7. INTER-CITY COMPARISON AND CONCLUSIONS

This comparative analysis between the 3 cities tackles 2 issues:

- firstly, what are the impacts of the rail investments in the 3 cities ? do the rail investments generate sprawl in all cases ? and to what extent ?
- secondly, whether sprawl is generated by the particular transport investments under study in SCATTER or by a general migratory trend, which policies are most effective to control sprawl and reduce its negative effects ?

7.1. Brief comparison of the spatial structure of the 3 cities

This section briefly reminds the overall spatial structure of the 3 case cities. The maps below show:

- the current densities in the 3 cities
- the macro-zones in the 3 cities
- the zones considered as urbanised in the 3 cities[1]
- the new transport services whose effects on activity location are investigated.

The “urban centre” (the central macro-zone) is defined as follows:

- in the case of Brussels: the Brussels-Capital Region (average density: 2 900 households/km²)
- in the case of Helsinki: the city centre of Helsinki (3 000 households/km²)
- in the case of Stuttgart: the city of Stuttgart (1 400 households/km²).

The zones which were considered as “urban zones” in the calculation of the indicators “number of households/jobs in urban zones” are defined as follows:

- in the case of Brussels: the Brussels-Capital Region (light blue on Figure 7.6), the surrounding ring of urban Flemish communes (yellow), the other communes defined as urban in the regional land use plans (grey), i.e. 60 communes in all (average density: 680 households/km²)
- in the case of Helsinki: the inner Helsinki Metropolitan Area (HMA), the outer HMA, the HMA suburbs, other urban conurbations outside HMA (i.e. all zones except the light yellow zones in the map) (50 households/km²)[2]
- in the case of Stuttgart: the city of Stuttgart and all the communes of the so-called “outer urban ring” (37 communes in all) (710 households/km²).

[1] This intervenes in the calculation of the indicators “number of households in the urban zones” and ”number of jobs in the urban zones”.

[2] In the case of Helsinki, the average density of the “urban zones” is relatively low because the other urban centres outside the HMA (in orange on the map) are small old towns including large sparsely populated areas inside their administrative borders, which have been the statistical base outside the HMA.

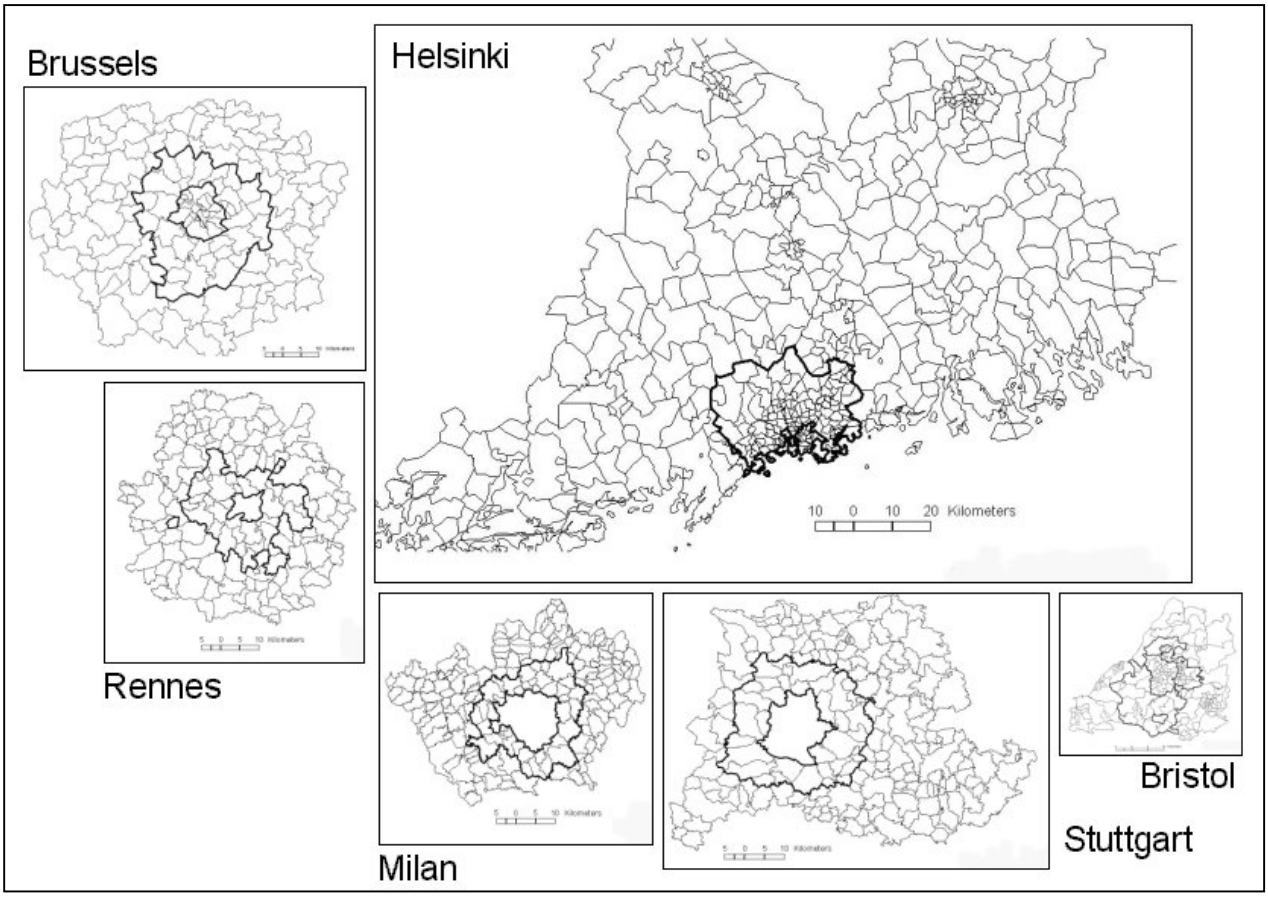


Figure 7.1. The 6 SCATTER case cities presented at the same scale

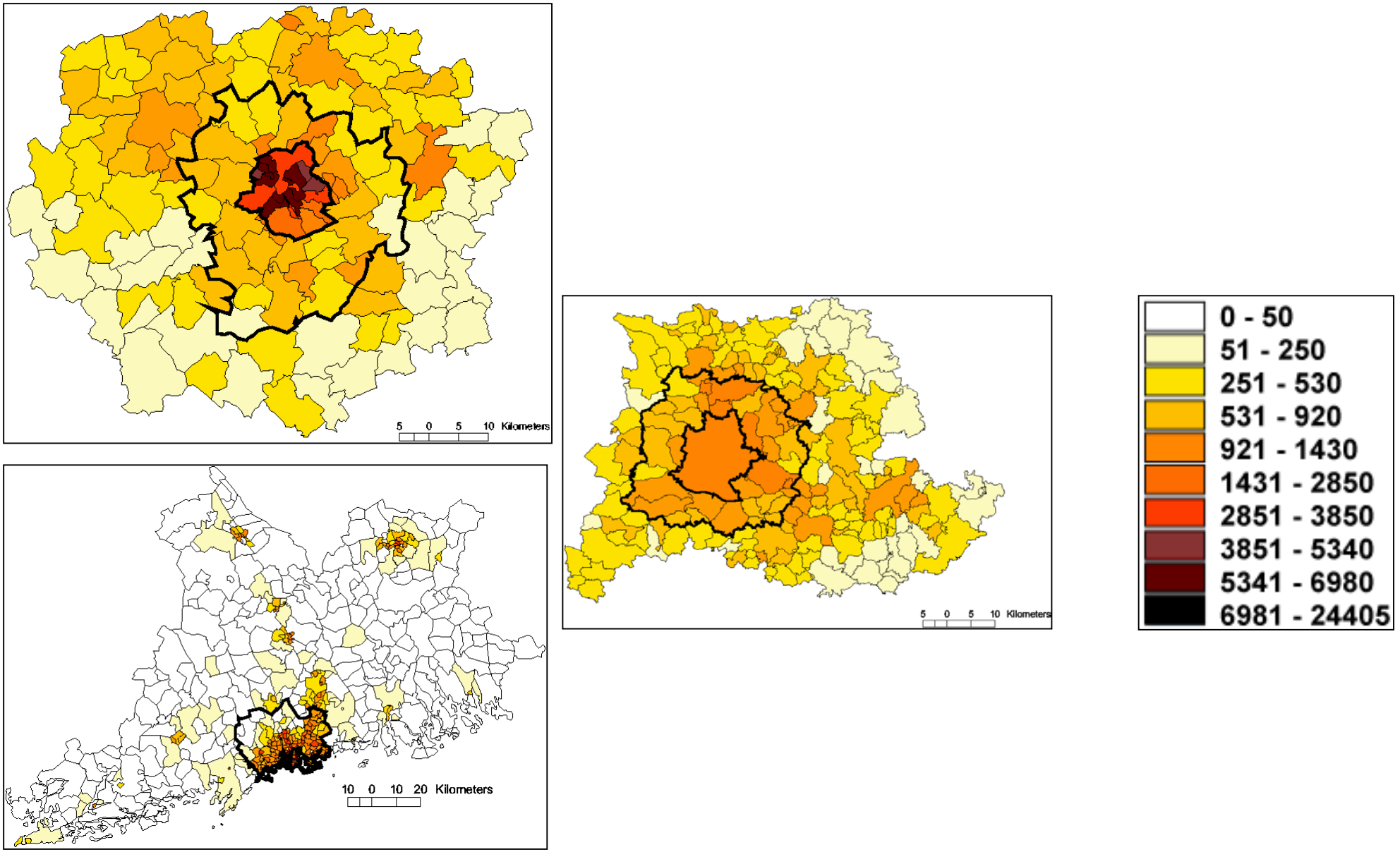


Figure 7.2 Population density in the study areas of Brussels (2001), Helsinki (1999) and Stuttgart (2000) (persons/km²)

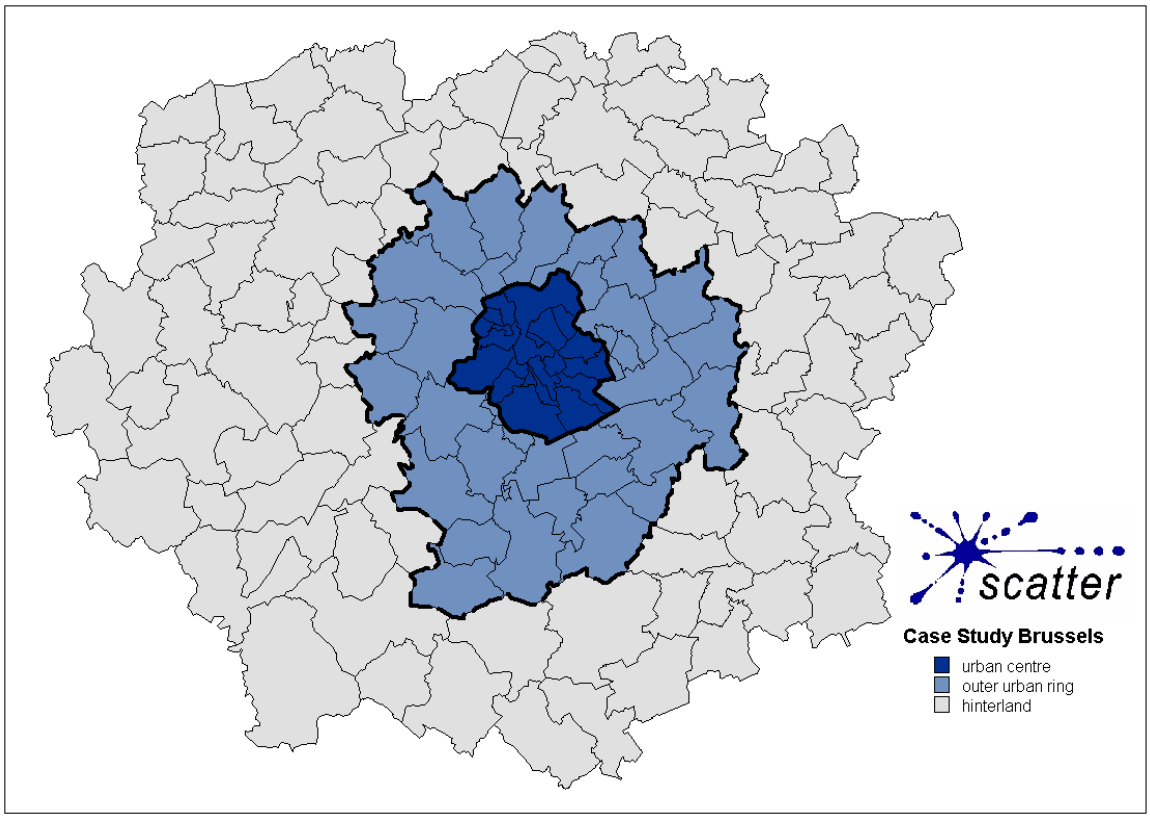


Figure 7.3 The Brussels study area and its 3 macro-zones

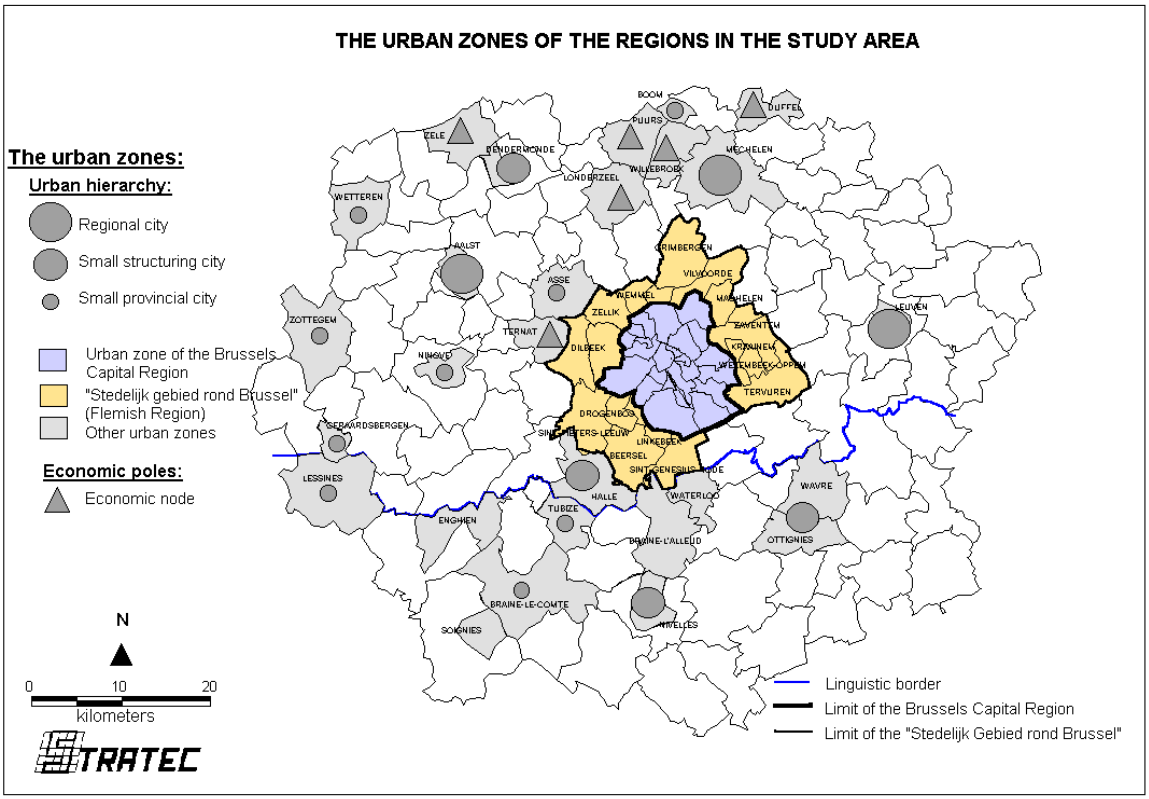


Figure 7.4 The Brussels study area – Urban zones

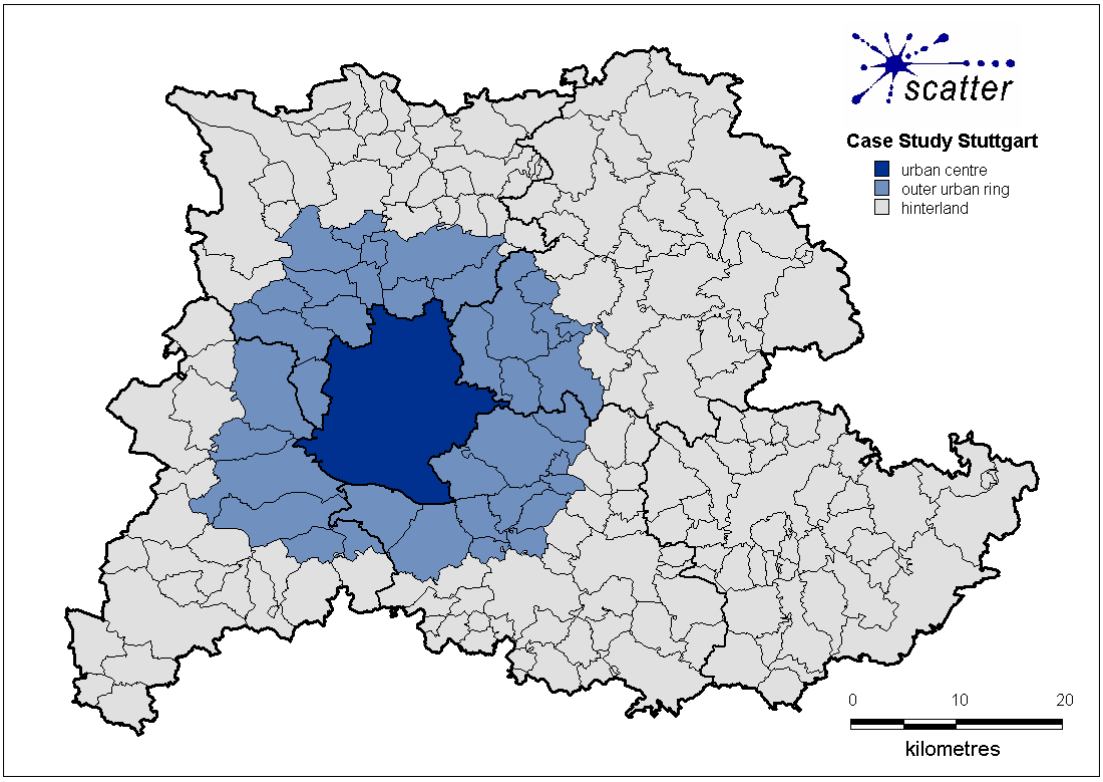


Figure 7.5 The Stuttgart study area and its 3 macro-zones

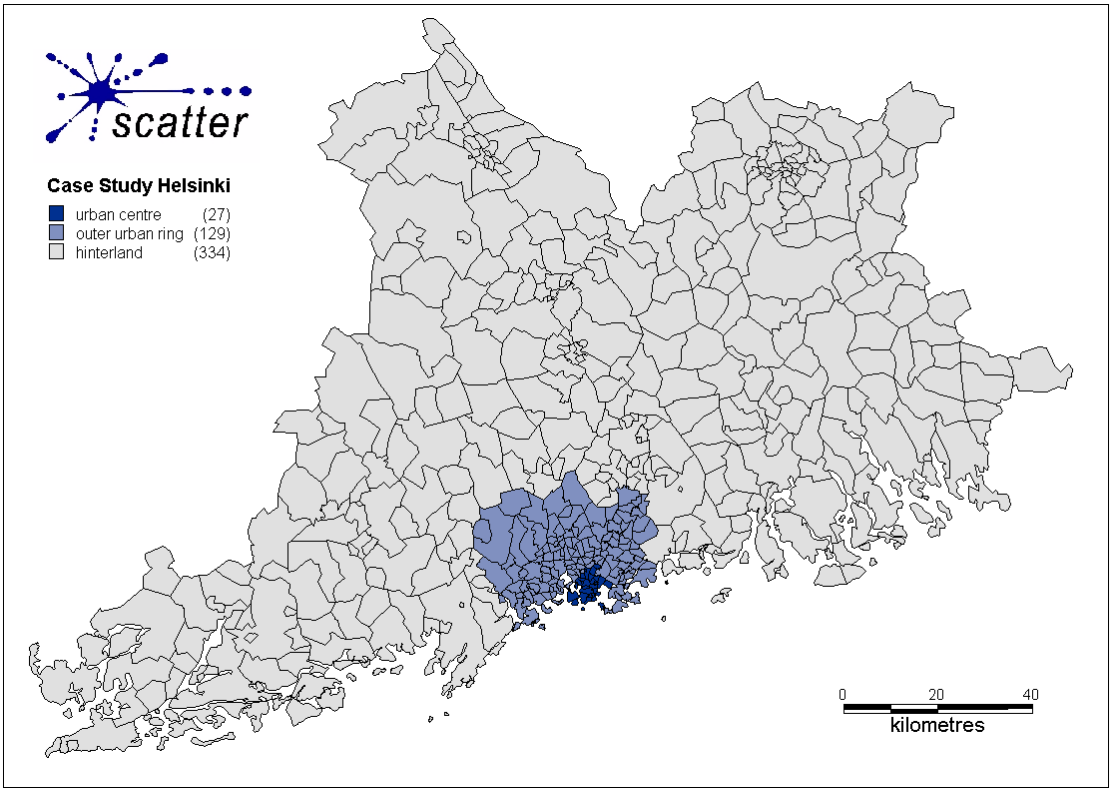


Figure 7.6 The Helsinki study area and its 3 macro-zones

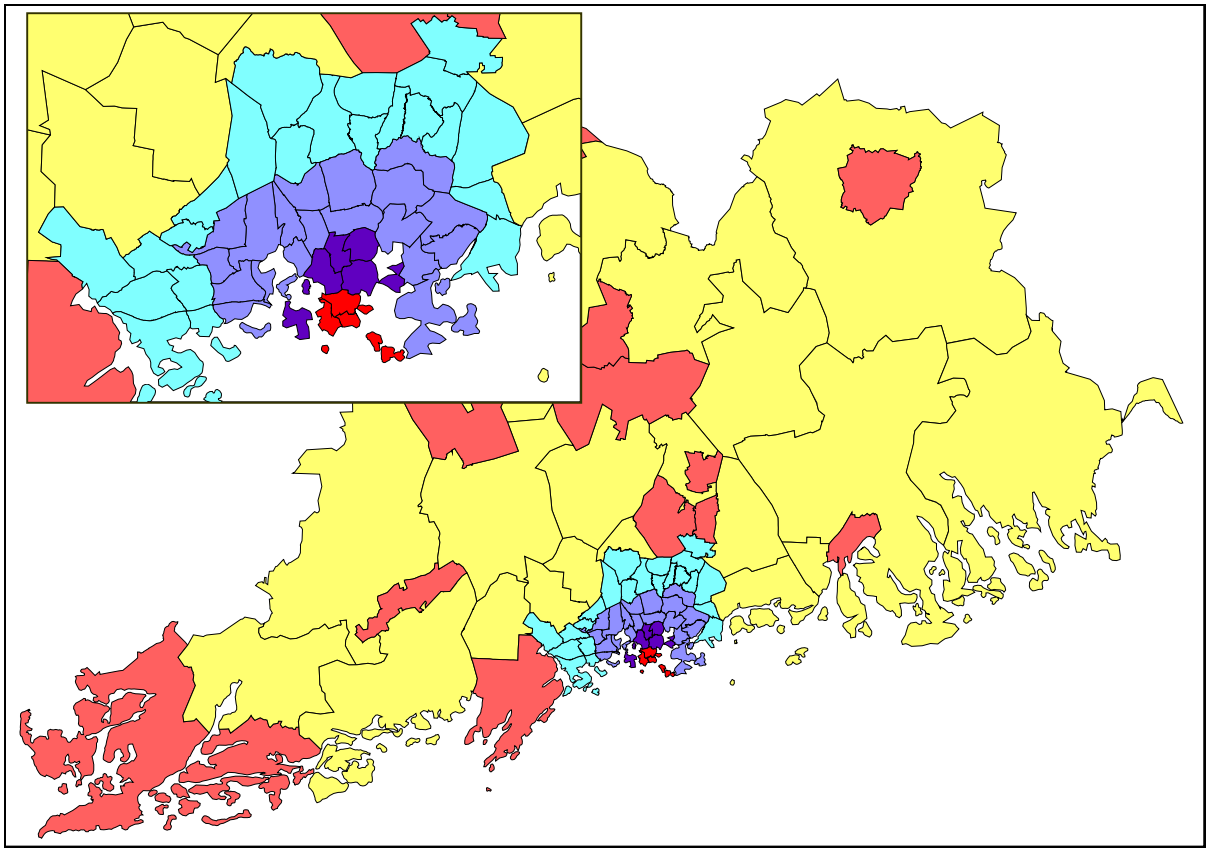
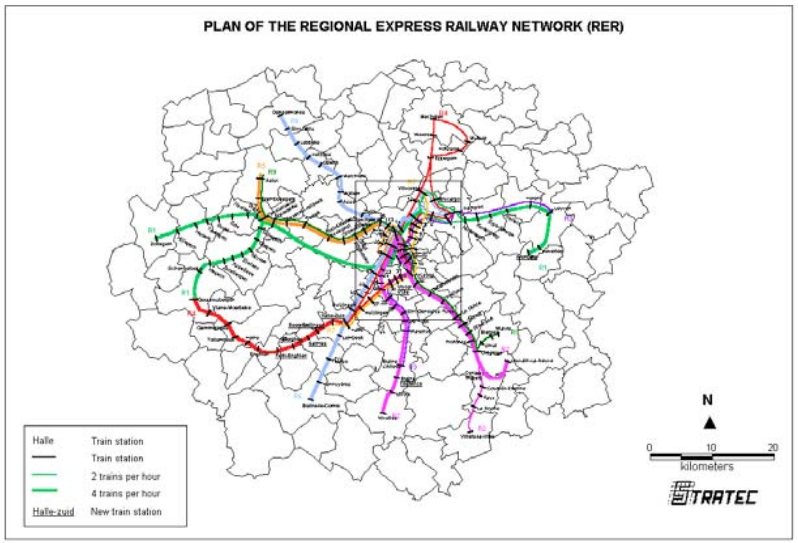
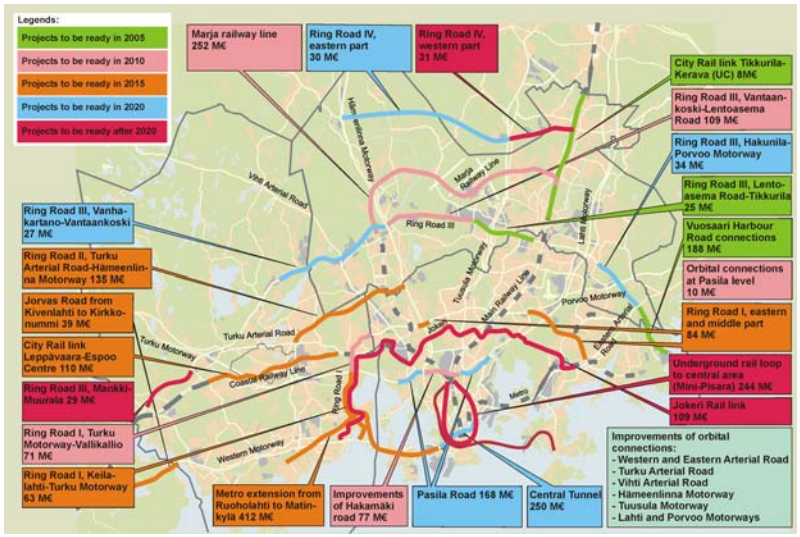


Figure 7. 7. Helsinki: The study area and detailed super-zone definitions used in the analysis of sprawl : Helsinki centre (red), Inner Helsinki Metropolitan Area (HMA) (dark blue), outer HMA (mid-blue), HMA suburbs (light-blue), other urban conurbations outside HMA (orange) and rural municipalities (yellow).





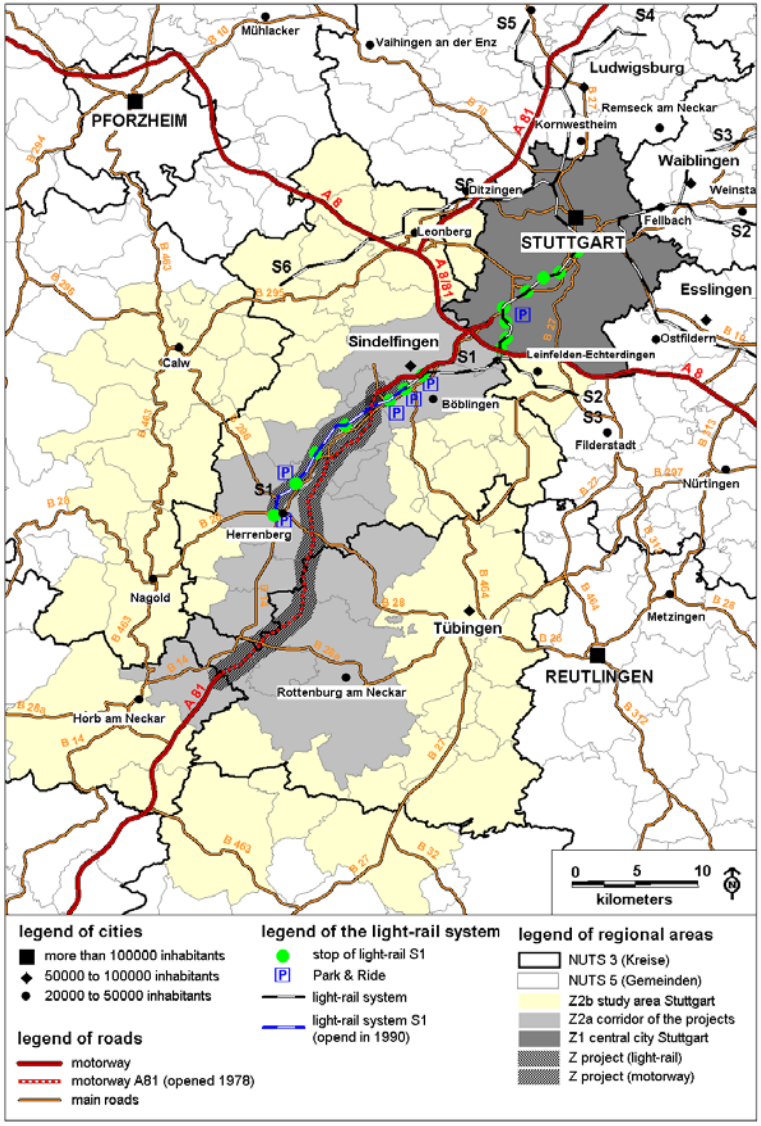


Figure 7.8 Brussels, Helsinki, Stuttgart: the new public transport services whose influence on activity location was investigated

Regarding the transport services, it is worth noting that their size or extent is quite different between the 3 cities: a whole network in the case of Brussels (replacing an existing network but with a drastic improvement), extensions of an existing network in the case of Helsinki, extension in one direction in the case of Stuttgart. It is therefore likely that the resulting effects in Stuttgart will be smaller than in the 2 other cities.

7.2. Comparison of the effects of the public transport investments in the 3 cities

The public transport investments which were simulated are as follows[3]:

- in the case of Brussels:
  - the future Regional Express Railway Network (REN) ("*Réseau Express Régional" – RER*) which will run on the existing rail tracks. The REN is made up of 8 new lines. It will serve Brussels and the surrounding area within a radius of 30-35 km. It will provide high quality, rapid and frequent train services. The total investment cost is estimated to about 900 millions € (scenario 111B=002B)
  - an alternative operating scheme of the REN, with more orbital connections, to facilitate trips from periphery to periphery (called "goose-foot" operating scheme) (scenario 121 B)
  - the effects of these both scenarios were assessed against the reference scenario without REN, at horizon 2021 (scenario 001B)
- in the case of Helsinki:
  - the Helsinki Metropolitan Area (HMA) full investment plan: this plan includes public transport investment as well as road investments (scenario 111H=scenario 004H) ; the public transport investments include extensions of metro lines and of urban rail lines ;
  - the same transport plan, with additionally speeding up the rail services by 25 % (scenario 116H)
  - development of orbital connections of public transport (scenario 121H)
  - the effects of these 3 scenarios were assessed against the reference scenario which includes the HMA road investments only (scenario 002H)
- in the case of Stuttgart:
  - the extension of the light rail line S1 (S-bahn), parallel to the motorway A81 (scenario 111S)
  - the same extension of S1, with additional investments: completion of missing link of the motorway A81 and park & ride facilities (scenario 114S)
  - the same extension of S1, with additional investments: completion of missing link of the motorway A81, park & ride facilities and a new road tunnel (tunnel Kappelberg) in the Eastern direction (scenario 114S, assessed against the scenario 001)
  - the effects of these 3 scenarios were assessed against the reference scenario 001S (without S1 extension and without the missing link of A81).The values of some key indicators are given for these 8 transport investment scenarios in the table below.

[3] For more details on the definitions of the scenarios (e.g. horizons), see Section 2 of this report.

Table 7.1 Effects of the new public transport services in the 3 case cities

	Variation in the number of households in the urban centre (%)	Variation in the number of households in the urban zones (%)	Variation in the indicator H-relative for population (%)	Variation in the number of jobs in the urban centre (%)	Variation in the number of jobs in the urban zones (%)	Variation in the average home-work trip distance (%)	Variation in the total car mileage (%)	Variation in the public transport modal share (points)	Variation in the total CO_2 emission (%)
Brussels – future REN (scenario 111B assessed against 001B)	-3.6	4					-6.2	8.	
Brussels – alternative REN with more orbital connections (scenario 121B assessed against 001B)	-5.5	8					-9.2	11	
Helsinki – HMA full investment plan scenario 111H assessed against 002H)	0.0	0.2	-0.5	0.2	0.0	-1.0	1.6	1.4	1.0
Helsinki – HMA full plan + speeding up the rail services by 25 % (scenario 116H assessed against 002H)	-1.6	-0.5	2.3			12	-0.8	5.	
Helsinki – developing orbital connections of public transport (scenario 121H assessed against 002H)	-0.1	0.1	-0.2	0.1	0.0	-1.3	0.7	1.5	0.0
Stuttgart – extension of the light rail line S1 (S-bahn) (scenario 111S assessed against 001S)	-0.3	-0.4	0.0	-0.1	-0.7	-2.7	0.4	0.5	0.4

Stuttgart – extension of the light rail line S1 (S-bahn) + missing link of motorway A81 + park & ride facilities (scenario 114S assessed against 001S)	-0.5	0.0	0.5	-0.4	0.6	-1.0	7.2	-0.1	7.2
Stuttgart – extension of the light rail line S1 (S-bahn) + missing link of motorway A81 + park & ride facilities + new road tunnel Kappelberg (scenario 115S assessed against 001S)	-1.8	0.7	0.7	-0.4	0.6	0.3	10.1	-0.7	10.1

Legend of colours:

- sprawl of population
- concentration of jobs
- lengthening of home-work trips
- positive effects of the PT investments, which might be higher without the sprawl

According to these figures, it appears that the answer to the first question “to what extent do public transport investments generate sprawl” is that they generate sprawl if they extend to the suburban or rural areas, if they provide a significant improvement in the accessibility from the suburban or rural areas to the centre or urban zones (where most of the work places are located), and whether the network is radial or radial *and* orbital.

Indeed, in the case of Brussels (both scenarios) and Helsinki (scenario 116H), the variation in number of households in the urban zones and other indicators reflect that the households move outside the urbanised zones. Simultaneously, the new public transport investments incite employment to concentrate in the urban centre.

The resulting change in the home-to-work mobility pattern is the lengthening of the home-work trips (by about 10 % in all 3 concerned scenarios).

Note that in the case of Brussels, the rail scheme with more orbital connections leads to even more sprawl, and to a higher increase in the home-work trip distance.

These effects of a significant improvement in the regional transport system also occur in the scenarios simulating a decrease of PT fare by 20 % (scenarios 512B-512H-512S).

On the other hand, the PT investments lead evidently to an improvement of the indicators related to the modal share: decrease of the car mileage and increase of the PT share. However, the total short-term improvement (i.e. the improvement which would have occurred if there was no change in activity location, neither lengthening of the trip distances) would have been even higher. In other words, one negative effect of sprawl is to “consume” a part of the potential benefits of the public transport investments, with regard to the modal shift and the reduction of car mileage.

Finally, sprawl causes negative effects directly because of the consumption of non-urban land, such as loss of high quality open space and agricultural land and higher costs of infrastructures and equipments.

Some of the results shown in the table, however, do not reflect sprawl, at least not clearly: the Helsinki investment plan (111H), and the extension of the light-rail line in Stuttgart (111S-114S). In the case of the HMA plan, the impact on sprawl is small because the investments are mainly orbital extensions. There is indeed no lengthening of the average home-work trip distance.

In the case of Stuttgart, the effects on sprawl are often smaller than in the 2 other cities for several reasons: first, the public transport investment consists only in one extension of line, which at the scale of the whole region cannot have as much effect as the improvement of a whole network; secondly, in some cases, movements of households occur from the urban centre (city of Stuttgart) towards a peripheral but still urban zone. However, the detailed analysis of the Stuttgart simulation results at communal level also shows that the extension of radial transport lines accompanied with a drastic reduction of travel times to the city centre support sprawl (see section 6.7 – scenarios 111S-114S). It also clearly appears in the simulation results that the effects caused by the S1 on the population distribution are not as strong as those caused by the motorway: this reflects the fact that the road network allows for more diffusion than the public transport network.

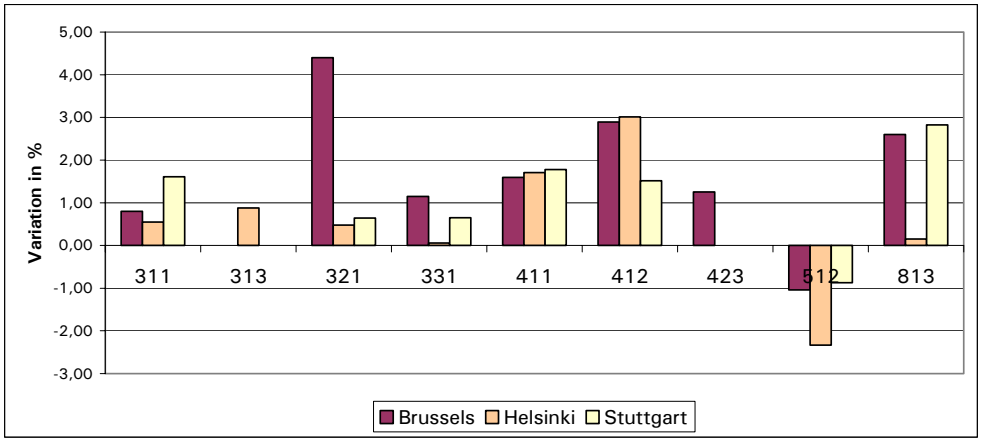
In conclusion, the answer to the question “to what extent do public transport investments generate sprawl” is that they actually generate sprawl if they extend to the suburban or rural areas, if they provide a significant improvement in the accessibility, and whether the network is radial or radial *and* orbital.

7.3. Policies most effective to reduce urban sprawl

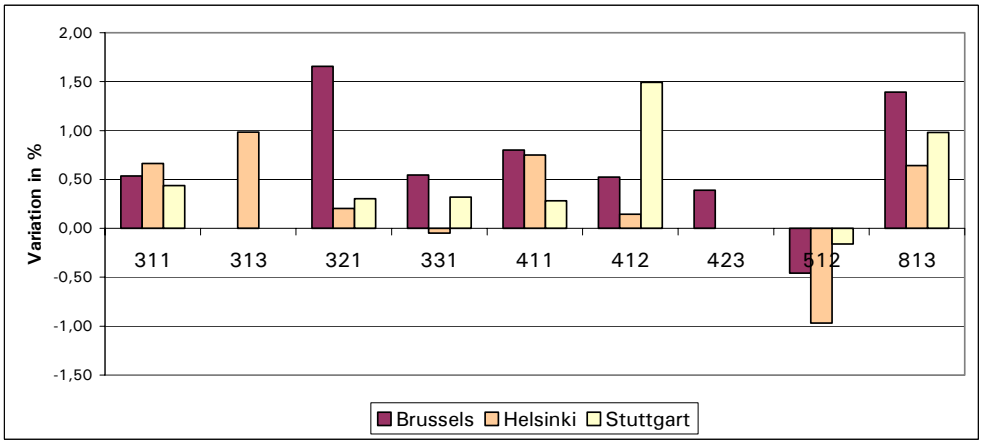
To answer the second question “which policies are most effective to control sprawl and reduce its negative effects”, the simulation results from the 3 cities have been brought together into comparative diagrams as follows. The definition of the scenarios is given in the Table 2.1 in section 2. The question is “do some policies appear as more effective in all 3 cities ?”.

Conclusions from the comparison of the simulation results on the *individual measures* (i.e. not the combinations) are given in the 2 next sub-sections, following the comparative diagrams.

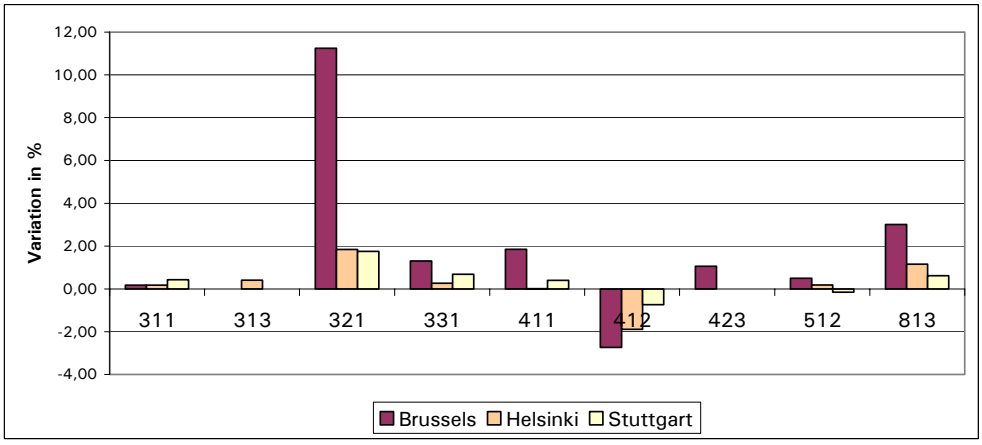
Variation of the number of households in the urban centre



Variation of the number of households in the urban zones

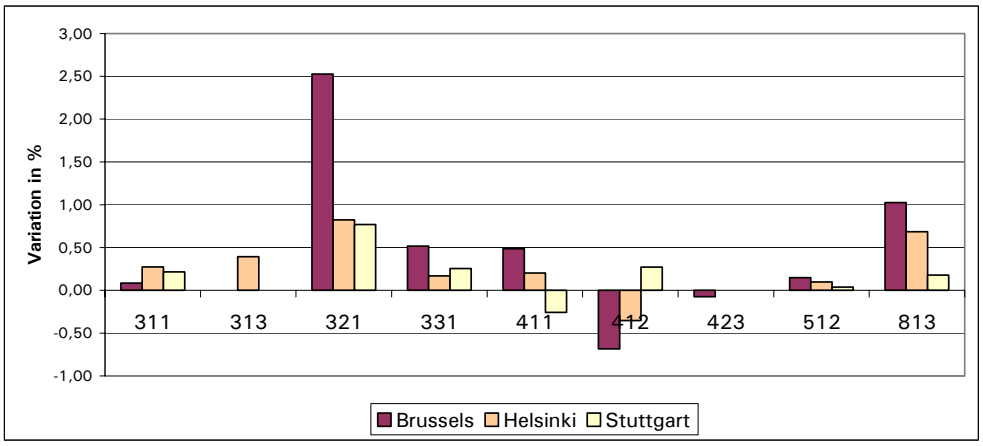


Variation of the number of jobs in the urban centre

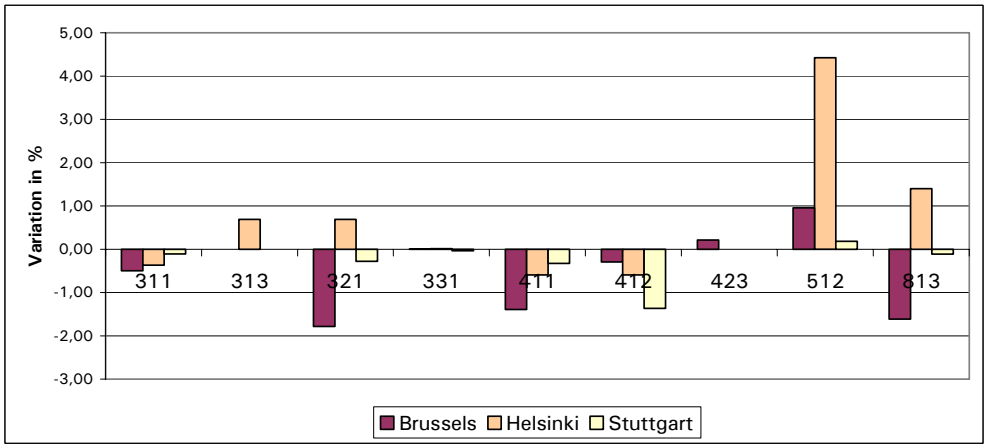


Figures 7.9-11 Impacts of the common scenarios in the 3 case cities

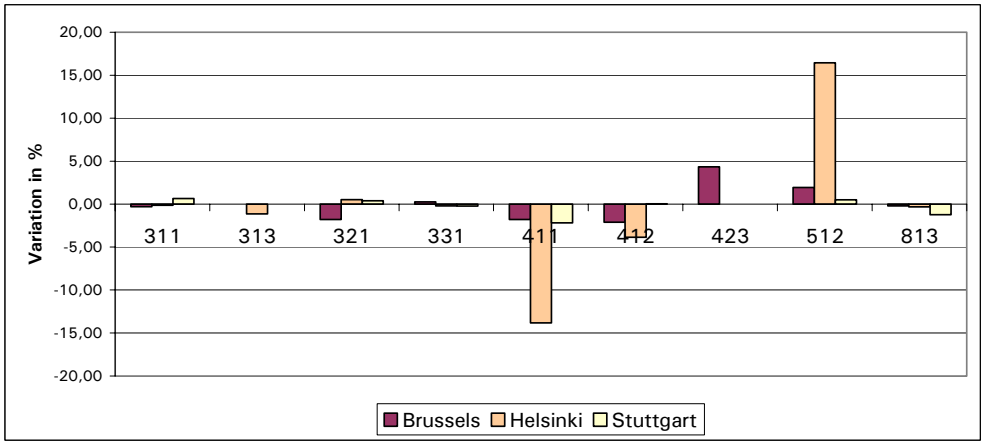
Variation of the number of jobs in the urban zones



Variation of the indicator H relative for population (%)

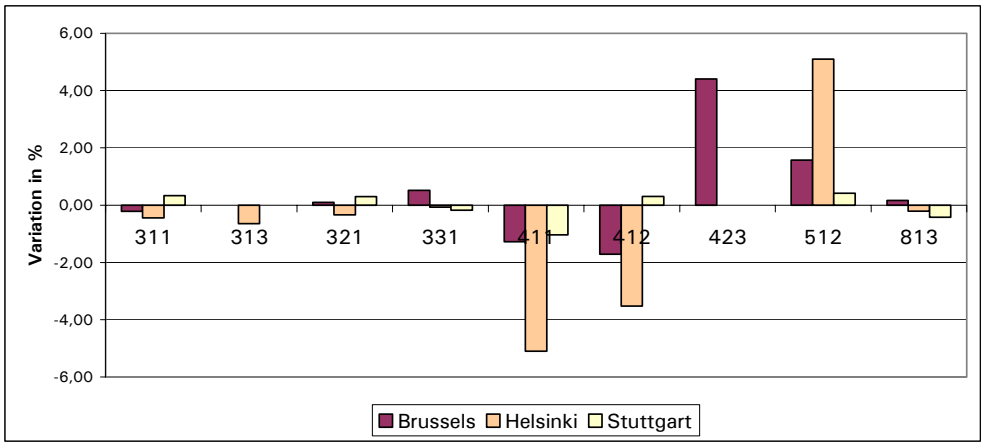


Variation of the home-work travel distance in the study area

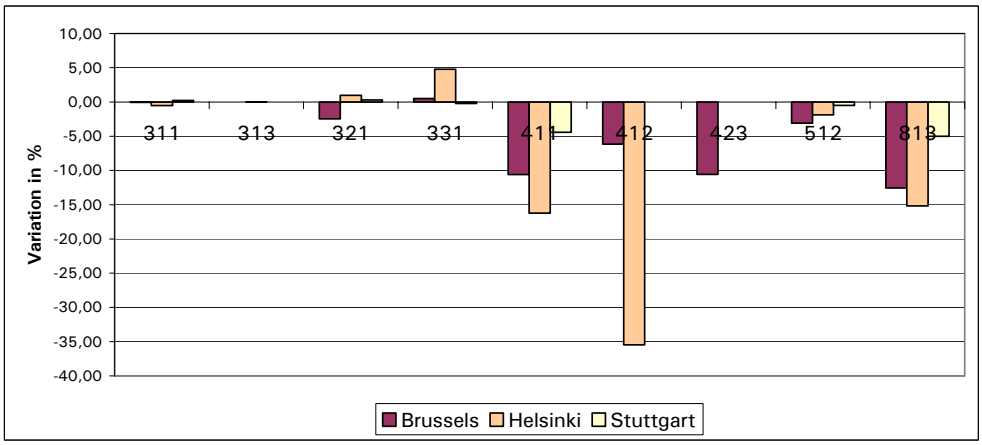


Figures 7.12-14 Impacts of the common scenarios in the 3 case cities (cont.)

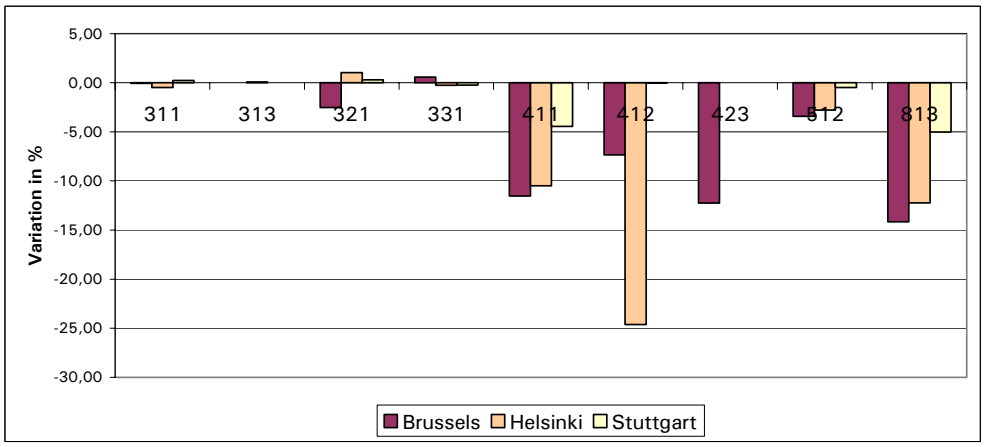
Variation of the average travel time in the study area



Variation of the total car mileage in the study area



Variation of the CO2 emissions in the study area



Figures 7.15-17 Impacts of the common scenarios in the 3 case cities (cont.)

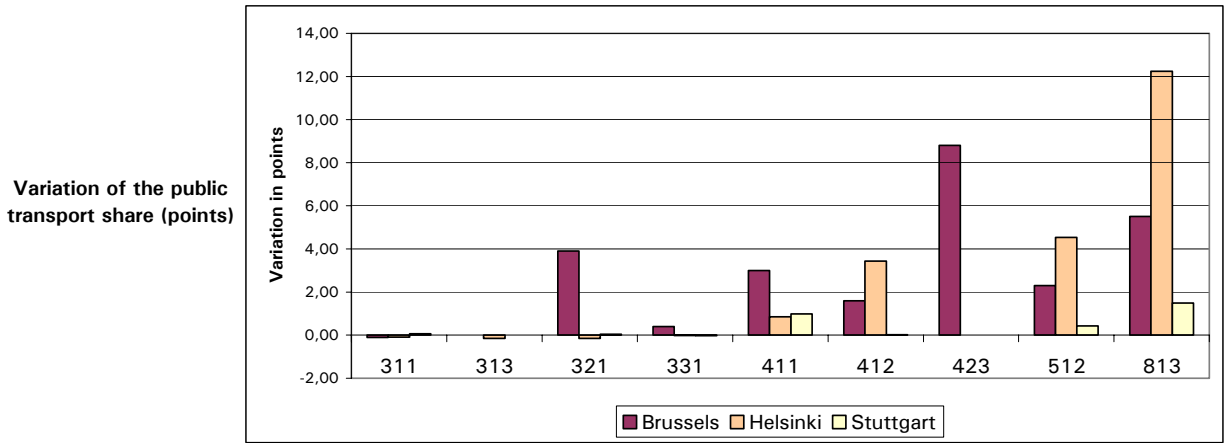


Figure 7.18 Impacts of the common scenarios in the 3 case cities (cont.)

7.3.1. Objective of urban concentration

The growing urbanisation is related to topics such as: consumption of land, loss of high quality agricultural land and open space, destruction of biotopes and fragmentation of eco-systems, changes in the streaming coefficient, but also: social segregation and social interactions, and higher costs for equipments and infrastructures.

Now, with regard to ***urban concentration*** and ***land consumption***, the most effective policies in the 3 cities are:

- road pricing: effective in all 3 cities
- impact fee on new suburban residential developments: effective in all 3 cities
- in some cases, fiscal measure to incite services (offices) to locate in zones served by high quality public transport (e.g. around rail stations), or constraining regulatory measure with the same purpose. For this type of measure, the potential effectiveness depends of the percentage of jobs already located in that kind of zones, in the reference scenario. For example, the percentage was 37 % in Brussels, versus 70 % in Helsinki, which explains that the policy appeared to be much more effective in Brussels than in Helsinki.

When looking at the indicators “number of households in the urban zones”, the impact fee policies (311 – 313) score roughly as well as the car use cost increase (411). This result of course depends on the level of the respective parameters (new fee and cost increase). In 311, the impact fee tested is 670 €/housing/year (which corresponds to a 13 400 € one-shot tax distributed on 20 years). In 313, the impact fee was 1 000 €/housing/year. In 411, the car use cost increase is + 50 %.

It is therefore an original result from SCATTER to have demonstrated through the simulations that, with regard to improving the urban concentration, a policy of impact fee on new suburban residential developments is as effective as the better known policies of road pricing.

That kind of fiscal measure (impact fee) has been among others recommended by the European Conference of Ministers of Transport[4]. It is used for more than 3 decades in the United States, to control urban sprawl and to "internalize" to some extent the external costs of the suburbanization. It appeared in the years 70’ and has the form of a one-shot tax imposed to the developers for new suburban developments. Roughly, it aims at financing the infrastructures and equipments on the area to be urbanised and also the works to connect these new infrastructures and equipments to the existing networks. Currently, 23 States impose this tax to any new housing development to cover the long-term marginal cost of the improvements to be provided to infrastructures, equipments and services.

Still regarding the urban concentration, cordon pricing (412) and parking policies (423) are effective too. However, they were not kept in the final packages (i.e. 811-813) because they produce a repulsive effect on employment. In scenario 423 (Brussels only), the parking restrictions are carefully balanced between the urban centre (the Brussels-Capital Region) and the urban centres of the 2 other Regions, so that the Brussels Region undergoes no employment decrease.

With regard to the effectiveness of the land fiscal measures, again, it is worthwhile comparing the effects on employment of the scenarios 321, 331 and 411. The regulatory

[4] *Politiques spatiales et transports – Le rôle des incitations réglementaires et fiscales, Conclusions de la Table Ronde de la CEMT n° 124*, Paris, 7-8 November 2002.

measure 321 (obligation for *all* jobs of some tertiary sectors to locate in A-type zone[5]) is the most effective one, with regard to the concentration of jobs, but is difficult to implement. The measure 331 works towards the same objective, but through a fiscal means: it consists in a tax amounting to the actual cost of a yearly public transport season ticket (1 985 € for Brussels, 710 € for Helsinki, 976 € for Stuttgart). When looking at the indicator "number of jobs in the urban zones", the measure 331 appears to be at least as effective than the measure 411. Again, as above, the results of course depend on the level of the respective parameters (tax and cost increase).

A final remark is that, generally speaking, the level of the variations is low (a few percents). It has to be reminded, when interpreting these results, that some categories of households, and some categories of economic activities are not affected by the variation of the travel times or costs. For example, the retired or old people are likely to not be encouraged to move towards suburbs, whatever the travel times. In the case of Brussels, for example, this category represents about 25 % of the households (in 2001). Similarly, central administrations, universities, as well as heavy industries do not respond to a local demand, but rather to an inter-regional or national demand; their location is therefore not or little influenced by the local accessibilities.

7.3.2. Objective of reduction of emissions due to transport

With regard to ***climate change*** and ***air pollution***, the most effective policies are: road pricing and parking policies.

Although they were the most effective with regard to these criteria, the cordon pricing and the parking strategies were discarded from the final selection of measures for the combinations, because of their negative effects on employment (for more details on the effects of parking policies on job location, see the case of Brussels – scenarios 421, 422, 423, 424).

In all 3 cities, land use policies seem to have only little impact on the transport indicators and especially on the CO_2 emissions due to transport, except the measure 331B in Brussels, which is quite drastic (regulatory measure forcing all jobs in the business services sector to locate in A-type zones). Several comments can be made on this result. Several experts have already stated that, although land use policies are not much effective by themselves to change the mobility pattern and the level of emissions, they set up a general context more favourable for the effectiveness of transport policies. Other potential explanations are as follows: in the case of Brussels for example, the modal share of public transport (rail) for the trips between the furthest periphery to the centre is relatively high; if the inhabitants of these areas move towards the urban centre or secondary urban centres, it may be that the benefit in modal shift be low (however, there will still be the benefit in terms of land consumption, etc). A second possible explanation is that in scenarios 321 and 331, where offices are moving towards urban centres, a part of the home-work travel distances decreases and another part increases, which again would lead to only a small benefit or no benefit. Finally, some observed facts seem to confirm the fact that land use policies alone have poor impact on congestion and transport emissions: Dutch researchers have analysed ex-post the long-term effects of the very firm land use planning strategy implemented by the Dutch government during the last decades. Roughly, this strategy aimed to a decentralised concentration (through the ABC and VINEX approaches). They came to the conclusion that these strategies were not effective (or not as effective as expected) to reach the objectives of reducing congestion and emissions due to transport[6].

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[5] According to the ABC land use theory developed in The Netherlands, "A-type" zones are zones very well served by public transport, at regional or even national scale (e.g. locations served by inter-city railway stations).

[6] Ex-post evaluation of Dutch spatial planning and infrastructure policies, K. Geurs, B. Van Wee, A. Hoen, A. Hagen, European Transport Conference, Strasbourg, 2003.

7.3.3. Evaluation through the sustainability indexes

With regard to the sustainability indicators and indexes which were calculated in the case of Helsinki only, the results show that the car pricing policies have significant positive effects on all the dimensions of sustainability (environmental, social, economic), whereas the effects of the land use pricing policies on the 3 sustainability indexes are very small. However, it is worth noting that some negative aspects of the suburbanisation, which are reduced by the land use policies, such as loss of the high quality agricultural land and open spaces, and the higher costs of infrastructures and equipments, are not taken into account in the sustainability indexes[7].

7.3.4. Combinations of policies – Integrated strategies

Also combinations of individual policies were tested and these simulations confirm that the best strategy is a combination of transport policy and land use policy. The table below resumes the values of some key indicators for the combination 813, which provides the best scores on the different criteria, in the 3 cities.

The best combination proposed by SCATTER (i.e. the scenario 813) combines congestion pricing, reduction of the public transport fare, impact fee on suburban residential measures and a fiscal measure intended to services (offices), to incite them to locate in areas well served by public transport.

With regard to congestion pricing, the measure actually simulated was an increase of car use cost during the peak period; the practical recommendation is congestion pricing (road pricing in congested areas, during congestion period).

The reduction of the public transport fare at a regional level encourages sprawl, but has a positive effect on the modal share and the emissions due to transport. In fact, the most adequate measure should be to implement the reduction of fare only inside the central city. Indeed a simulation in the Brussels case (local scenario 517B) has shown that a reduction of the transport generalised cost (increase of the commercial speed of public transport, as it was) territorially limited to the central area increases the attractiveness of the central area both for population and for jobs.

The combination 813 includes several pricing measures. Generally, pricing policies (either pricing land use or transport) can be more easily adjusted to the observed problems (congestion, land consumption, spatial competition, etc) than regulatory actions, and hence can be more effective, but on the counter-side their acceptability is generally lower.

Sustainability indexes were calculated in the Helsinki case city (see Section 5.6.6). The sustainability evaluation shows that the combinations (scenarios 811-813) are able to simultaneously improve all the dimensions of the sustainability. The most effective way to tackle sprawl is to create policy packages that combine the best qualities of individual policy measures and even out some inevitable side-effects or problems of the used main measures (what is for example difficult to control are both the household and employment sprawl at the same time).

[7] Some other effects of the consumption of suburban or rural land are not or incompletely taken into consideration in the sustainability evaluation: the change in the water streaming coefficient, the social segregation or social interactions. This is a perspective for future research.

Table 7.2 Effects of the scenario 813 in the 3 case cities

	Variation in the number of households in the urban centre (%)	Variation in the number of households in the urban zones (%)	Variation in the indicator H-relative for population (%)	Variation in the number of jobs in the urban centre (%)	Variation in the number of jobs in the urban zones (%)	Variation in the average home-work trip distance (%)	Variation in the total car mileage (%)	Variation in the public transport modal share (points)	Variation in the total CO_2 emission (%)
Brussels – combination 813B (scenario 813B assessed against 003B)	2.6	1.4	-1.6	3.0	1.0	1.1	-12.6	5.5	-14.1
Helsinki – combination 813H (scenario 813H assessed against 111H)	0.2	0.6	1.4	1.2	0.7	-0.3	-15.2	12.2	-12.2
Stuttgart – combination 813S (scenario 813S assessed against 003S)	2.8	1.0	-0.1	0.6	0.2	-1.2	-5.0	1.5	-5.0

Combination 813 is made up of 4 measures:

- increase by 50 % of the car use cost/km
- reduction of the public transport fare by 20 %, either for the home-work trips only (Brussels) or for all trips (Helsinki and Stuttgart)
- impact fee on suburban residential developments, combined with a reduction of land tax in urban zones
- tax on tertiary employment (offices) locating in areas non well served by public transport.

The conclusions on the overall effectiveness of the policies also depend on the context to what the impacts are compared: in the case of Brussels, the indicators values have shown that the combination 813B (i.e. 4 measures combined with the local investment plan) could roughly counter-balance the loss of population in the Brussels-Capital Region which would be due to the REN. In the case of Stuttgart also, the combination 813S brings back about 3 % of the households to the urban centre. In the case of Helsinki, the relative effects of the combination 813 on the household location are smaller, probably due partly to land use regulatory constraints; the combination 813H could however counter-balance an intensive transport investment policy (such as scenario 116H); but the overall effect of the policy 813 is small compared to the general trend of sprawl in the Helsinki region, due to the population growth[8] and the welfare growth.

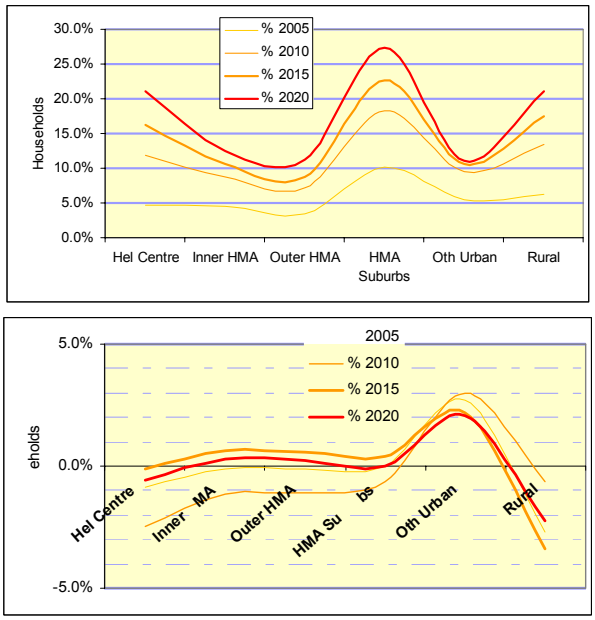
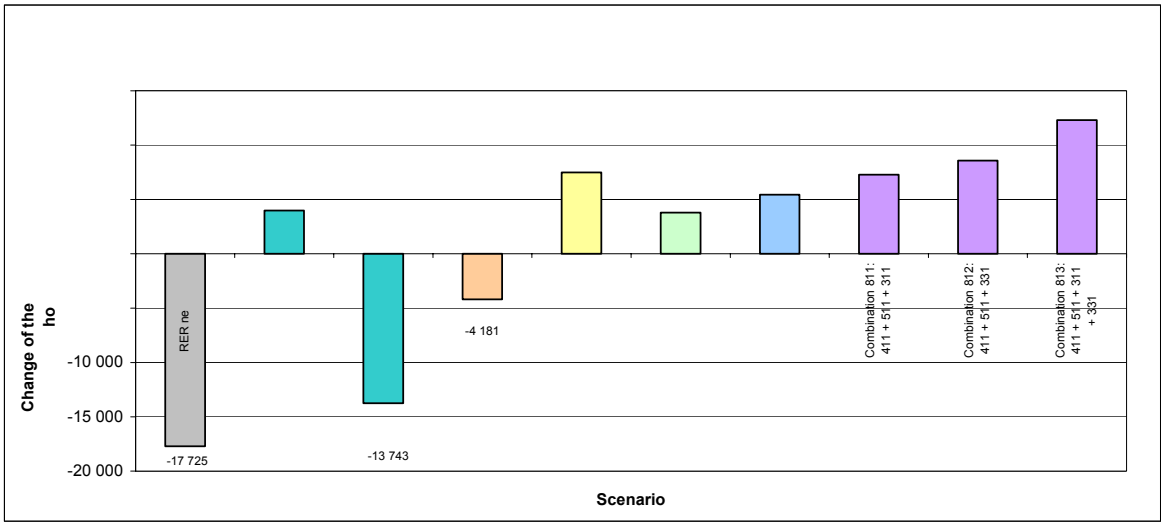


Figure 7.19 Helsinki –Top: evolution 2000-2020 due to the base trend; bottom: effect of combination 813

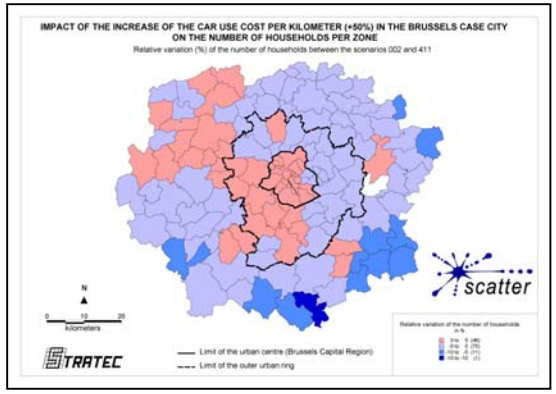
[8] The population growth is supported by a strong trend of migration from rural areas towards the metropolitan area. This was also highlighted in work package 3 (see Deliverable 3 of SCATTER). These last years, the strong growth due to the national migration towards the few urban agglomerations of high technology employment has created a crowding effect in the Helsinki region causing the sprawling effect towards the fringes of the Helsinki Metropolitan Area and outside it. Moreover, the Helsinki Metropolitan Area (which is made up of Helsinki, and 3 other smaller cities) will face a rapid population growth from now to 2020 (an increase by 19.6 % is expected). This increases the pressure for urban sprawl as well as the use of natural and other green areas. It is expected that Helsinki can accommodate less than ¼ of the growth, the rest being redirected to the other cities of the HMA. However, this does not influence the net assessment of the policies, as the policy results are compared to the 2020 situation.

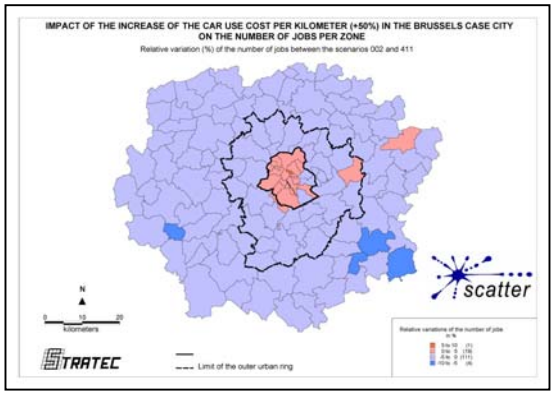


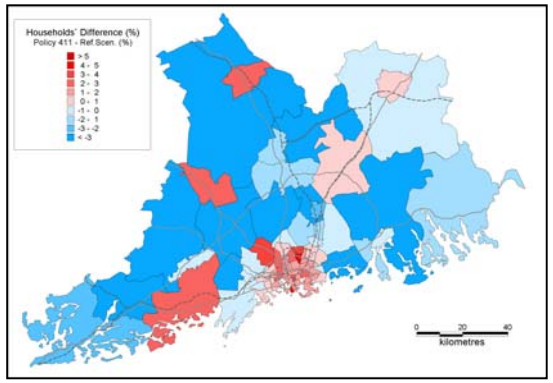
(1) The effect of the RER network is calculated in comparison with the 2021 reference scenario
(2) The effect of the priority measures is calculated in comparison with the 2021 RER scenario
(3) The effect of the priority measures is calculated in comparison with the 2021 reference scenario
The effects of the other meaures are calculated in comparison with the priority measures

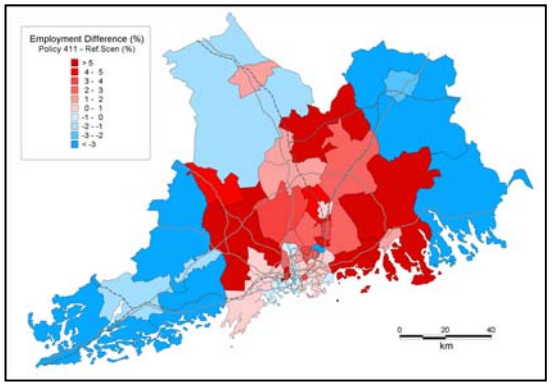
Figure 7.20 – Brussels: how the scenario 813 together with the local investment plan ("priority measures") compensate the out-migration of households due to the REN

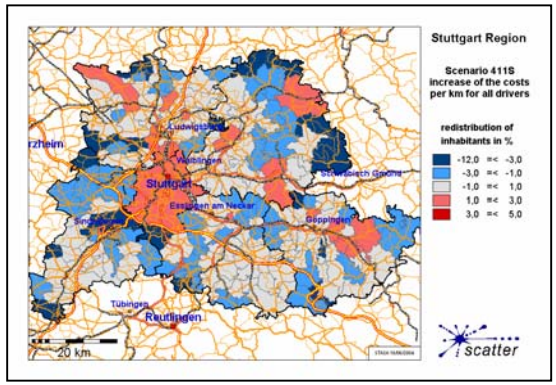
7.21 Effects of the scenario 411 on household location and job location, in the 3 case cities
(411: car use cost increase by 50 %)











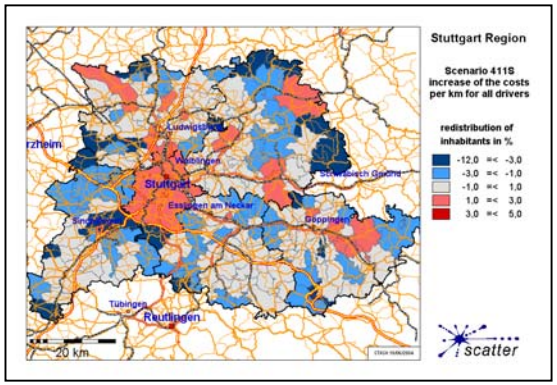
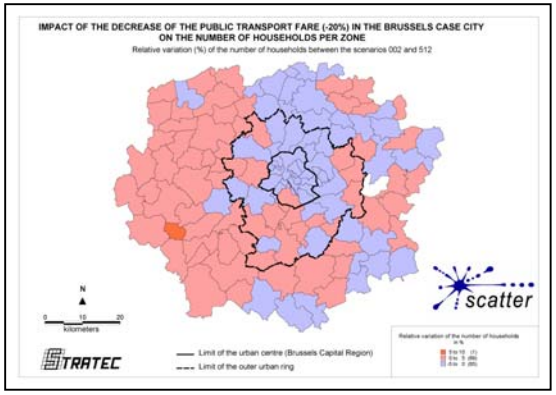
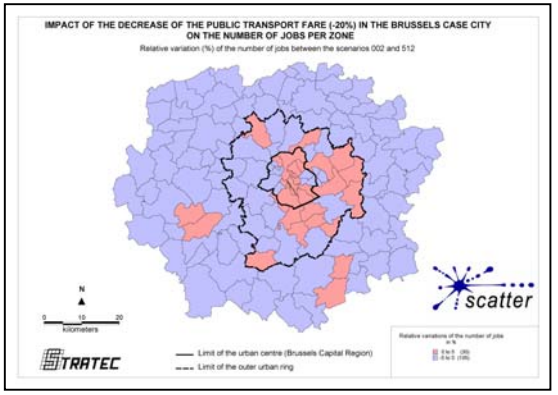
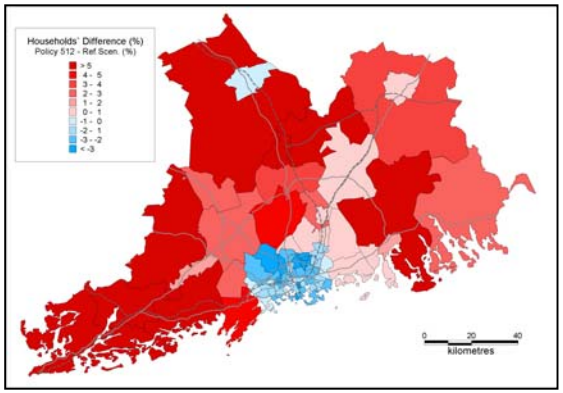
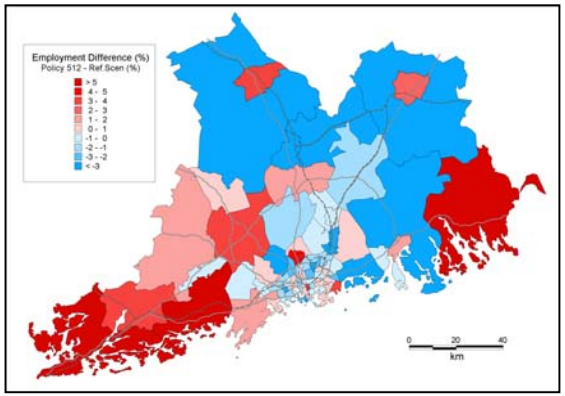


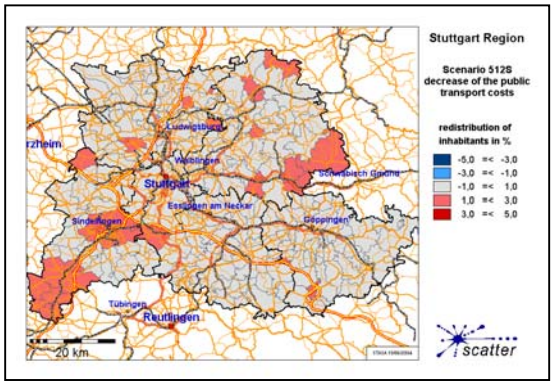
Figure 7.22 Effects of the scenario 512 on household location and job location, in the 3 case cities (512: reduction of public transport fare by 20 %)











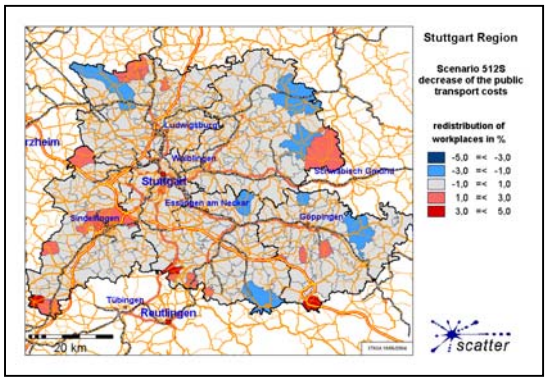
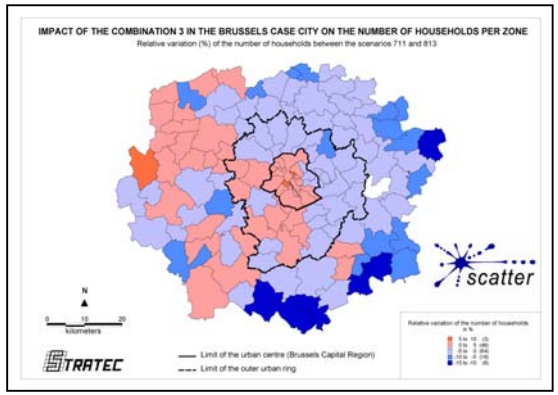
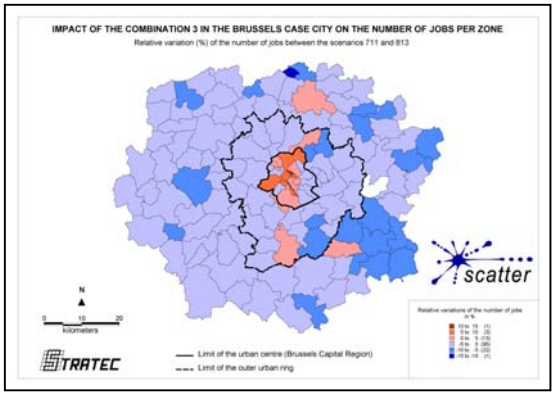
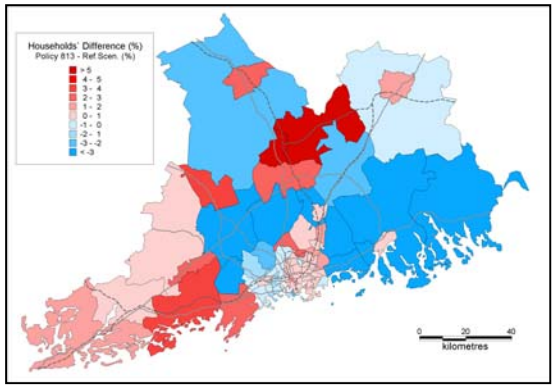
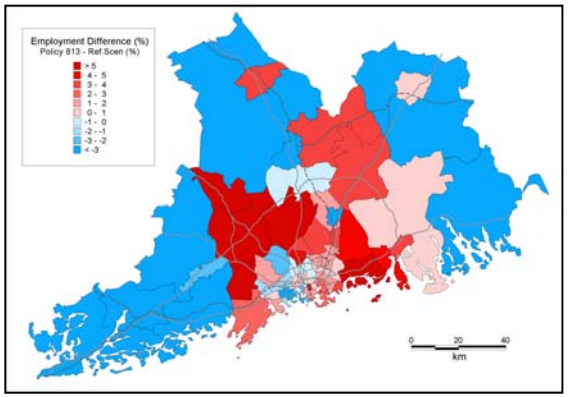


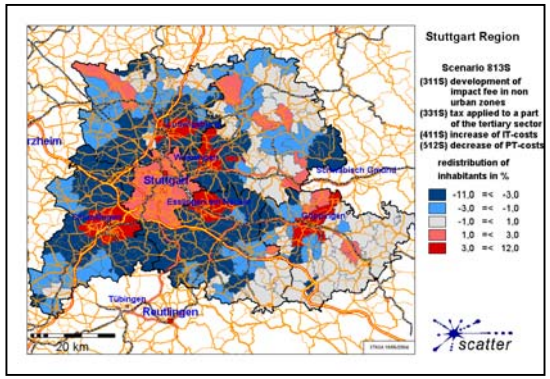
Figure 7.23 Effects of the scenario 813 on household location and job location, in the 3 case cities (813: combination of 4 measures)

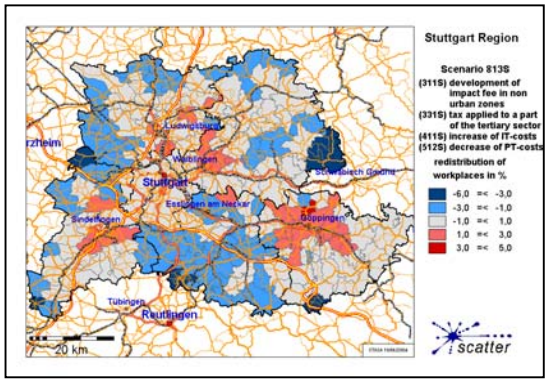












7.4. Conclusions

In conclusion, to the question “to what extent do public transport investments generate sprawl”, the simulations provide the answer that they actually generate sprawl if they extend to the suburban or rural areas, if they provide a significant improvement in the accessibility, and whether the network is radial or radial *and* orbital.

With regard to ***urban concentration*** and ***land consumption***, the most effective policies in the 3 cities are:

- road pricing
- impact fee on new suburban residential developments
- in some cases, fiscal measures to incite services (offices) to locate in zones served by high quality public transport (e.g. around rail stations), or constraining regulatory measure with the same purpose. For this type of measure, the potential effectiveness depends of the percentage of jobs already located in that kind of zones, in the reference scenario.

Cordon pricing and parking policies are effective too. However, they were not kept in the final packages because they produce a repulsive effect on employment.

With regard to ***climate change*** and ***air pollution***, the most effective policies are road pricing and parking policies. In this respect, land use policies seem to have only little impact, except a drastic regulatory measure on office location in Brussels.

On the basis of the simulations, the final recommendation of SCATTER is to combine 4 approaches:

- ***congestion pricing: i.e. car use cost increase in congested areas, at peak hours***
- ***reduction of the public transport fare territorially limited to the central agglomeration (indeed a reduction of fare at regional level encourages sprawl, whereas a reduction of fare inside the central area should increase its attractiveness – both measures have of course a positive effect on the modal share)***
- ***impact fee on new suburban housing developments***
- ***fiscal measure to incite offices to locate in areas well served by public transport at regional level (e.g. rail stations).***

The policies selected to be combined in the final package 813 are pricing policies or fiscal measures. Three of them appeal to the general principle “polluter pays” which is considered by the economists as the most adequate means to distribute among users the external costs of transport. Besides, pricing policies (either pricing land use or transport) can generally be more easily adjusted to the observed problems (congestion, land consumption, spatial competition, etc) than regulatory actions, and hence can be more effective. But on the counter-side, their acceptability is generally lower.

Another point is that there are close interactions between the cost of transport and the land rent. Measures increasing the travel cost (and in particular the car use cost) can have significant effects on the land market. The more costly the transport is, the more this contributes to reduce the urban sprawl, the more there will be a pressure to an increase of the urban land rent. This increase in land rent may in turn have effects on the socio-spatial

repartition, and the social segregation. This effect is to some extent taken into consideration in the models[9].

But pricing polices also provide the governments with revenue which enable them to make public transport investments or to make investments to increase the attractiveness of the cities (embellishment, open spaces, etc).

[9] The Helsinki and Stuttgart models include a sub-model of land market or housing market.