SUSTAINABLE STRUCTURE FOR THE METROPOLITAN AREA
FINLAND NEEDS A STRONG AND THRIVING METROPOLIS. The growth and expansion of the region poses challenges for land use, environment and transport that will require wide co-operation amongst the authorities. The future structural development of the larger Helsinki area and its impacts on the ecological, socio-cultural and economic sustainability has been studied in a development project called METKA (Sustainable Structure for the Metropolitan Area).

The Regional Councils of Uusimaa, Itä-Uusimaa, Kanta-Häme, Päijät-Häme and Kymenlaakso together with the Finnish Rail Administration, Finnish Road Administration, Ministry of Environment, the Regional Environment Centres of Uusimaa and Häme, the Regional Centre Programme for the Economic Area of Hyvinkää – Riihimäki as well as The South Finland Regional Alliance have studied models of regional structure, which would support sustainable development in the Helsinki metropolitan region.

For the first time the development of the regional structure has been researched and visualised this extensively using various existing databases of the area. Along with the recent regional plans, the METKA-project has been able to utilise the national information system for monitoring land use planning, the analysis methodology for land use and transport interaction developed by Strafica Ltd as well as the new assessment methods for ecological efficiency developed by the Technical Research Centre of Finland VTT.

This report describes the central premises and conclusions of the project. The various working phases and more detailed research reports may be found at www.metkaprojekti.info (in Finnish).
The METKA-project was divided in three working phases: analysis of present situation in the wider metropolitan area and definition of indicators for sustainability, definition and assessment of alternative models for regional structure, and finally creation and assessment of the METKA-model. The process included two working seminars. Background material consisting of several research reports (in Finnish) may be found at www.metkaprojekti.info.

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A SUSTAINABLE REGIONAL STRUCTURE IS NECESSARY FOR BOTH ECONOMY AND THE ENVIRONMENT

The overall structure of the expanding metropolitan area will become most sustainable by keeping the new urban development close to the existing structure and predominantly within the rail corridors. The conclusions of the METKA-project “Sustainable Structure for the Metropolitan Area” show that the greenhouse emissions from land use and transport cannot be reduced enough just by measures on a regional level. Other substantial policies are required to bring change to the present habits of living and mobility.

Due to growth in population and economic development, the wider Helsinki metropolitan area is expanding and gaining in strength. The commitments of sustainability must be observed in the development. The project “Sustainable Structure for the Metropolitan Area” (METKA) has studied various approaches to the regional structure of Helsinki and its surrounding cities in the light of ecological, socio-cultural and economic sustainability.

To visualise these approaches, a methodology has been developed to comprehensively utilise the available data on the past development of the region. Using this methodology, four variants of regional models were generated to describe the possible developments of the urban centres and the connections between them. These regional models are

The regional structure of the Helsinki metropolitan area in year 2005. Nearly 2 million people live in the five regions concerned.
in turn based on two different background visions on the economic and social future of the region. The models allocate new urban development according to the accessibility offered by the transport system. The models are assessed by measuring the performance of certain central indicators against the criteria defined in the project.

Based on these principles and the experiences from the first models, a “METKA-model” has been defined. It aims towards an ambitious but realistic densification of the current centres and the rail corridors between them. This kind of development will however need significant contemporary means of regulatory measures and co-operation. Nonetheless, the indicators show that the possibilities for large reductions in the greenhouse gas remain limited.

Therefore, to realise a sustainable regional structure in practice, the authorities have to increase the efforts for co-operation. The development of the metropolitan area has to be directed also towards other policies that support the measures for controlling the regional structure. Still, it is well understood that the regional structure is prerequisite to many other measures.

**Principles for promoting sustainable regional structure:**

- Development should principally be contained within the existing urban structure.
- Eventual greenfield development should be located adjacent to existing urban areas.
- Growth should be directed to the rail and road corridors between cities.

The METKA-model created with a land use and transport interaction methodology aims for a sustainable Helsinki metropolitan area until year 2050 when the population growth could reach 2.7 million. New rail connections shown are preliminary suggestions.
THE EXPANDING METROPOLITAN AREA

Helsinki and its surrounding cities form a metropolitan area of two million people, and plays a competitive part in the network of urban areas in Europe. It is the national center of economy, culture, research and education. It is also an important node of national and international connections. The Metropolitan area is strengthened by the interaction between Helsinki and the surrounding cities.

The functional area of the metropolis is expanding. Commuting to the core of the Helsinki metropolitan area has increased and commuting distances have been getting longer during the last decades. In the METKA-project the metropolitan area is defined by the Uusimaa, Itä-Uusimaa, Kanta-Häme, Päijät-Häme and Kymenlaakso regions. The population of the area exceeded 2 million in year 2005. METKA-project has examined the structure of the metropolitan area using growth scenarios for year 2050 of over 2.7 million inhabitants.

METKA-project has concentrated on the regional issues but the results also concern the local urban structure at a broad level. Regional structure is understood here as to deal with the relative strengths of the urban areas and the major arteries between them, whereas local urban structure would concentrate on a single commuting area. Many issues are, however, intertwined and both structures aspects affect the location of households and employment together.

The metropolitan area around the city of Helsinki has a significant role in the national economy of Finland. The strengthening economic and cultural interaction around the Baltic Sea and in the European Union emphasizes the importance of international connections. Especially the role of St. Petersburg as the strongest metropolis of the Baltic Sea is gaining attention. The economic specialization of regions around the Helsinki metropolitan area directs the development of the area as a whole.

Helsinki region is the driver of the economy in the metropolitan area, acting as a national centre in research and education as well as a national and international transport node. The Hyvinkää-Riihimäki region hosts a vibrant cluster of machine industry, which is located in the traffic artery connecting the cities of Helsinki, Hämeenlinna and Tampere. The cities of Hämeenlinna and Forssa have a comprehensive industrial base supplying the rest of Finland along with their universities and other institutes for education.
The metropolitan area expands, as an increasing part of the labour force from other cities of the area commute to Helsinki region.

Several significant export and building companies are located in Lohja. Karkkila has a base of metal industry. The region of Raasepori agglomerates versatile industrial and logistics companies. The nearby city of Salo (outside METKA study area) with its electronics industry is at the moment mostly gravitating away from Helsinki towards Turku and the region of Varsinais-Suomi. Due to the completion of a new motorway connection E18 and plans for a new rapid railway connection, Salo may in due course integrate more with the Helsinki metropolitan area.

Strong chemical, oil and energy clusters are located in Eastern Uusimaa around the cities of Porvoo and Loviisa. The urban regions of Lahti and Heinola are strategically located between Helsinki, as well as Western, Central and Eastern Finland. They have strong export and domestic product clusters, universities and other educational institutions. Kymenlaakso is part of an internationally significant concentration of forest industry with a strong emphasis on research and development. The local logistics cluster is also very vibrant. In addition to these, the cities of Kouvola, Kotka and Hamina have their own special sectors, as well as three major army bases. Kymenlaakso is strategically well located for the emerging Russian market.

A characteristic feature of the Helsinki metropolitan area are the rural areas that surround the cities. They combine valuable cultural landscape with a variety of employment sectors. The area also boasts extensive pristine forest areas and lake districts.
FACING THE CHALLENGES

The direst challenges of the Helsinki metropolitan area concern the need to harness climate change, especially by reducing the dependency on private cars, improving the global competitiveness of the metropolitan area and enhancing the quality of the living environment.
The operational context of planning is changing rapidly. The challenge of harnessing the climate change has become a major issue in creating a sustainable regional structure. The global threats posed by the climate change include rising sea levels, extreme weather conditions and diminishing biodiversity. In the future welfare has to be maintained by producing much less greenhouse gases. The emission levels need to be halved by the mid-century. This means that also Finland has to make a transition to a low-carbon society. Regulatory measures will be needed, as market processes will not reduce the emissions enough. Behavioural changes will be needed in addition to the technological development.

A major population shift is taking place in Finland to the southern parts of the country and to the Helsinki metropolitan area. Urban settlements are growing especially in the fringes and outside of the metropolitan core area, which means that the sprawling urban structure is generating more traffic than before. Land use planning is challenged to find solutions that can reach the tightening international goals for fighting the climate change. The urban sprawl increases demand for private cars and reduces the competitiveness of the public transport. A fifth of the green house gas emissions emanate from transport sector, which is largely dependent of the urban and regional structure of the land use. Urban sprawl also creates other major costs both for municipalities and their inhabitants.

Globalisation changes the global rules of competition. As the economy becomes more international, the labour force needed in production and agriculture is diminished in Finland. The challenge is therefore to create jobs in high tech and service sectors. In the information-based economy the regions need to provide a favourable environment for creativity. The employment typically agglomerates to locations that are most competitive. Agglomeration facilitates specialization, economy of scale and the use of common resources. Even though Helsinki metropolis is widely considered as one of the most innovative areas in Europe, it has been difficult to attract foreign investments and companies to the area. Therefore, the status of the metropolitan area in the front row of information societies needs to be strengthened further.

The future challenge is to attract more employees to the Helsinki metropolitan area and to help the integration of immigrants by means of education and services. This change also requires an adjustment process for the whole society towards a multi-cultural way of life. Both immigration and ageing of the population will mould significantly the Finnish society during the next decades. On one hand the demand for family housing will increase and on the other hand the ageing population will move to the centres. These developments will increase the demand for municipal services.

The above trends pose special challenges for enhancing the quality of the living environment. Already at present the cost of living is higher in the Helsinki region than in the rest of Finland while the standard of affordable housing is in general lower. The potential for segregation is higher than elsewhere in the country. The population growth and new suburbs create pressure on the natural environment as the built areas wear out and fracture the current green areas and weakens their biodiversity. As the structure of the built environment becomes denser, the need to access the high quality green corridors becomes evident in the urban centres and areas surrounding them.
The structure of the metropolitan area has been studied by combining the national information system for monitoring land use planning with regional plans and data on transport systems. The analysis is based on a specifically developed GIS-methodology that generates alternative regional structures and calculates their effects on sustainability.

The geographical direction of the growth of the metropolitan area may be realised in numerous ways. Four variants of regional models that differ distinctively from each other have been defined for the analysis. It examines outcomes of the models from several viewpoints. The METKA-project concerned the location of the built structure and the interaction of the regional centres based on the accessibility i.e. the relative sizes of the centres and the level of service of the transport connections between them. A visual modelling methodology was developed in the project to utilize the large databases available on the metropolitan area. The project is based on earlier studies and the OECD National Territorial Review of Finland (2005)

A set of indicators was chosen to measure sustainable development of the regional structure in a comprehensive way. These indicators have been used to estimate the effects of the various regional models on ecological, socio-cultural and economical development. Sustainable development was evaluated against a set of criteria concerning the population, transport systems, environment and economy, employment and businesses.

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### THE INDICATORS OF SUSTAINABLE REGIONAL DEVELOPMENT:

**Population, quality of living and services**
- Standard of living (m²/inhabitant)
- Utilisation of current residential areas
- Cost of travel and living
- Dependency ratio
- Accessibility of services
- Accessibility of strand areas

**Transport**
- Households with 2 cars or more
- Mileage by person cars
- Amount of adequate public transport zones
- Modal share of sustainable modes of transport
- Mobility of inhabitants
- Work trip lengths

**Environment**
- Greenhouse gas emissions
- Consumption of energy, concrete and water
- Occupation of land by buildings
- Fragmentation and degradation of green areas
- Amount of ecologically important zones endangered

**Economy, business and employment**
- Economic structure
- Agglomeration
- Employment level
- Workplace self-sufficiency
- Accessibility of workforce and workplaces
MODELLING THE ALTERNATIVE REGIONAL STRUCTURES

STAGE 1
Visualising the current regional structure:
The modelling starts by presenting the current land use and its accessibility. The study area is presented in a 1 square kilometre grid where each cell is coloured according to the number of inhabitants and employment. Squares with dense land use are shown in dark colour.

STAGE 2 Estimating the distribution of new structure with a distance function:
The closer the cell is to the big regional centres, the more new land use is allocated there. A steep curve is used for creating centralized and dense urban structure. Sprawl is represented with a gradual curve. A new, unconstrained structure is calculated first where the current structure and plans do not affect the relocation process. The picture becomes filled with a smooth gradient surface.

STAGE 3 Visualising the effect of land use constraints on the new structure: The effect of existing buildings restricting the free development of buildings is taken into account by progressively constraining the new structure from those cells that already have a substantial amount of existing land use. The new structure is removed also from recreational and protected areas as well as from cells covered with water. These excesses are relocated to other available cells. The end result is a new regional structure can be assessed by reading the amount of inhabitants and employment from the cells.
ALTERNATIVE PATHS FOR DEVELOPMENT

The regional models that were generated represent typical directions that the structure of the metropolitan area can take: Sprawling “Old Way”, rail-oriented “Rail Necklace”, transport arteries-based “Strong Connections” and multi-centred “Balanced Centres”. Two economic background scenarios for year 2050 have been developed to support those assumptions.

The development of the regional structure is strongly connected with regional economy and development. The regional models have been based on two differing background scenarios, one emphasising the agglomeration economics and the other concentrating on the specialisation of the regional centres. From these, four visions for transport and land use were developed. The quantitative models were all based also on the current regional structure and existing land use plans.

TWO BACKGROUND SCENARIOS FOR THE REGIONAL ECONOMIC DEVELOPMENT


Jobs based on the proximity with the main centre develop strongly and their share of employment grows significantly. This scenario largely continues the current trends in the Finnish economy.

2. Emphasis on the agglomeration economics: “Balanced Centres”

Specialized regions become the engines of new growth due to the structural changes in the global trade and growth of Russia. This strengthens the relative position of other centres than Helsinki, as they have industries and related services that can supply for the new demand like manufacturing and other sectors, which are independent from the proximity of the main centre.

The assumptions made in the background scenarios have to be taken into account especially when considering the “Balanced Centres”-model. There it is assumed that the past agglomeration trend diminishes and the growth is directed more towards other centres instead of Helsinki. Therefore the model is not comparable with others as it assumes different kind of future for external factors affecting the metropolitan area.

The regional models use different planning principles, but all aim for sustainable development. Different land use allocation rules allow for different strategies for supplementary planning e.g. in the vicinity of railway stations or in a smaller scale in villages. Also the “Old Way”-model is based on active stance to curb the urban sprawl and therefore cannot be considered as a laissez faire alternative.

The natures of the regional models become different from each other when different parts of the transport system develop with different pace. “Old Way” and “Balanced Centres” aim to maintain at least the current level of service everywhere, which leads to urban sprawl in the end. “Rail Necklace” and “Strong Connections” on the other hand aim to increase accessibility through much denser land use in the most efficient transport corridors.

The regional models concentrate on the large-scale issues of transport and land use relocation. In practice the effectiveness of the models would depend also on other policies, but these issues were not considered in this project.
To keep the models comparable, general assumptions on e.g. mobility behavior and energy prices were kept largely the same. For example, significant changes in modal split or prices of energy would clearly alter the results. The assumed substantial population growth includes major immigration that also creates difficulties in the predictions due to the changes in social and cultural environment.
The position of the Helsinki region will remain stable or strengthen moderately, but the overall locus of the metropolitan area will move outwards from the Capital. Supply of labour to the metropolitan core will largely be based on commuters from the surrounding municipalities and beyond. No major new investments to the transport networks or services will be done. The focus of transport systems will be kept on reactive maintenance instead of proactive measures. The challenge is to turn the sprawling trend towards networks of agglomerations, cities and villages based on supplementary planning.

**OLD WAY**

The growth will be directed to the current and new concentrations of residential and employment zones especially along the railway corridors. Land use will be mixed and integrated into dense urban settlements based on slow modes. Built environment will be strongly centralized and urban settlements will interact tightly with the Helsinki metropolitan core. This will result in more use of rail services and will lead into new investments in railway connections. The challenge for dense communities is to ensure the quality of living environment and access to recreation areas.

**RAIL NECKLACE**

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Growth and changes in planning context will lead to pressure to develop land use along the logistically and environmentally beneficial nodes of the transport networks. New major investments will be done mainly to ensure orbital connections in the Helsinki region. Highly specialized sectors of private services that need employment with high education and good communication networks relocate outside metropolitan core, because the rapid traffic connections make long traveling distances possible. The challenge is to create urban environments that promote slow modes in large suburban residential areas.

A balanced development of land use in all large regional centres will ease the pressure for growth in the Helsinki region as the other conurbations exploit their connections to the metropolitan core in addition to domestic and Russian markets. Large concentrations of employment develop in all large cities of the metropolitan area whose rail and motorway connections will facilitate efficient interaction. Helsinki will continue its role as the capital but will act more clearly as one of the many individual centres in the metropolitan area. The challenges are to use land more efficiently in all centres, to promote public transport, and to develop the urban environment as to provide good environment for walking and cycling.
RAIL TRANSPORT PROVIDES FOR THE MOST SUSTAINABLE REGIONAL STRUCTURE

According to the comparative assessment, the model “Rail Necklace”, which emphasizes rail corridors, emerges as the most sustainable. However, it requires particular attention on the detailed planning of the living environment. “Balanced Centres” evens out the growth of Helsinki, but the problem in the other regional centres is the low modal share of public transport.

The ecological efficiency of the alternative structures was assessed by the Technical Research Centre of Finland (VTT). Results were based on the typology of areas and their density, which lead to variations in the building types. The differences to “Old Way” in CO₂ekv-emissions varied between -4,5 %...+1,5 %. Especially emissions from transport were lower in all other models compared to “Old Way”.

1. The location of residential areas in “Old Way” and “Balanced Centres” are closer to the consumer preferences when the quality of the habitat is considered, whereas “Rail Necklace” and “Strong Connections” are typically more efficient for the society as a whole. Condensed living environments pose challenges to the detailed planning.

2. “Rail Necklace” enables the development of the most sustainable transport systems. Also “Strong Connections” has sustainable features. “Old Way” creates problems in maintaining the public transport level of service due to the urban sprawl. The difficult feature of “Balanced Centres” is the relocation of inhabitants and employment outside the metropolitan core where the current modal share of public transport is lower.

3. The results concerning the ecological efficiency show that the regional structure has a significant effect on the environment. The differences in ecological indicator values vary between -13 % and +29 %. “Rail Necklace” is clearly the most efficient model in the use of construction materials, energy consumption and emissions. Indicators show that regional models that create sprawl are especially problematic for maintaining wide continuous natural areas and for promoting biodiversity.

4. The regional models that have an agglomeration-based background scenario can be ranked “Rail Necklace” – “Strong Connections” – “Old Way” from the competitiveness point of view. The specialization-based “Balanced Centres” is efficient if the scenario of the simultaneous concentrated and expanding development is realized.
## COMPARISON OF ALTERNATIVE REGIONAL MODELS

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<th>CRITERIA FOR SUSTAINABLE DEVELOPMENT</th>
<th>OLD WAY</th>
<th>RAIL NECKLACE</th>
<th>STRONG CONNECTIONS</th>
<th>BALANCED CENTRES</th>
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<tbody>
<tr>
<td>1. Population, living conditions and services</td>
<td>Good</td>
<td>Requires attention</td>
<td>Moderate</td>
<td>Good</td>
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<td>- Living costs and conditions, quality of living environment</td>
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<td>- Ensuring services</td>
<td>Problematic</td>
<td>Easy</td>
<td>Possible</td>
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<td>- Possibilities to supplement current structure and socio-economics</td>
<td>Weak</td>
<td>Good</td>
<td>Moderate</td>
<td>Requires attention</td>
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<td>2. Transport</td>
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<td>- Reducing car dependency</td>
<td>Difficult</td>
<td>Conceivable</td>
<td>Moderate</td>
<td>Requires attention</td>
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<tr>
<td>- Sustainable transport system</td>
<td>Problematic</td>
<td>Good</td>
<td>Problematic</td>
<td>Requires attention</td>
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<tr>
<td>- Mobility management</td>
<td>Difficult</td>
<td>Conceivable</td>
<td>Difficult</td>
<td>Requires attention</td>
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<td>3. Environment</td>
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<td>- Climate change control and ecological efficiency</td>
<td>Least efficient</td>
<td>Efficient</td>
<td>Relatively efficient</td>
<td>Not efficient</td>
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<td>- Accessibility of recreation areas</td>
<td>Good</td>
<td>Requires attention</td>
<td>Good</td>
<td>Very good</td>
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<td>- Wide continuous natural areas and biodiversity</td>
<td>Big risks</td>
<td>Controllable</td>
<td>Problematic</td>
<td>Requires attention</td>
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<td>4. Economy, business and employment</td>
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<td>- Business opportunities</td>
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<td>Moderate</td>
<td>Good</td>
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<td>- Operational labour markets</td>
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<td>- Accessibility</td>
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<td>- Prevention of exclusion</td>
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<td>Conceivable</td>
<td>Possible</td>
<td>Conceivable</td>
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The alternative regional models have been based on different principles and their feasibility can therefore differ substantially. For example, "Rail Necklace" requires new kind of strategies for enhanced co-operation between the municipalities. Developed as a result, “METKA-model” is an ambitious but realistic combination that resulted from the assessments of the regional models examined. Thus its assessment indicators position themselves between those of the studies models.

METKA-model is a combination of certain characteristics in the compared models that were considered to increase sustainability. An implementation path towards such model was also developed. The final model and the implementation path leading to it are based on the idea of balancing the conflict that was found between growth and sustainability in the indicator analysis.

In the METKA-model each railway corridor forms a functional system that locates around 200 000 inhabitants with the associated workplaces. The growth has been directed so that each railway station serves approximately 10 000 inhabitants. New railway corridors extend the existing ones and utilise the same population and employment base, thus requiring less new land use to be efficient. Measured by the current demand factors, the new stations will have to compete for the land use to gain enough travel demand, as it is not economic to empty up the existing land use structure. It is useful to study the possibilities to create dense land use along existing motorway corridors in such cases where it proves to be uneconomical to create a railway corridor.
Proper public transport supply is facilitated along the railway corridors and in the major cities. In a sustainable regional structure, population will locate beneficially for railway services so that each station can serve approximately 10,000 inhabitants.

The METKA-model extends the structure along networks between the major centres and hierarchically towards smaller centres. Rapid railway services connect the major cities.
FIRST CONDENSE AND SUPPLEMENT THE EXISTING CENTRES

The regional structure becomes more sustainable by supplementing and condensing the existing urban areas and by directing new construction next to locations where good public transport services already exist.

It is beneficial to grow and condense the centres of the existing regional structure as centralised dwellers and businesses enhance e.g. the accessibility of services. Condensing the existing structure enables good opportunities to develop economical public transport services, because the new capacity will benefit also the existing passengers e.g. by increasing the frequency of the services.

An efficient way to supplement the existing large centres is to base them on railway networks as rail transportation is highly dependent on the economy of scale. The more efficient the land use can be made around the stations, the more profitable the railway services become. however, this poses a challenge for the detailed planning to create good living environment.

Concentration of all growth in the Helsinki metropolitan core would eventually require large-scale reconstruction of existing areas to be more efficient. The METKA-model divides this pressure more equally among the cities.
Utilize the existing structure

The assessment shows that the problems of growth are smaller when the regional structure is developed inside the current structure i.e. in the existing centres where services and public transport is already being provided. Large centres are especially suited for condensing urban structure.

Construct railways to support existing suburbs

There are limits for how long condensing can be continued. The closer the activities can locate, the more sustainable the regional structure becomes. Railways that complement the existing structure enable new dense land use to be developed next to the existing suburbs. This requires long-term planning and focused land use policy.
THEN EXTEND TO EXISTING
AND NEW RAILWAY CORRIDORS

Centralised and dense regional structure extends to sustainable directions along the existing railway corridors. Enhancing the level of service of public transport increases the accessibility of new station neighbourhoods. Only after existing railway corridors have been utilised the growth can be directed efficiently into new railway corridors – one at a time.

The expansion of growth outside the centres will inevitably lessen sustainability when new areas will be introduced for construction. The trips will lengthen when the new land use is located further away from the employment and service centres. The share of public transport will diminish if it is not economical to arrange public transport with a high level of service.

Rail services with high frequency should be extended also outside the metropolitan core, especially to other major cities in the area. However, the profitability of rail services depends highly on the economy of scale. It requires intensive land use around the stations to ensure good basis for high transport demand. Therefore, existing rail corridors with abundant space for new efficient station neighbourhoods should be utilised first. A dense “pearl necklace” –form promotes the use of railways for commuting and slow modes for short other home-based trips in well-functioning local centres with services.

The implementation of the METKA-model should stay as long as possible within the existing rail corridors. Only after that should the growth be directed efficiently into new ones. Rail investments are expensive but they allow for large traffic flows with small marginal costs.
Keep to the existing rail corridors when expanding

The regional structure will be reinforced between the largest centres. As the urban development along the Helsinki-Hämeenlinna-Tampere corridor has shown, the radial railway and road corridors that increase the accessibility will accelerate the urban development. The areas that are not in the corridors should be efficiently attached to rail with connecting services.

Select one new rail corridor first

When growth cannot be contained in the present rail corridors or when new corridors prove more accessible from main centres, the most sustainable and efficient corridor should be chosen for implementation. It has been estimated that a new rail corridor requires a population of 200,000 to be efficient. The efficiency and costs finally depend on many details.
LAND USE AND TRANSPORT MUST BE PLANNED TOGETHER

The planning of land use and transport should happen simultaneously and in wide co-operation. The planning approach should be holistic over the municipal and regional borders. Well-functioning public transport and local centres planned for slow modes need to be realised also in smaller cities. Development resources should be directed to the implementation of well-balanced and multi-centred regional structure of knowledge-based metropolitan area and not to the municipal competition for new inhabitants.

The decision-making and planning processes of the metropolitan area need to be able to meet the challenge for urban and regional structure from the climate change and its control mechanisms. Regional structure has a significant effect on energy consumption and greenhouse gas emissions.

If the growth of the metropolitan area emerges as urban sprawl, the competitiveness of the area will suffer. The ecological efficiency weakens and the infrastructure costs for the society rise. The position of public transport will be jeopardised together with the expansion of urban areas. The planning and timing of railway connections need to be aligned with land use planning and implementation. The measures for strengthening the share of walking, cycling and public transport need to be found throughout the metropolitan area.

The planning and assessment of new built areas in the expanding metropolitan area should reach over the municipal and regional borders. The development of the area will require significant choices and decisions of funding. Political courage and administrative innovations will be needed as well as new models for financing and co-operation. The government should commit itself to major public transport investments and their schedules, which are
The sustainability of the regional structure may be visualised by showing the continuous natural areas that face the risk of fragmentation. If growth creates sprawl in the regional and urban structure, the ecologically sensitive areas (green colour) are in danger of subduing to built areas (grey colour). These conflict areas are marked with a blue colour. METKA-model creates significantly less risks for the ecologically sensitive areas, but still requires efforts to handle the conflicts properly.

The position of the urban centres outside the Helsinki region will rise in the development work. The cities of the “Balanced Centres” – model should control the growth in a sustainable way. The risk of spreading out growth from the metropolitan core is that the competition of the cities will not heed to the concentrated development of the station neighbourhoods. The end result might be that the urban sprawl will get worse e.g. along the coastlines of waters. The home-based trips from these areas could easily be exclusively car dependent. The locations of the big shopping centres have particularly big consequences on the realisation of sustainable regional structure. Operable education and research institutions should support the development of the largest centres.

**METKA-model preserves environment**

The sustainability of the regional structure may be visualised by showing the continuous natural areas that face the risk of fragmentation. If growth creates sprawl in the regional and urban structure, the ecologically sensitive areas (green colour) are in danger of subduing to built areas (grey colour). These conflict areas are marked with a blue colour. METKA-model creates significantly less risks for the ecologically sensitive areas, but still requires efforts to handle the conflicts properly.

"Old way"  "METKA-model"
A sufficiently high area density (floor space per area of land) and population density (inhabitants per area of land) are prerequisite to a sustainable regional structure. A thumb rule is that doubling the area of land increases the energy consumption and emissions of transport by half. The costs of infrastructure maintenance can grow uncontrollably in a fractured regional structure.

The comparison of four regional models for ecological efficiency showed that the management of the regional and urban structure can increase relative efficiency of the “Old Way” by 29 % or in some cases reduce it by 13 %. By ecological efficiency we mean the material and energy consumption in addition to the production of pollution and waste per inhabitant. The biggest positive effects can be achieved by relocating the construction near the current centres and suburbs. Thus the average area density in the metropolitan area increases, which alleviates the need to build new infrastructure. This particularly means reduction in demand for construction materials.

Area efficiency has traditionally had a strong connection with the distribution of building types and therefore the use of wood and concrete. Increased use of wood in construction may be preferred in order to reduce emissions of greenhouse gases and increase ecological efficiency. That goal calls for low rise, dense urban areas so that the use of wood becomes technically feasible and conforms to the fire safety regulations.

The way the regional structure is planned has a significant impact on the consumption of energy and the greenhouse gas emissions. If the most ecologically efficient measures are utilised fully, the efficiency of the regional structure can be
improved significantly, probably even by 20% from the structure of “Old Way”. By strengthening these effects with new construction and energy technologies, transport systems and various regulations that increase ecological efficiency, the ecological efficiency of the built environment may be further increased from this figure.

The regional and urban structure of Finland is in international comparison scattered and the average area efficiency in urban areas is low. The capacity of the infrastructure allows for substantial increase in ecological efficiency. Many new activities can be located along the current infrastructure. More efficient regional and urban structures facilitate the introduction of new ecological technologies in construction and networks.

The life span of choices concerning the built environment is so long that the assessment of measures should be done at an adequate level for at least next 50 years, preferably even for 100 years.

The regional structure affects the greenhouse gas emissions

A comparison of “Old Way”-model and METKA-model for total greenhouse gas emissions from land use and infrastructure (construction and use). Blue colour indicates the reduction of emissions and red marks increase. Even though the emissions concentrate in the rail corridors, the overall sum shows a 163 million ton reduction per year.

-17 000 000 − 1 000 000
-1 000 000 − -50 000
-50 000 − 0
0 − 50 000
50 000 − 1 000 000
1 000 000 − 12 100 000
IN THE FUTURE THE FOCUS SHOULD BE ON THE MEASURES

The overall effect of the regional structure on sustainability will remain too small unless other measures are also introduced. A sound regional structure is nevertheless prerequisite to other sustainable measures. Therefore the efforts should be continued by identifying efficient measures of sustainable regional policies and by considering the synergies of the regional structure with them.

The four alternative models of regional structure and their combination, METKA-model, have been assessed with the present day practices and behaviour. Comparability to the present day situation was the main reason for this. Therefore, it was assumed also that no new policies will be introduced in addition to the ones that affect directly the regional structure. The aim was also to examine the pure effect of the regional structure. Therefore the effects of behavioural or economic factors (e.g. prices and incomes) were not analysed. This way the effectiveness of regional policies that affect the structure can be estimated.

The ongoing trend of urban sprawl is problematic for the sustainable development. Economic growth generates rising incomes and more production. Increased welfare in turn raises standard of living. This and population growth demands more floor space, which can increase the values of land leading to expansion of the structure to more affordable areas. A decentralized structure lengthens the distances, increases traffic and creates pressure to build new capacity in the transport system. And so the sprawling growth continues to reinforce itself. This sprawling development needs to be reversed through consistent regional policies for the metropolitan area. The METKA-model and its implementation path show one example of this kind of strategy.

The effect of the regional structure stays limited according to the results. This result cannot, however, be interpreted so that the regional structure does not matter as many policies require a supporting regional policy. The reduction of greenhouse gases and sustainable growth require efficient regulation mechanisms for housing, employment and transport systems. The METKA-project has not concentrated in regulation yet. The Kyoto protocol and EU directives cannot be complied with one or two measures. Enhancing of the ecological efficiency requires that all possibilities of modern technologies in addition to planning or construction practices are tried. Furthermore, totally novel solutions need to be invented and deployed efficiently.

Various measures should be invented, assessed, selected and balanced next in view of all objectives. In this way a regional structure that enables other sustainable policies, functional everyday life for people and a good operational environment for businesses could be developed also in a low-carbon society. The METKA-model serves as a well researched starting point for this work.
The sustainability of transport and land use should be promoted at least in following policy areas:

- Sustainable land and housing policy
- Supplementary planning
- Mobility management
- Public transport
- Research and education
- Monitoring and information
- Taxation and charges
- Innovation and technology
- Controlling the location of traffic generators