ***energy transition*** in the municipalities of the ***Ruhr Area***. Here two projects of the programme are reported:

- The aim of the project ***Integrated Model Ruhr 2050*** was the development of an integrated model, with which the impacts of policies to reduce energy consumption and CO_2 emissions in the Ruhr Area can be assessed.
- The focus of the project ***Regional Modal Shift*** was the development of transport policy scenarios and their evaluation with respect to the shift from car traffic to public transport, car-sharing, cycling and walking.

The Ruhr Area

With a population of more than five million, the Ruhr Area is one of the ***major urban agglomerations*** in Europe.

Through its industrial past and polycentric settlement structure it has a particular potential for the promotion of transport-saving urban development on former industrial sites.



Method

Ruhr model

In the two projects the ***IRPUD model*** originally developed at the University of Dortmund was applied.

The model is a ***simulation model*** of intraregional location and mobility decisions in an urban region. It predicts for each simulation period

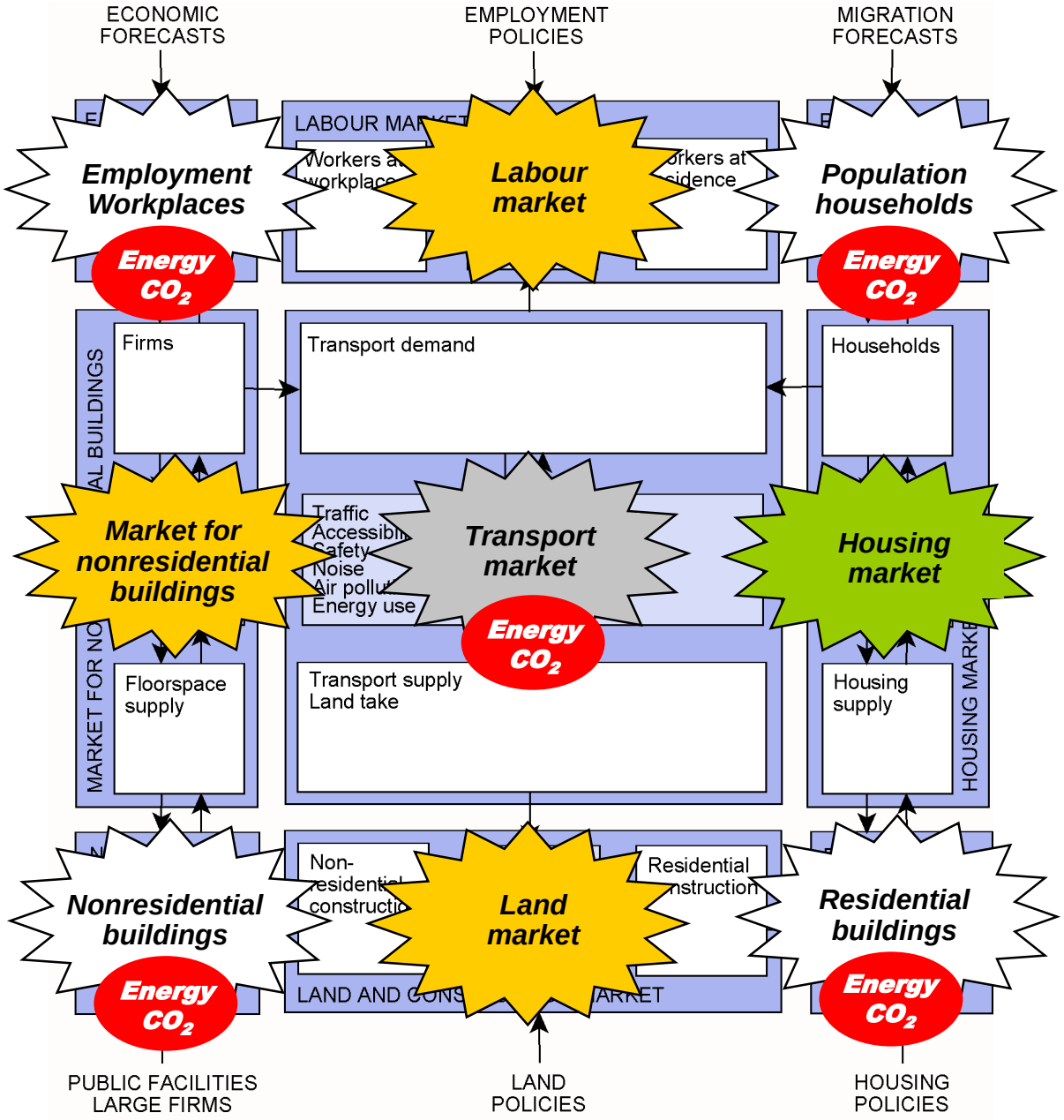
- intraregional location decisions of ***firms***, ***residential developers*** and ***households***,
- the resulting ***migration*** and ***transport flows***,
- the development of ***buildings*** and ***land use***,
- the impacts of public policies in the fields of ***economy***, ***housing***, ***infrastructure*** and ***transport***.

Ruhr model

In the two projects the model was extended in ***space***, ***time*** and ***policy fields***:

- The study area of the model was extended to comprise the whole ***Ruhr Area***.
- The ***time horizon*** of the model was extended to ***2050***.
- The ***policy fields*** of the model were extended to include
  - ***energy consumption*** and ***CO_2 emissions***,
  - ***cycling*** and ***walking*** as separate modes,
  - ***energy retrofitting*** of residential buildings,
  - market penetration of ***electric vehicles***,
  - free-floating ***car-sharing***.

Ruhr model



Microsimulation

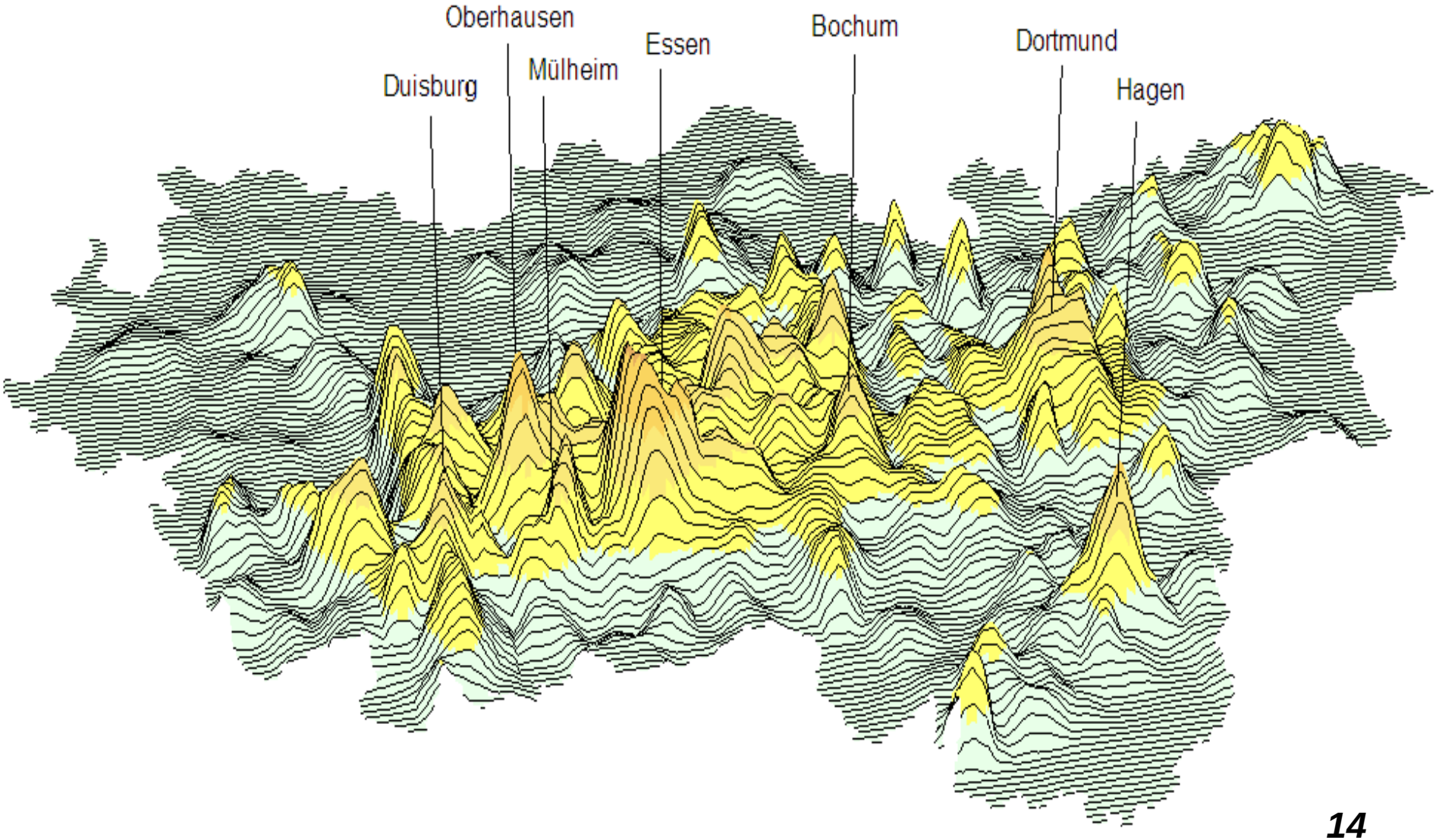
Model results

In the two projects the extended model was applied to answer the following questions:

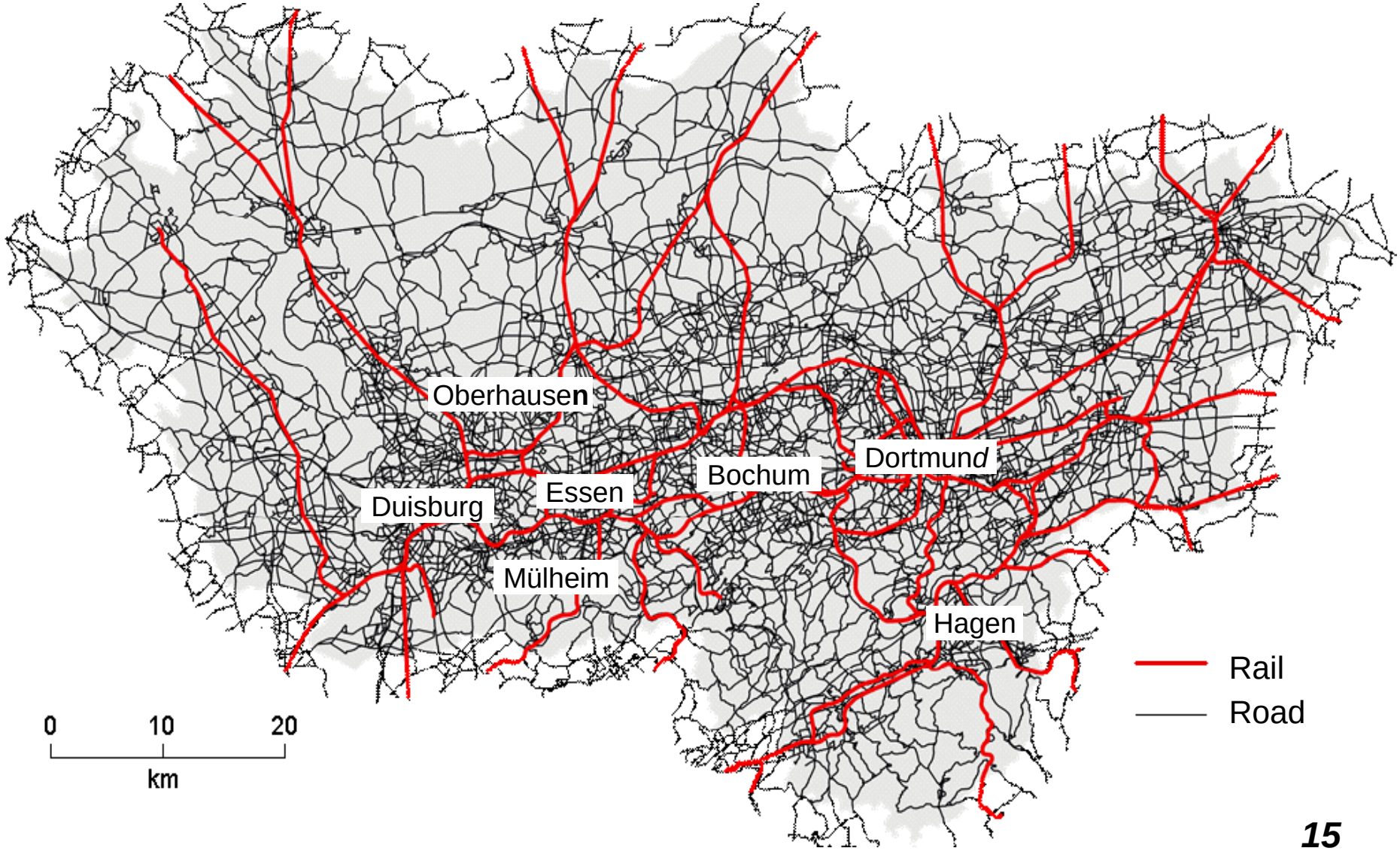
- How will ***settlement structure***, ***transport***, ***energy*** and ***environment*** in the ***Ruhr Area*** develop until the year 2050 under different ***assumptions*** about urban ***land use*** and ***transport*** policies?
- What will be the impacts of ***land use*** and ***transport*** policies on ***energy*** consumption and CO_2 emissions?
- Which ***policy recommendations*** can be derived from the results?

Study Area

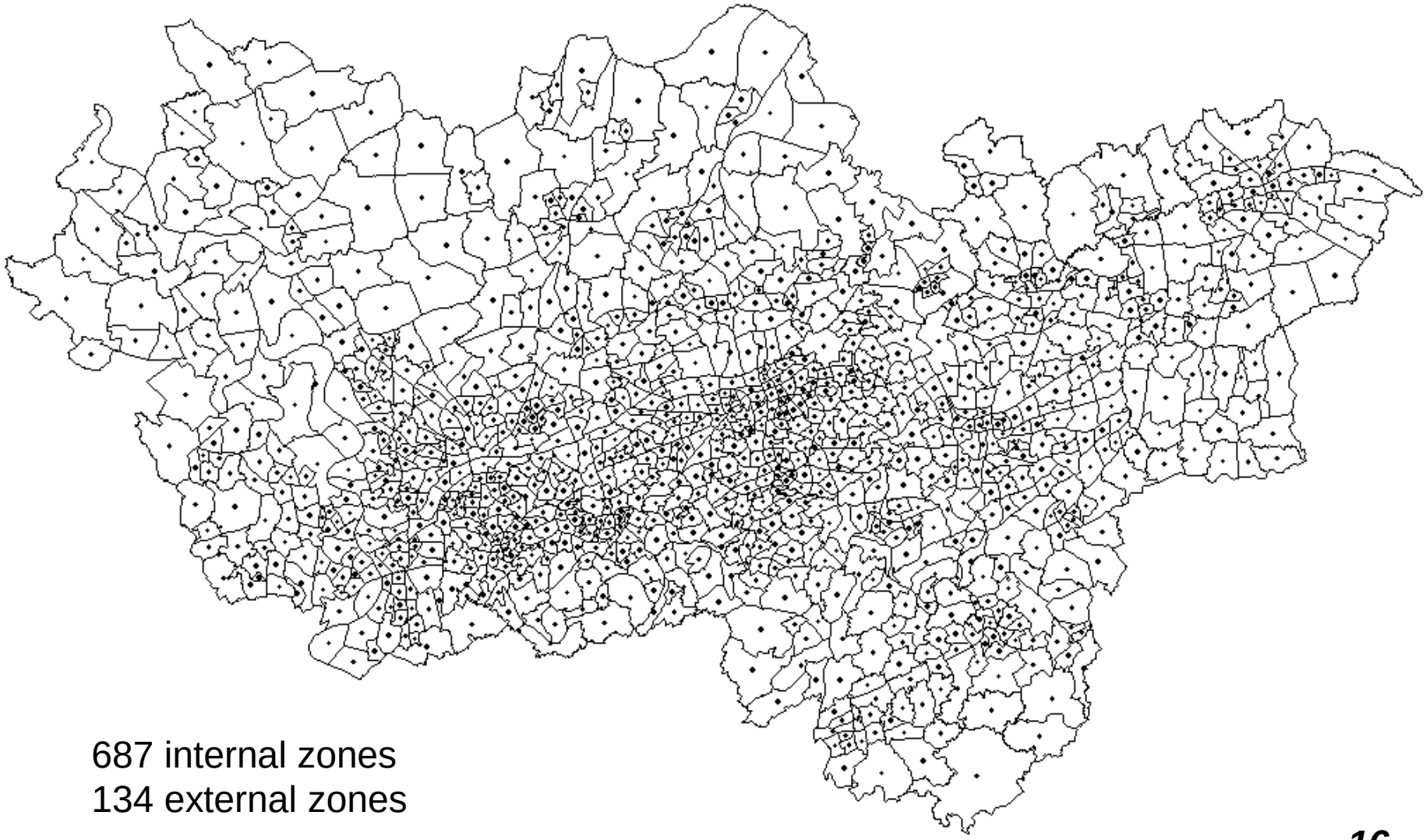
Polycentric Ruhr Area



Transport networks



Ruhr model internal zones



687 internal zones
134 external zones

Scenarios

Scenarios

In the two projects ***twenty scenarios*** from ***seven policy fields*** were examined:

Base:	00	***Base scenario***
Urban form:	*11-14*	***Land use***
	23	***Housing***
Energy:	*33-36*	***Energy efficiency***
Transport:	41-44	***Car traffic (Push)***
	51-53	***Public transport (Pull)***
	61-62	***Cycling (Pull)***
	71	***Walking (Pull)***

In addition ***six combinations*** of policies were examined as ***integrated strategies***:

81-86	***Integrated strategies***

Scenarios

All ***twenty scenarios*** were combined with two different assumptions about the development of ***fuel prices***:

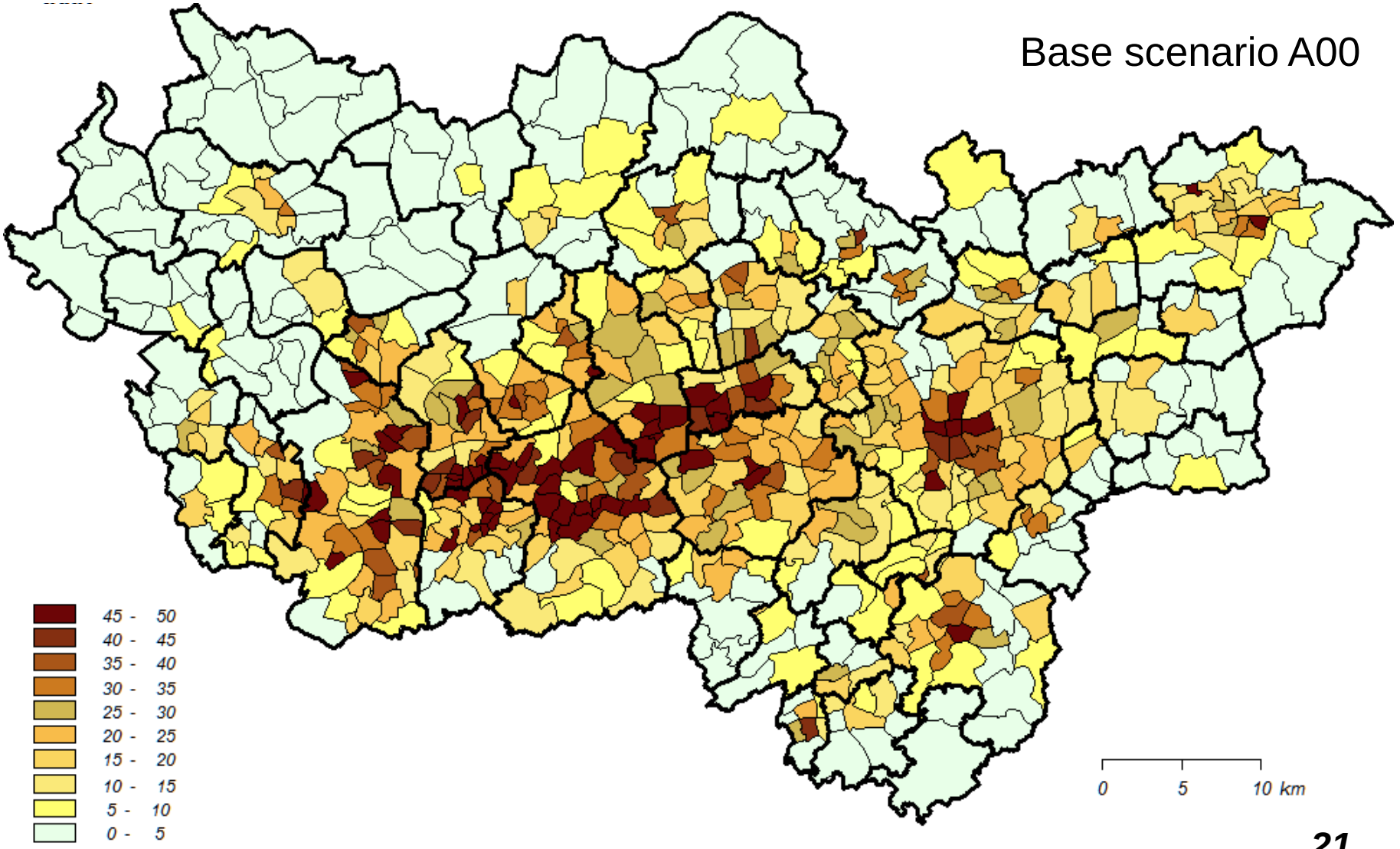
- In the ***A scenarios*** it was assumed that fuel prices will grow by ***one*** percent annually.
- In the **B scenarios** it was assumed that fuel prices will grow by ***four*** percent annually.

The base scenarios are ***business-as-usual*** scenarios, i.e. it is assumed in them that all currently implemented policies will be continued in the future.

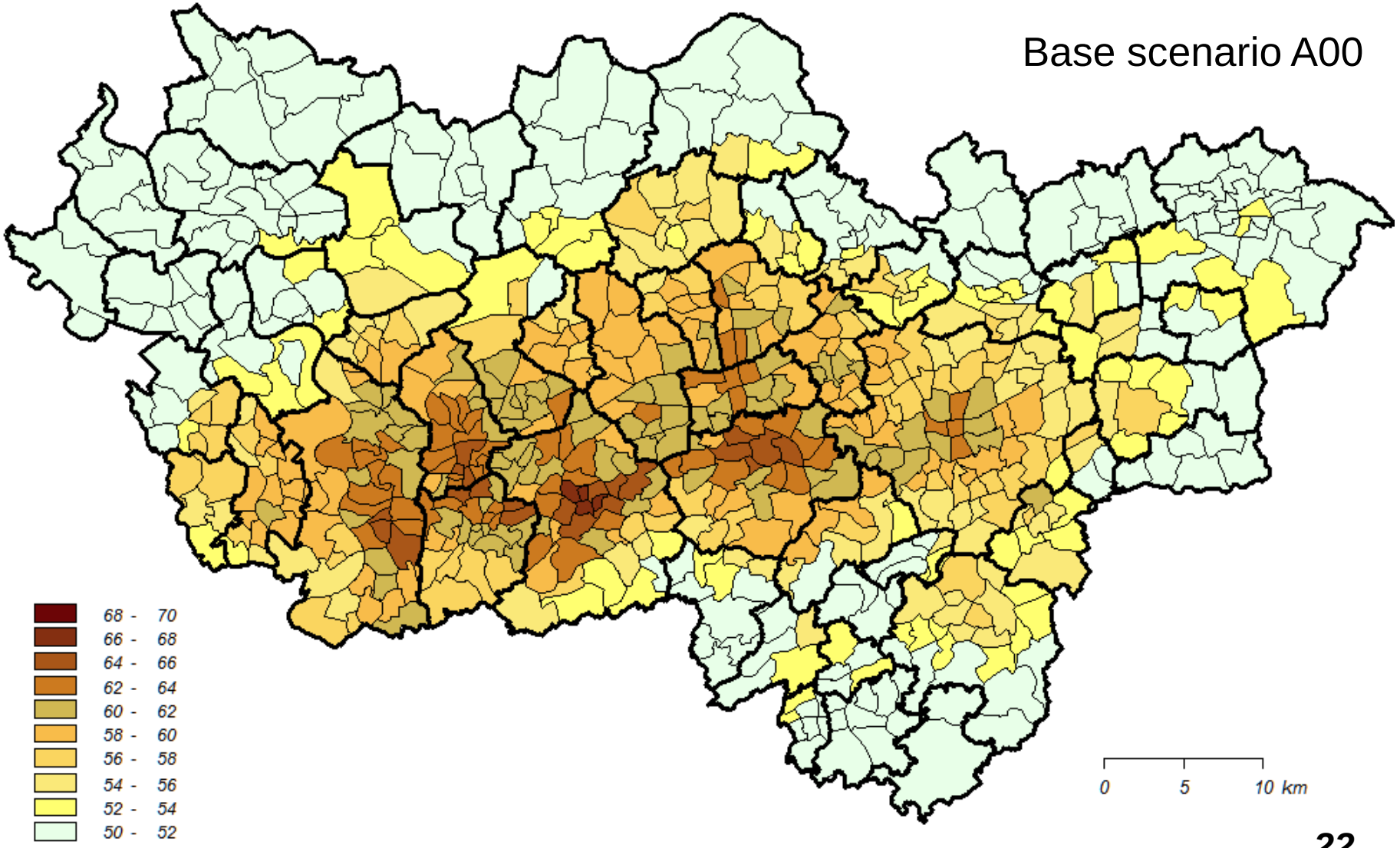
The ***base scenarios*** are the basis for the ***comparison*** between the scenarios.

Base Scenario

Population density 2050 (pop/ha)

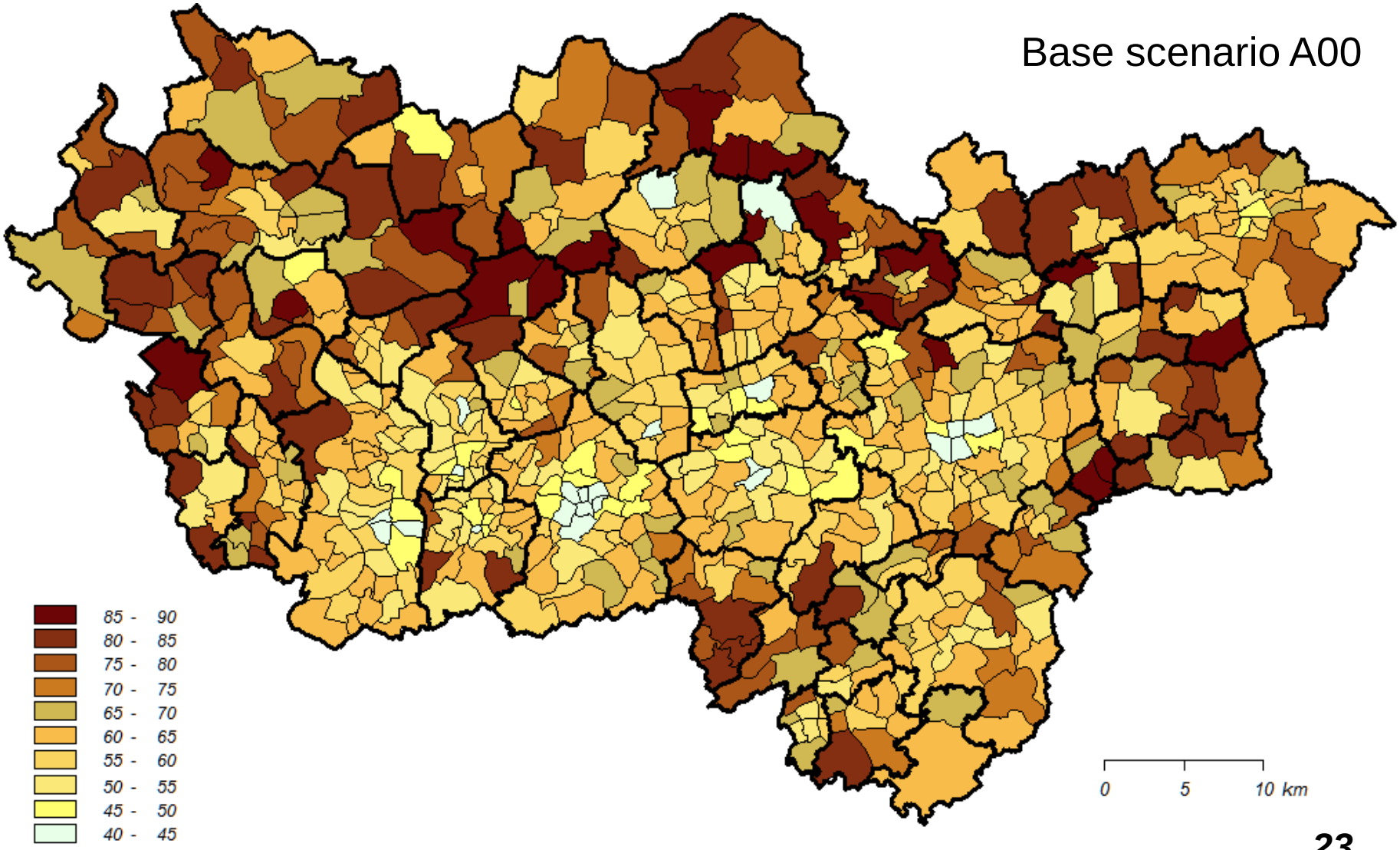


Accessibility work places 2050



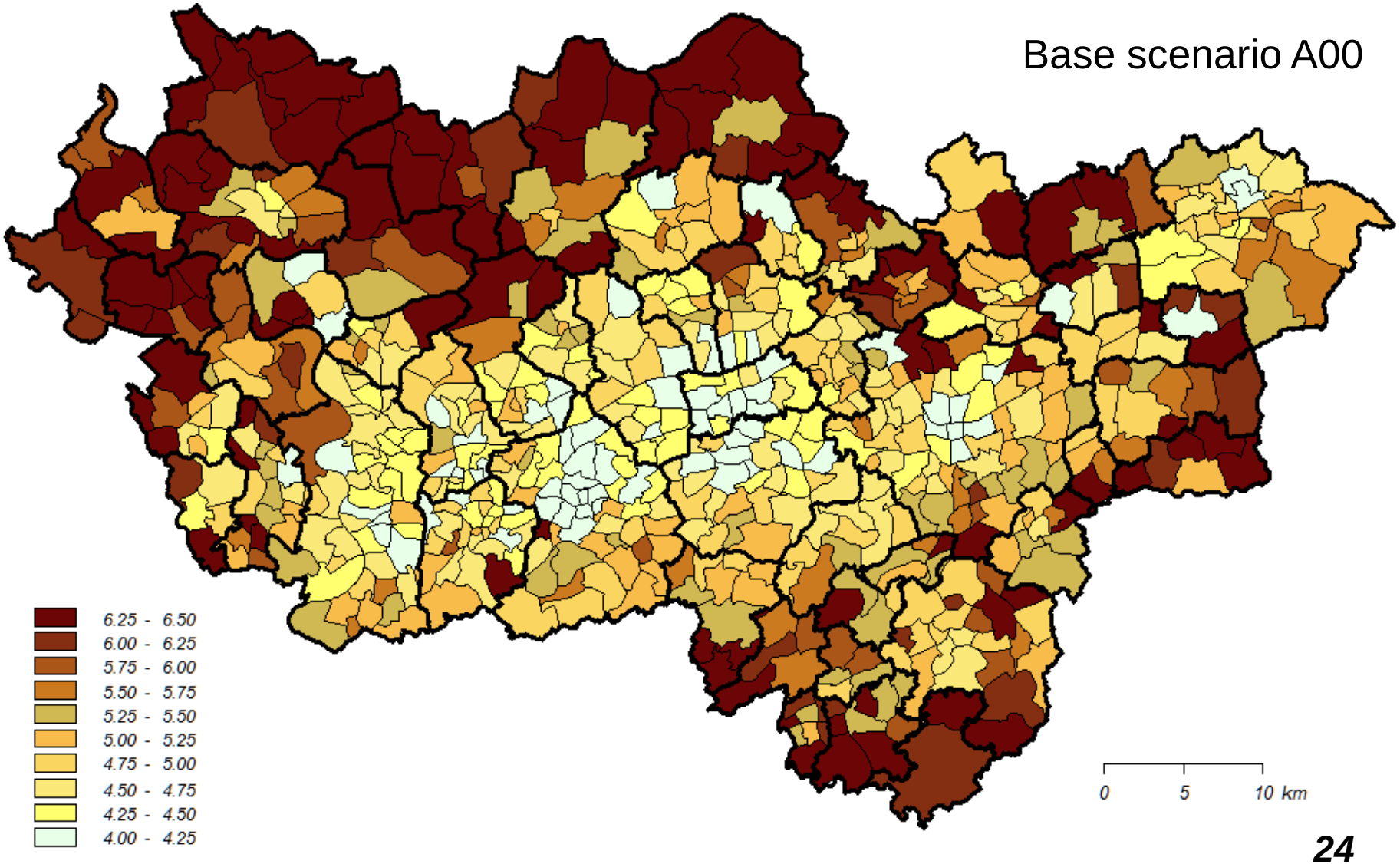
Share of car trips 2050 (%)

Base scenario A00

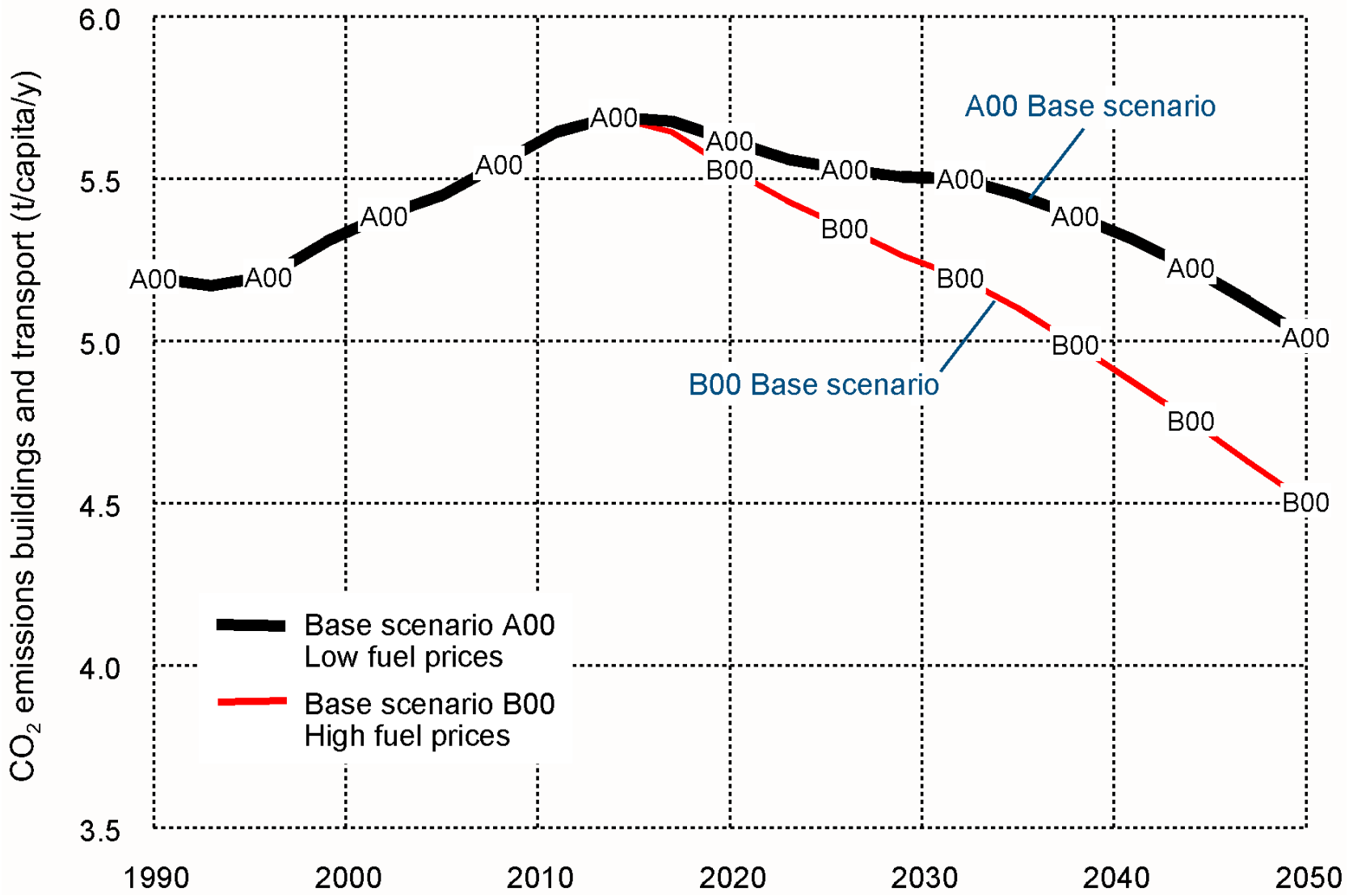


CO_2 emissions 2050 (t/capita/y)

Base scenario A00



Base scenarios A00/B00



Policy Scenarios

Urban form scenarios

In the first two groups of scenarios policies to control the development of ***urban form*** were analysed:

1. ***Land use scenarios:***
   - A11/B11 Densification at ***local centres***
   - A12/B12 Densification at ***public transport stations***
   - A13/B13 Densification at ***railway stations***
   - A14/B14 Densification in ***main cities***
2. ***Housing scenarios:***
   - A23/B23 Housing construction at ***railway stations***

In the ***A scenarios*** low fuel prices and in the ***B scenarios*** high fuel prices were assumed.

Energy efficiency scenarios

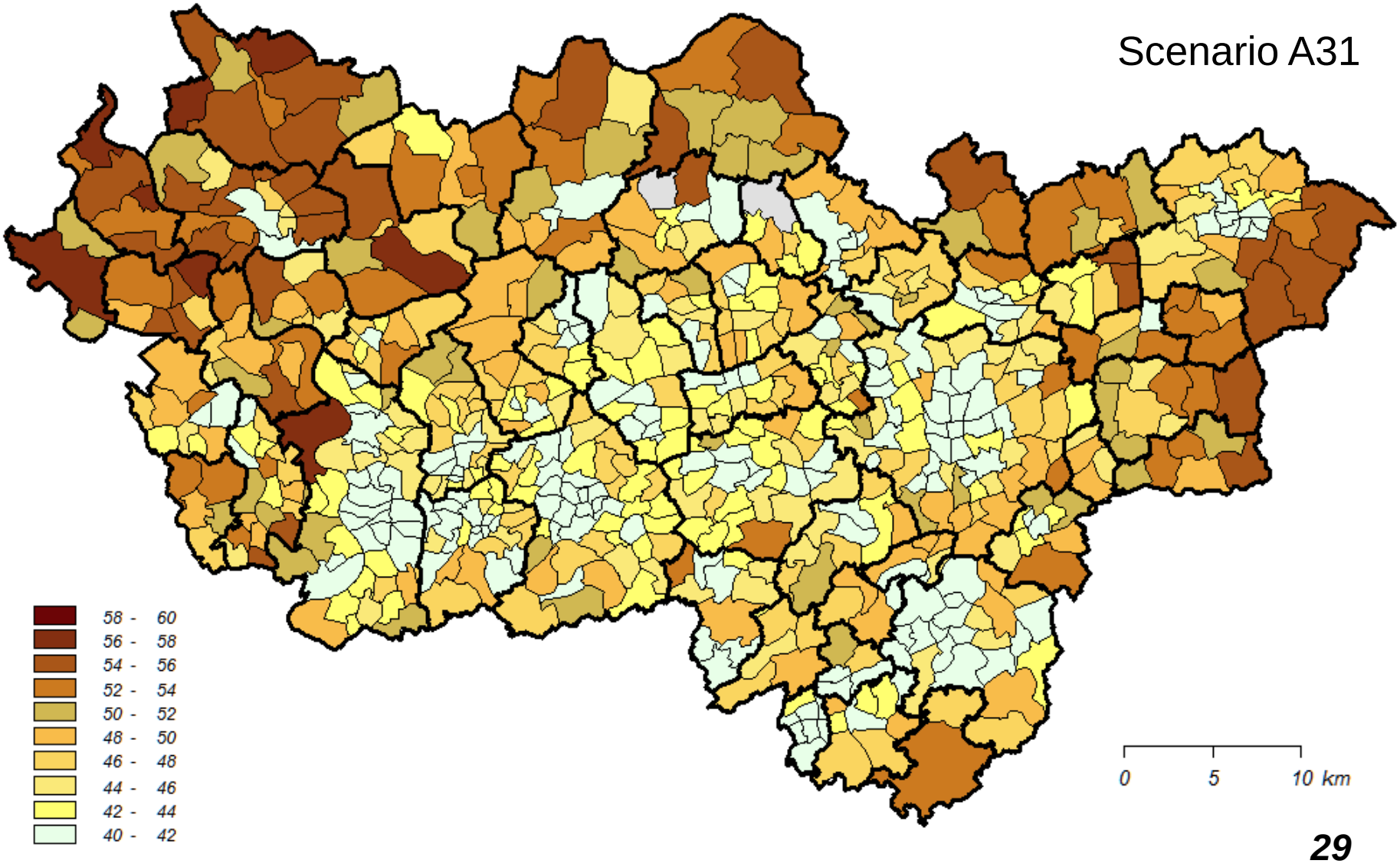
In the third group of scenarios policies to ***save energy*** were analysed:

3 Energy efficiency scenarios:

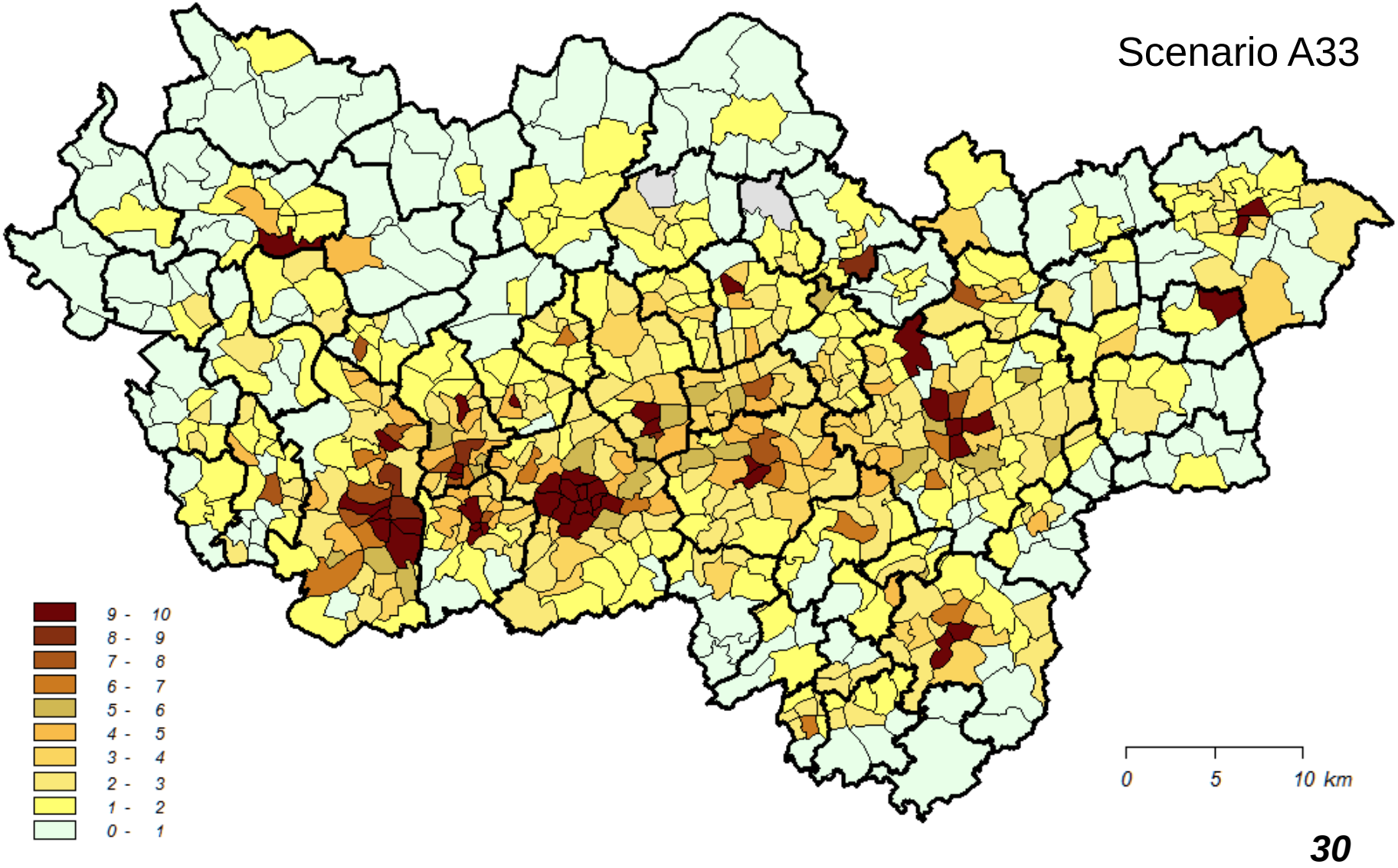
A31/B31 Energy ***retrofitting of buildings***
A32/B32 Promotion of ***electro mobility***
A33/B33 Station-less ***car sharing***
A34/B34 Reduction of ***fuel consumption***

In the ***A scenarios*** low fuel prices and in the ***B scenarios*** high fuel prices were assumed.

Energy-retrofitted residential buildings 2050 (%)



Station-less car-sharing cars 2050 (%)



Car scenarios (Push)

In the fourth group of scenarios policies to ***reduce car traffic*** by making driving less attractive (push policies) were analysed:

4 Car scenarios (Push):

A41/B41 Regional ***cordon fee***
A42/B42 Closing lanes of ***main roads***
A43/B43 Area-wide ***speed limits***
A44/B44 Higher ***parking fees***

In the ***A scenarios*** low fuel prices and in the ***B scenarios*** high fuel prices were assumed.

Public transport scenarios (Pull)

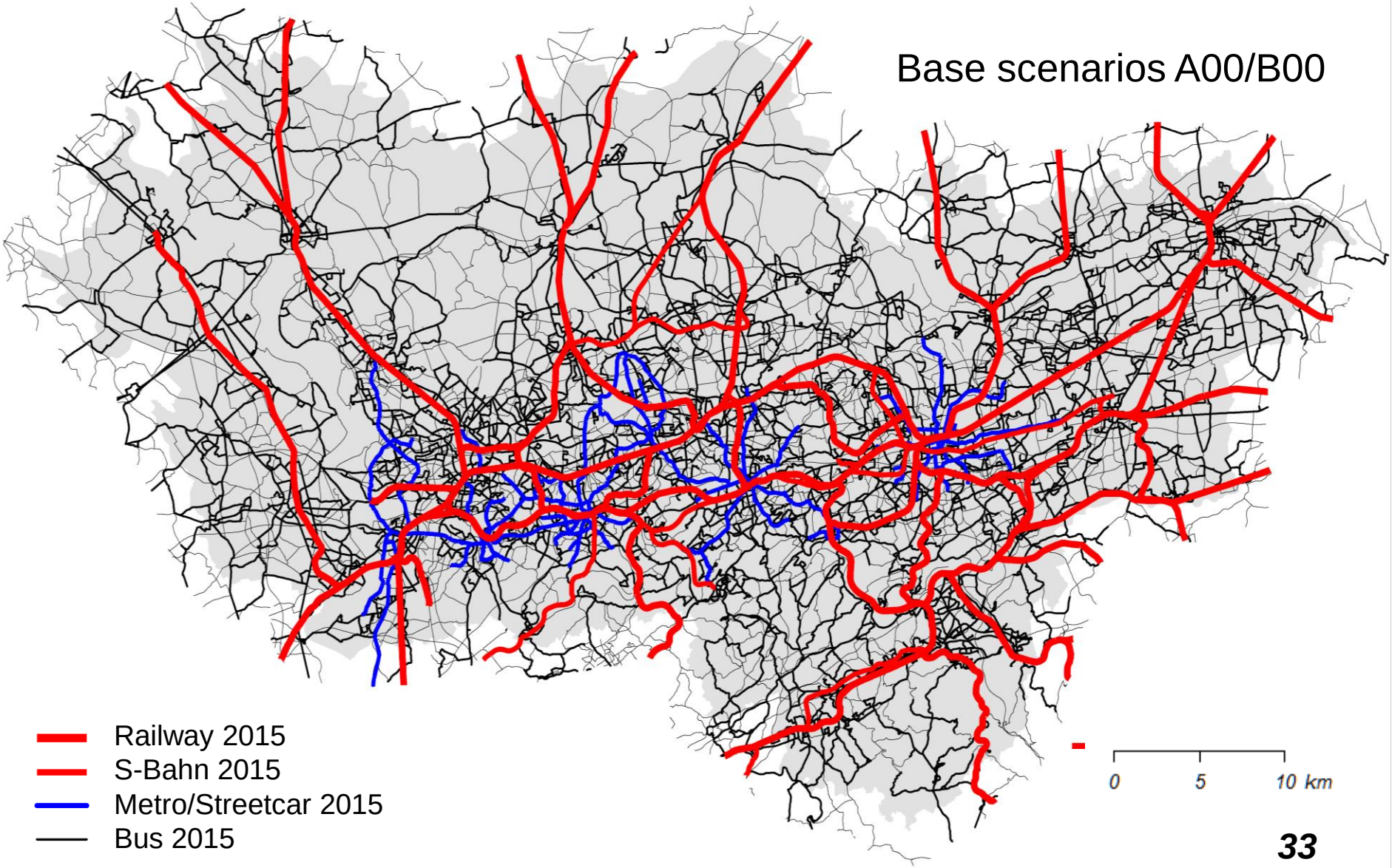
In the fifth group of scenarios policies to increase the attractiveness of ***public transport*** (pull policies) were analysed:

5 Public transport scenarios (Pull):

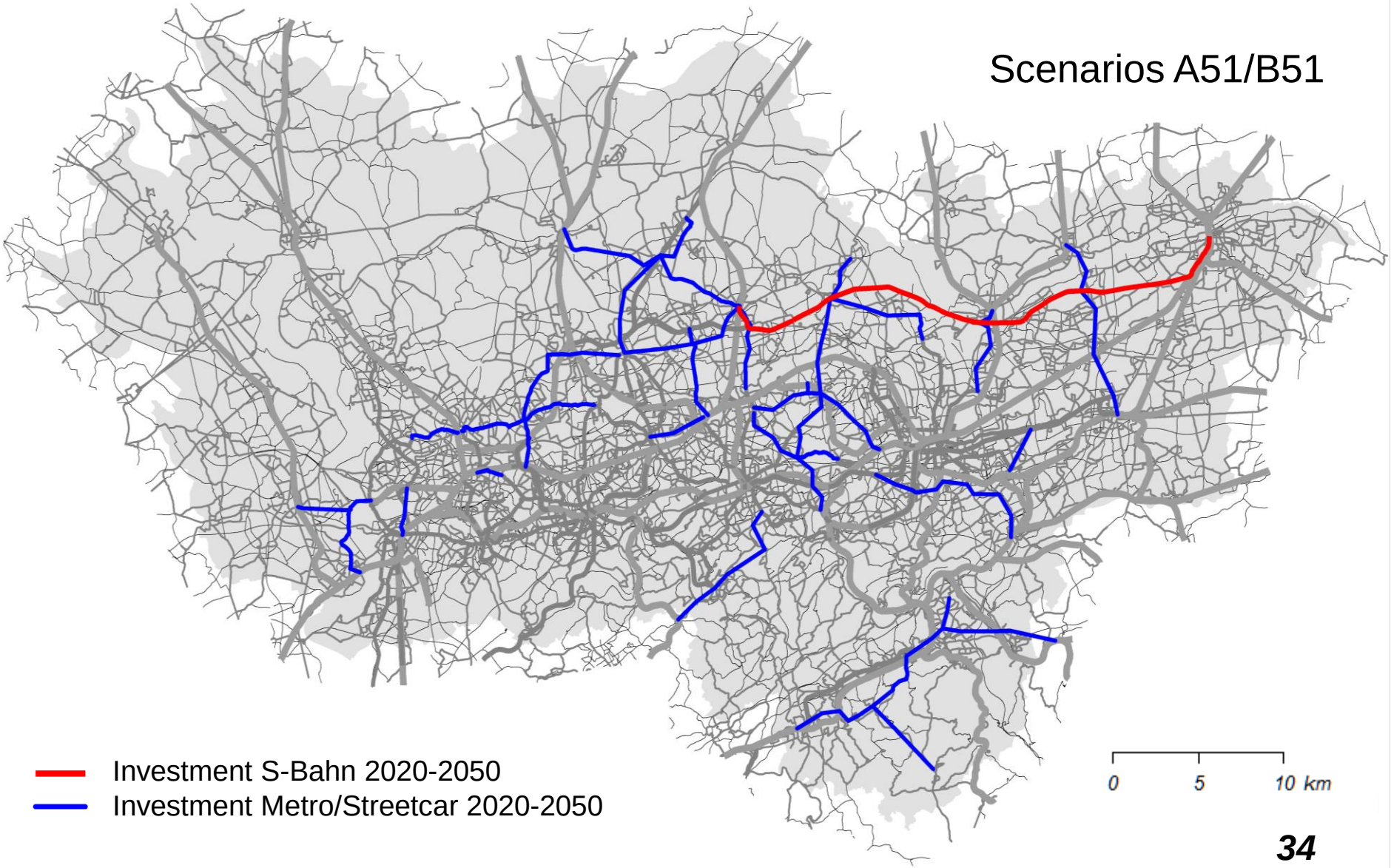
A51/B51 ***Public transport*** investment
A52/B52 ***More trains/buses*** per hour
A53/B53 ***Citizen ticket***

In the ***A scenarios*** low fuel prices and in the ***B scenarios*** high fuel prices were assumed.

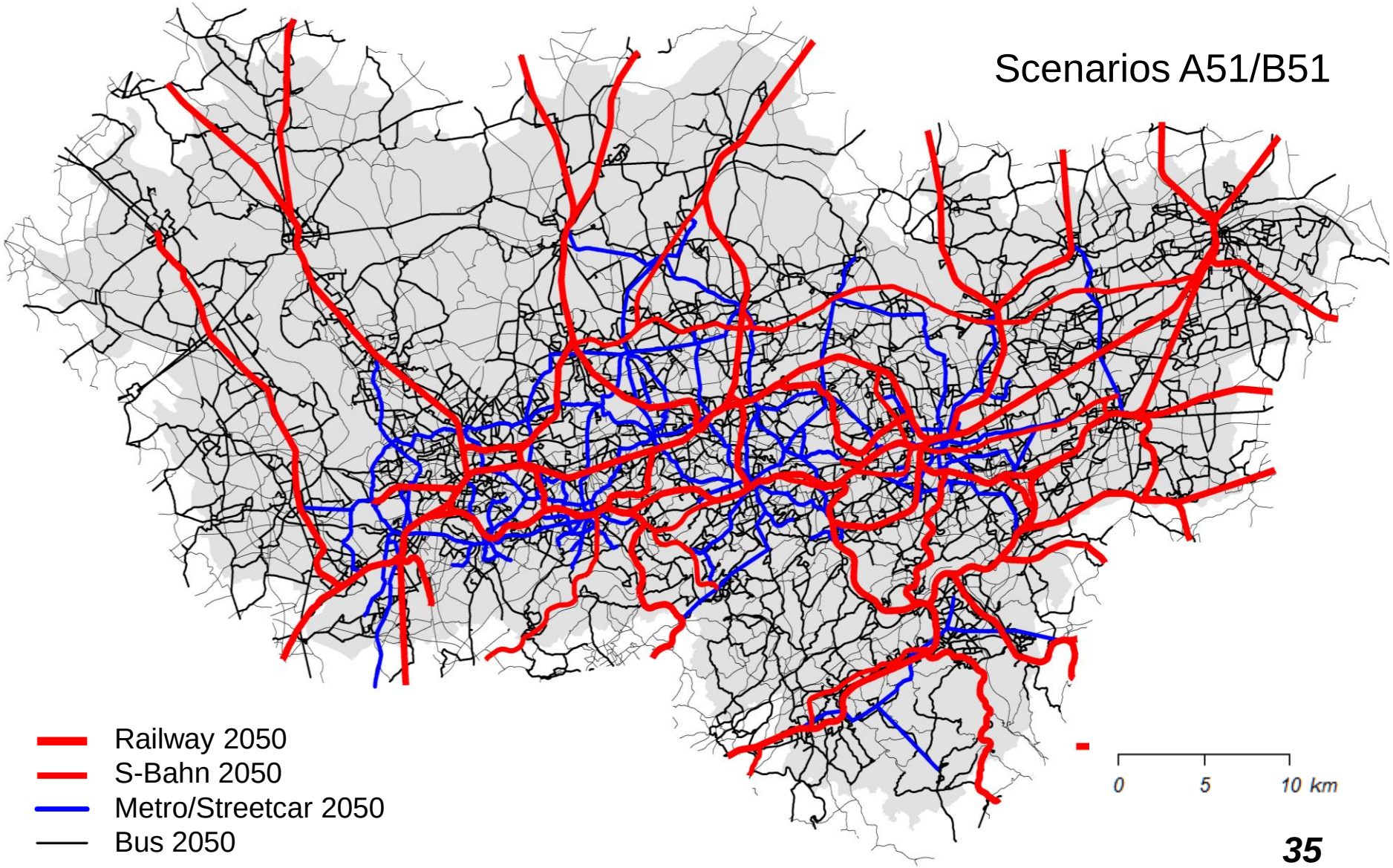
Public transport networks 2015



Public transport investment 2020-2050



Public transport networks 2050



Cycling and walking scenarios (Pull)

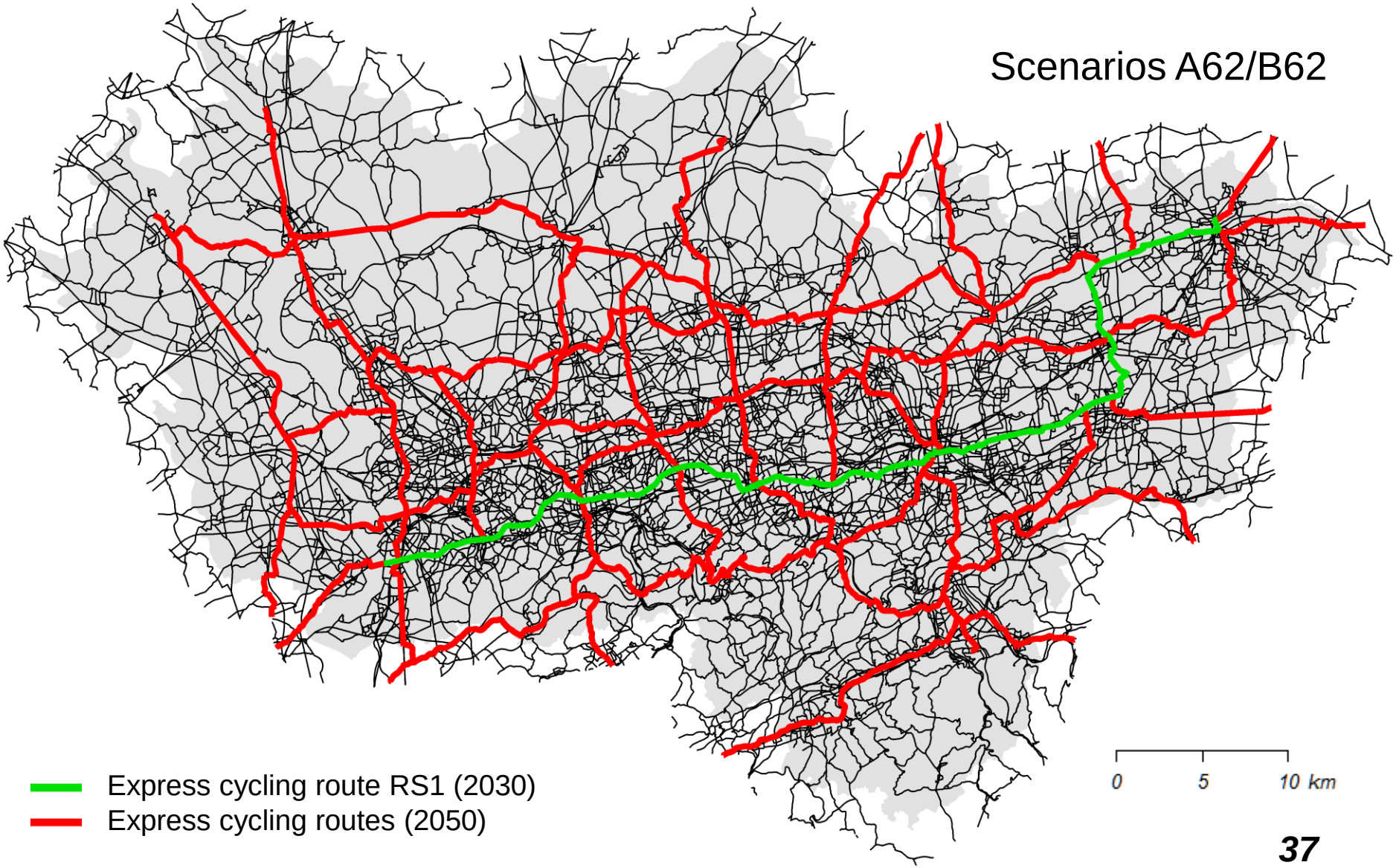
In the sixth and seventh groups of scenarios policies to increase the attractiveness of ***cycling*** and ***walking*** (Pull-policies) were analysed:

6 Cycling scenarios (Pull):
A61/B61 Faster ***cycling***
A62/B62 Express ***cycling*** routes

7 Walking scenarios (Pull):
A71/B71 Shorter ***walking*** distances

In the ***A scenarios*** low fuel prices and in the ***B scenarios*** high fuel prices were assumed.

Express cycling routes 2050



Integrated Strategies

Integrated strategies

In the last group of scenarios different ***combinations*** of policies were analysed:

8 Integrated strategies:

A81/B81 Urban form
A82/B82 Energy efficiency
A83/B83 Car traffic (Push)
A84/B84 PT/cycle/walk (Pull)
A85/B85 All policies
A86/B86 Selected policies

In the ***A scenarios*** low fuel prices and in the ***B scenarios*** high fuel prices were assumed.

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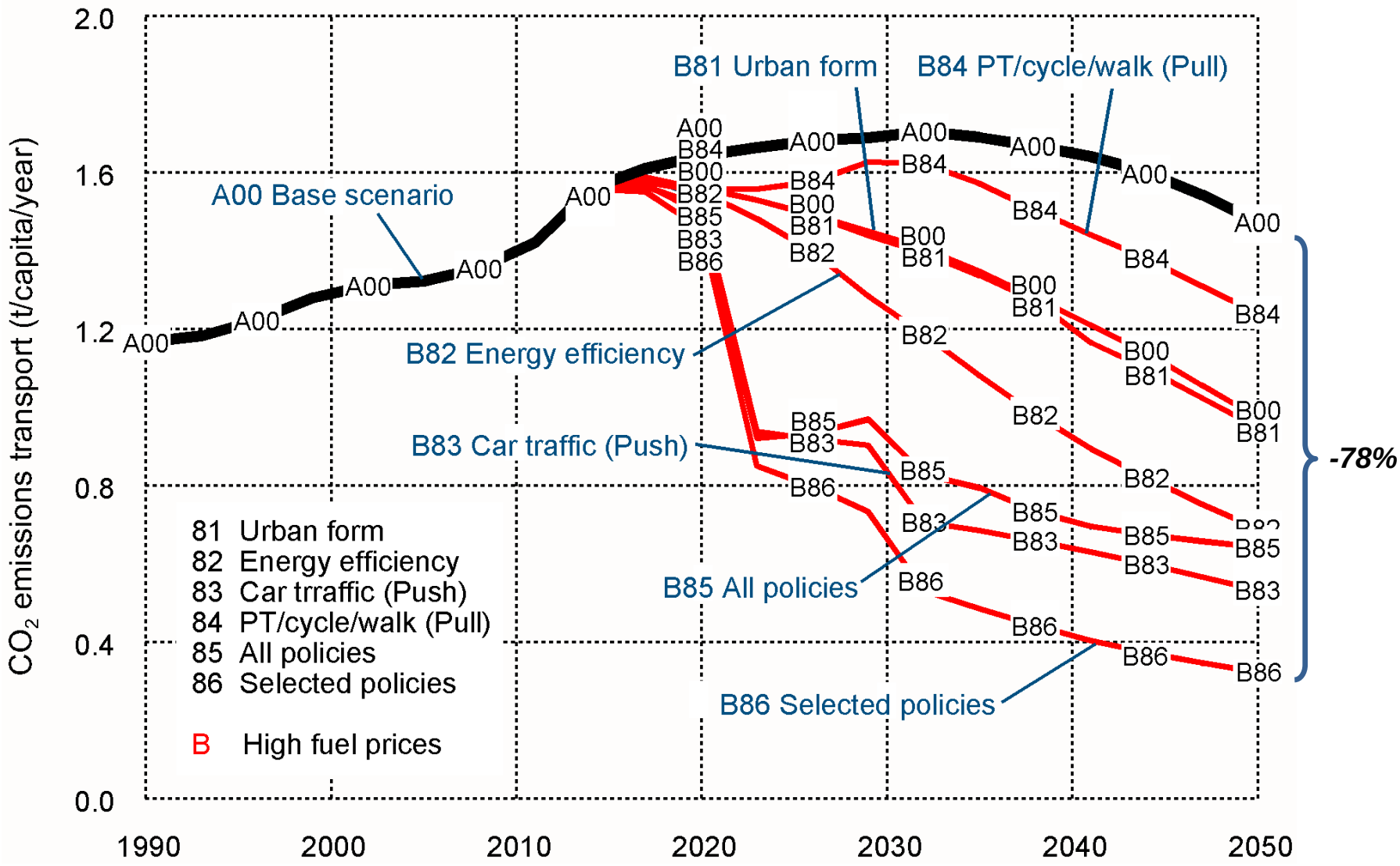
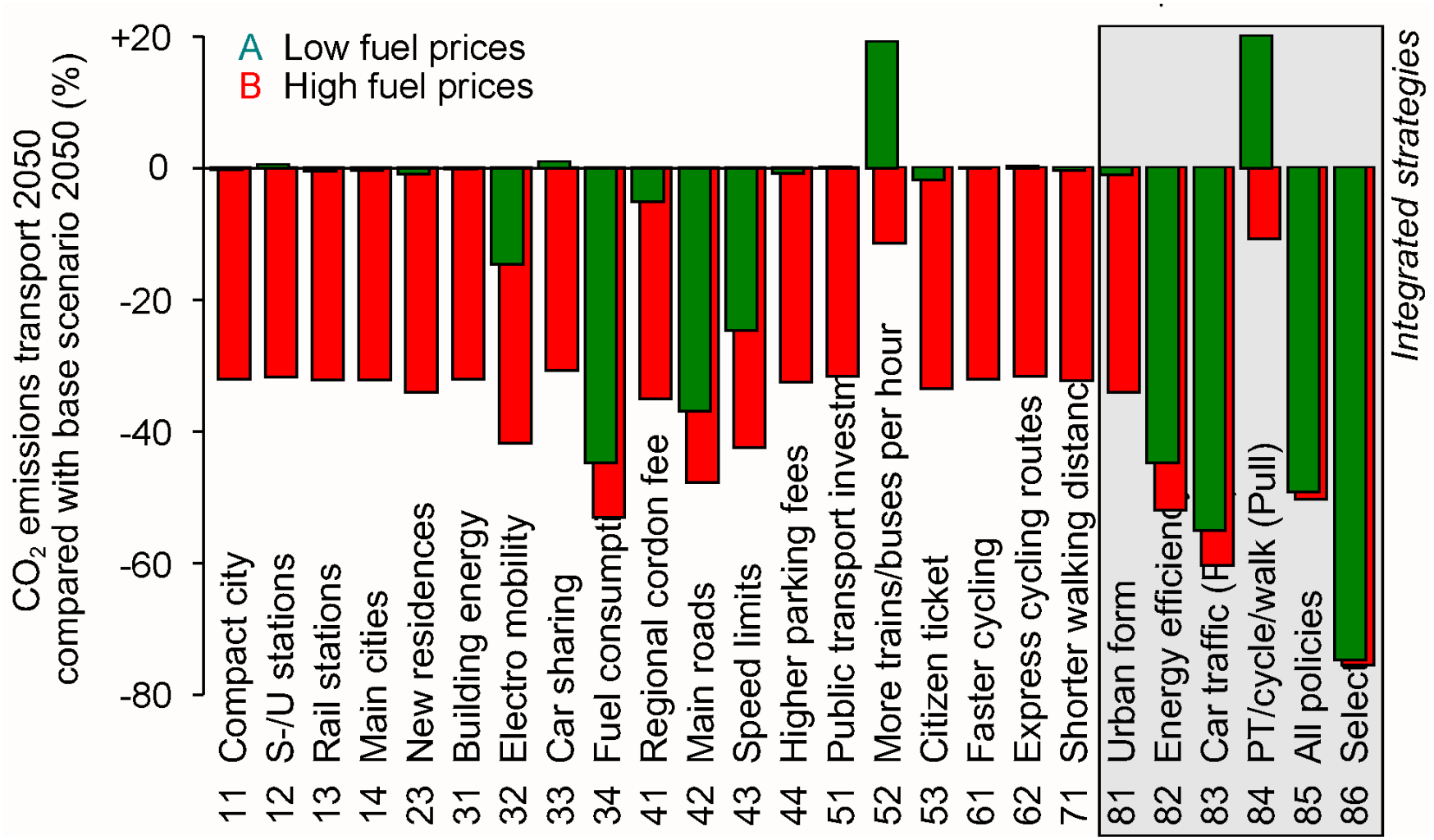
Integrated strategies: transport



Comparison of scenarios: transport



Summary of Results

Summary of results

The results of the two model projects can be summarised as follows:

- ***Urban form:*** Urban form and transport are in mutual interaction. The ***polycentric*** structure of the Ruhr Area offers a ***rich potential*** for the promotion of development in small and medium-sized towns in the vicinity of the core cities, a precondition for shorter commuting and retail trips. But policies to develop urban form need a ***long time*** to be become effective.

Summary of results

- ***Transport:*** Policies for the implementation of the energy transition in transport can be ***pull*** or ***push policies***:
  - ***Push policies*** make car driving less attractive, i.e. slower or more expensive.
  - ***Pull policies*** make public transport and cycling and walking more attractive.

  In general, push policies are more effective than ***pull policies***.

- ***Integrated strategies:*** The most successful strategies are ***integrated*** strategies, in which ***urban form*** policies and ***transport*** policies are combined.

Policy Recommendations

Policy recommendations

From the results of the two research projects clear policy recommendations for the municipalities and the state and Federal governments can be derived:

- ***Urban form:*** A comprehensive ***land use plan*** for the whole Ruhr Area with binding effect for counties and municipalities needs to be developed, which limits the occupation of land and promotes the concentration of development at public transport stations. Retrofitting of buildings for ***energy efficiency*** should be supported.

Policy recommendations

- ***Transport:*** To achieve the energy transition in transport, fast and consequent action by the municipalities, the public transport agencies, the regional government and the state government are required.
- ***Integrated strategies:*** For the implementation of the energy transition in the Ruhr Area integrated strategies are required, which address urban form, transport infra-structure and fiscal policies together.

Policy recommendations

Many of the necessary policies, in particular the push-policies, are likely to be perceived by many people as ***restrictions*** of their mobility and quality of life.

It is therefore necessary, to communicate ***"inconvenient truths"*** with rational arguments and make it clear that the recommended policies can bring significant advantages, such as improved ***environmental quality*** and a revival of ***neighbourhood relationships***.

More information

http://www.energiewende-ruhr.de/
http://www.spiekermann-wegener.de/pro/ruhr2050_e.htm