OECD Green Growth Studies

Compact City Policies: Korea

TOWARDS SUSTAINABLE AND INCLUSIVE GROWTH

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BETTER POLICIES FOR BETTER LIVES

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Foreword

This publication is the first country-specific case study following the OECD report *Compact City Policies: A Comparative Assessment* published in June 2012.

Compact City Policies: A Comparative Assessment offered policy makers in national and local governments a comprehensive understanding of how urban spatial policies can help achieve green growth, which is a central concern of the OECD Green Growth Strategy. Based on the evidence and analysis on compact city policy practices in OECD member countries, including five case studies in cities, the report presented the compact city concept, its role in today's urban contexts and its potential outcomes, indicators and recommendations on key strategies and governance challenges. In particular, one of the key findings from the report is that no single, comprehensive compact city model is applicable to all cities and regions, because each must take local circumstances into account. For example, in fast-growing regions with strong development pressures, regulatory tools are important to prevent uncontrolled urban extension, and complementary fiscal tools can orient market-based decisions about the location and volume of development. In contrast, a region with a shrinking population may find it difficult to contain urban development, and as such instead needs sophisticated measures to induce people to urban centres. This calls for a further country-city specific case study.

In this context, the current volume aims to provide "food for thought" for national, sub-national and municipal governments in Korea seeking to address urban challenges through improving urban spatial structure, and to find how compact city strategy could contribute to enhancing urban policy. More specifically, this publication aims to assess national and local governments' compact city policies and provide policy recommendations, focusing on explicit and comprehensive policy set to achieve compact city goals, together with relevant sectoral policies that may impact such developments. In addition, this publication identifies urban trends and challenges by adopting the OECD's compact city indicators, and examines compact city policies impacts by applying urban simulation methodology to two cities with different local contexts: Daejeon and Hwaseong.

The findings and recommendations contained in this publication build on a wide range of research, discussions and exchanges of opinion conducted during the study. This study was funded by a voluntary contribution from the Korean government.

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This study was led and co-ordinated by Jongwan Joo, Policy Analyst, Regional Policies for Sustainable Development Division, and Seongkyun Cho, Policy Analyst, Regional Policies for Sustainable Development Division, under the supervision of Setsuko Saya, Head of the Regional Policies for Sustainable Development Division. Chapter 1 was written by Hyunji Lee and Jongwan Joo, Chapter 2 by Jongwan Joo, and Chapter 3 by Jongwan Joo and Seongkyun Cho.

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- United Kingdom: Keith Thorpe, Officer of the Order of the British Empire, Head of Urban Policy Unit, Department for Communities and Local Government
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Acronyms and abbreviations

ABM	Agent based modelling
ADU	Accessory dwelling unit
BRT	Bus rapid transit
CBD	Central business district
CSO	Combined sewer overflow
CTOD	Center for Transit-Oriented Development (United States)
DATAR	*Délégation interministérielle à l'aménagement du territoire et à l'attractivité régionale* (France)
	Delegation for Territorial Development and Regional Attractiveness
FAR	Floor area ratio
GDP	Gross domestic product
GHG	Greenhouse gas
GFA	Gross floor area
GRDP	Gross regional domestic product
HAI	Housing Affordability Index
IEA	International Energy Agency
INEGI	*Instituto Nacional de Estadística y Geografía*
	National Institute of Statistics and Geography (Mexico)
ITF	International Transport Forum
IVL	*Integriertes Verkehrs- und Landesplanungkonzept für Luxemburg*
	Integrated Transport and Spatial Development Concept for Luxembourg
KOTI	Korea Transport Institute
KRIHS	Korea Research Institute for Human Settlements
KTX	Korea Train eXpress
LRT	Light rail transport
MAC	Multifunctional administrative city

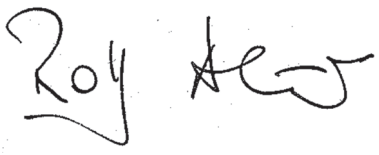
MLTM	Ministry of Land, Transport and Maritime Affairs
MLU	Mixed land use
MMTC	Multi-Modal Transfer Centre
MOLIT	Ministry of Land, Infrastructure and Transport
NGO	Non-governmental organisation
PPP	Public-private partnership
RDA	Regional development authority
ROT	Road-oriented transport
SIAAP	*Syndicat Interdépartemental pour l'Assainissement de l'Agglomération Parisienne* Department of Wastewater and Stormwater Treatment for the Paris Metropolitan Area (France)
SMA	Seoul Metropolitan Area
SRU	*Loi relative à la solidarité et au renouvellement urbains*
TDM	Traffic demand management
TOC	Transit-oriented corridor
TOD	Transit-oriented development
TOZ	Transit-oriented zoning
UDC	Urban development corporation
URC	Urban regeneration company
VMT	Vehicle miles travelled
WHO	World Health Organization

Preface

Korea's cities face increasing challenges as a consequence of the country's fast urbanisation. The best use of limited land resources has become a major concern of urban policy makers and wider economic disparities across Korean cities are calling for better urban policy to boost urban activities sustainably. The demographic shift towards smaller, ageing households requires urban policy makers to develop a policy framework for the well-being of urban communities with better mobility and walkability. And finally, increased environmental challenges, such as intense energy consumption, air quality and water management, require urgent policy actions.

A compact city, which highlights how urban spatial policies can help foster economic growth and development while preventing environmental degradation, can be a sound and reasonable urban development model for Korea. In this regard, this book analyses Korean cities from the view of urban forms, and in particular, their "compactness", and proposes policy recommendations at the national and sub-national levels to improve the sustainability of Korean cities. It also provides a number of insights gained from experience in other OECD countries, in terms of both public policy and governance.

I hope this report will further contribute to improving Korean urban policy to address diverse urban challenges and sustainable urban development. In addition, policy recommendations from this report will provide food for thought to help countries or cities develop policies to improve their competitiveness through better design of urban form.



Rolf Alter
Director
Public Governance and Territorial
Development Directorate, OECD

Executive summary

Key Findings

Korea faces increasing challenges as a consequence of its unusually rapid urbanisation. As Korea's share of urban population doubled from 40.7% in 1975 to 81.9% in 2009, it also saw its real gross domestic product (GDP) increase sixteen-fold over the same period. Meanwhile, Korean cities face economic disparities. The Seoul-Incheon Metropolitan Area (SMA) accounted for 45.4% of Korea's national GDP in 2008 and SMA's population holds 69.54% of national GDP while 90% of Korea's 244 municipalities' fiscal independent ratios fall below the national average of 51.5%.

The country's shift toward smaller and ageing households, high energy consumption, air pollution and water management require urgent attention. The ratio of single-person households in Korea increased from 5% in 1980 to 24% in 2010 while the OECD average increased from 22% to 29%. Korea is projected to have the second oldest population among OECD countries by 2050 with its elderly dependency ratio reaching nearly 80%, despite it having been third youngest OECD country in 2010. Road Oriented Transport (ROT) increased energy consumption and exacerbated air pollution. Four of its metropolitan cities rank among the top 20 most polluted areas in OECD countries. Urban flooding is also a serious and growing problem in inadequately maintained built-up areas.

These urban challenges call for more systematic and integrated policy packages that address the diverse perspectives of "urban form", a concept that is helpful to understanding the compactness of Korean cities. Increasingly complicated and interdependent challenges facing cities require intersectional policies.

Korean cities exhibit scattered development that often leaves existing urban areas underutilized. In addition to the doubling of urbanisation share between 1975 and 2009, a number of new town developments around SMA contributed to the scattered development. Clusters of large scale vertical mixed buildings, known as a traditional compact development, have been constructed without enough integrated consideration of their potential benefits such as closer proximity between jobs and housing. The dominance of apartments, which comprise 58.5% of Korea's total housing supply, has been criticized for extinguishing sense of place. Half of all regions in Korea contain less than $9m^2$ of green space per person, the World Health Organization's international standard, and these urban green areas are shrinking by 3.5% on average every year. Meanwhile, parking lot size has increased faster than the rate of car registration.

Korean cities have overwhelmingly promoted ROT, incurring several side effects. Average commuting distance in SMA increased from 9.7 km in 1996 to 13 km in 2010. Construction of roads almost doubled from 1990 to 2012, by which time roadways accounted for approximately 10% of total urban area. As a result, traffic congestion cost increased by 32% between 2003 and 2007 and accounted for 2.4% of national GDP in 2010. Unequal public transportation accessibility (in Seoul 91.2% of people live within a five minute walk from public transport, but only 68.2% in Daejeon), Unequal job density (85.96% in Seoul, 58.95% in Incheon) and an unbalanced matching index in local service accessibility (0.04 in Jung-gu/Seoul, 0.069 in Gangnam-gu/Seoul) all show room for

improvement by integrating transportation, while unbalanced job density in SMA also begs for a better understanding of socio-economic networks.

Some compact city policies (CCP) have already been introduced to promote urban sustainability, but to date they have not been implemented completely. Several new town projects in suburban areas, land use deregulations and green belts have led to leapfrog developments pushing Korean governments to deregulate green belts and transform outdated city hubs into vibrant urban areas by such methods as increasing the supply of rental housing near rail road stations.

Recommendations

A national policy framework for CCP is called for and urban centres need redevelopment to cope with multifaceted changes. Consolidated strategic policies for CCP should go hand in hand with the latest urban developments such as Ubiquitous city and with giving local authorities room to drive compact development in their own urban contexts. Urban regeneration issues including declining centres, one of the most serious challenges facing policy-makers at all levels, should focus on integrating social cohesion, environmental sustainability and economic competitiveness.

Mixed land-use could enhance cities' appeal and integrate land-use policy with transport policy through transit-oriented development (TOD) strategies. More flexible zoning based on urban form, such as form based code and place-type designation, as well as tax incentives could optimize the mixed land use response to cities' demands. TOD could be integrated with broad regional goals such as addressing traffic congestion, improving local economies and enhancing public health. Traffic management encouraging residents to use public transport more would optimize TOD strategies.

Improving multi-level governance is indispensable to achieving CCP goals. Local governments are responsible for decisions on dense development, public transport networks and services and jobs within their jurisdictions while national governments play a critical role in making national land use plans, which in turn serve as the basis of local plans, and in approving some urban plans. Congestion charges and road taxes are good tools for national governments to support local governments' CCP implementations. Partnerships bringing together public, private and community sectors on equal footing would encourage co-operation at both ministerial and local levels.

Case studies are helpful in shedding light on the challenges of implementation. For example, Daejeon city, Korea's fifth largest metropolitan area, exemplifies how expansion of built-up areas and relocation of town centres has led to a decline in retail business in old towns, a growing need for new settlement in the suburbs and uneven access to local services in decaying urban centres, creating a need to improve living conditions by regenerating urban centres rather than expanding cities. The Eastern District of Hwaseong, one of Korea's fastest growing cities, is a residential area that nonetheless contains many factories within its boundaries, a case that calls for avoidance of further piecemeal development that will exacerbate disparities within the city.

Scientific approaches such as urban modelling are needed to analyse the impacts of CCP in order to identify the best set of CCP to implement. To meet this need, a conceptual framework to develop an integrated urban model to assess economic, environmental and social impacts is suggested. Pilot simulations based on the notion of conceptual framework show that both of Daejeon and Hwaseong reduced leap-frog developments when they implemented CCP such as promoting redevelopment and high-density development around the old town centre.

Assessment and recommendations

Korea faces increasing challenges as a consequence of its unusually rapid urbanisation

The real gross domestic product (GDP) of Korea has increased about sixteen-fold since 1970, going hand in hand with the one of the highest urbanisation ratios. Its share of urbanisation doubled during the same period, from 40.7% to 81.9%. This rapid change has generated cross-sectional urban challenges: economic, social and environmental.

Economic disparities have deepened, but local cities have considerable potential

The polarisation observed in Korean cities is accentuated when examining GDP per capita and GDP growth rates in different regions. The Seoul-Incheon Metropolitan Area accounted for the highest share of Korean national GDP in 2008 (45.4%), and the metropolitan areas with a population of over 500 000 account for 69.54% of GDP, which is the second highest among OECD member countries. This polarisation is even more acute by comparison with the weak financial capacity of local cities. Korean local cities' revenues represent less than 20% of total government revenue, and 90% of Korea's 244 municipalities' fiscal independence ratios fall below the national average of 51.5%. Only 18.5% of total regions represent not only higher GDP per capita than the national average, but also a higher-than-average annual GDP growth rate.

The shift towards smaller and ageing households demands better transport and walkable cities …

The recent slowdown in the urban share of the total population has been accompanied by a lowered shift of population from urban to rural areas. This is probably related to the rapid ageing of the population and to an increased preference for living in rural areas. Meanwhile, the ratio of single-person households in Korea has increased, from 5% in 1980 to 24% in 2010, much faster than in other OECD countries, where the ratio increased from 22% to 29% over the same period. A rapid ageing trend has been recorded for decades in Korean cities. Although in 2010, Korea's population was the third youngest among OECD countries, it is projected to have the second oldest population by 2050, with its high elderly dependency ratio reaching nearly 80%. This prospect of rapid entrance into an ageing society has identified mobility for the elderly a critical element for preparing for the demographic changes in store. In particular, the high road fatality rate of 31.8% for those over 65 years old (as compared with an OECD average of 24.5%), of which 54% of the elderly fatalities are pedestrians, indicates that land use and transport planning should be carefully adjusted to ensure that the older generation can retain its independence and travel safely.

Korea's high energy consumption, air pollution and water management require urgent attention

In recent decades, better living standards, rapid urbanisation and industrial growth have made Korea one of the OECD's most energy-intensive economies. High energy use caused by "road-oriented transport" (ROT) rather than transit-oriented development (TOD) has exacerbated air pollution in that ROT leads to more vehicles consuming more energy, which increases vehicle miles travelled (VMT) accompanied proportionately by air pollutant emission. Four of its metropolitan cities rank among the top 20 polluted areas in OECD countries. These growing environmental concerns underscore the need for Korean policy makers to focus on the transport and building sectors, two key contributors to increasing energy consumption. Urban flooding is also a serious and growing problem in inadequately maintained built-up areas. Runoff from storm water, one of the main causes, is becoming an important issue not only in environmental policies, but in urban planning and infrastructure management.

Urban challenges call for more systematic and integrated policy packages …

A number of urban policies have evolved over time to promote sustainability, but the increasingly complicated and interdependent challenges facing cities now require more than a sectorial approach. Although sectorial policies for economic growth, social development and environmental improvement can enhance quality of life to a limited degree, intersectional policy can help unravel the complicated web of urban challenges. In Korea's fast-changing context, thorough diagnoses and policy responses are urgently needed to grapple with diverse urban components and different urban contexts.

… that can be viewed through the diverse perspectives of "urban form" …

Investigating urban problems through the prism of "urban form" offers urban policy makers a useful tool. The current urban structure, which regards large-scale vertical mixed-use developments as one of general forms, must be analysed to uncover any missing links between diverse urban functions, and strategies to exploit synergies must be developed. Local governments have established clusters of high-rise buildings in the name of mixed land use without enough consideration of the benefits, such as better proximity between jobs and housing or more transit use. The form-based code, preferring integrated urban forms rather than areas labelled by different land use, has been suggested as one effective tool contributing to Korean urban sustainability, by directly influencing urban forms.

… which is helpful to thoroughly understand the "compactness" of Korean cities

The urban forms in Korean cities can be distinguished into three major areas: land-use patterns, transport networks and socio-economic networks.

Korean cities show a scattered pattern of development ...

In addition to the doubling of urbanisation share between 1975 (40.7%) and 2009 (81.9%), a pattern of scattered development is observed in most large metropolitan areas, in particular in Seoul-Incheon. This trend is due to a number of new town developments in suburbs around the metropolitan area, and a policy of allowing rapid development in areas of high demand. Suburbanisation has led to an increase in commuting distances and a decline in the vitality of the urban cores, resulting in urban problems. In areas subject to sprawl, diversified land-use patterns are a fundamental issue in managing growth and improving quality of life.

...but there is room to maximise the use of existing urban areas

Urbanisation in the past neglected the importance of greening urban areas. Half of all regions in Korea have less than 9 m² per person of green space, the international standard set by World Health Organization (WHO), and urban green areas are shrinking by 3.5% every year. Meanwhile, the size of parking lots has increased even faster than the rate of car registration. The provision of a large number of parking lots in a short period will help to reduce the lack of parking lots in cities, but is also likely to cause an increase in private car traffic. Attention must be paid to avoid the new development in green space, especially in highly populated areas. An examination of building forms in Korean cities shows that high "perceived" density can be mitigated by well thought out urban planning, by determining the right type of building form and increasing public spaces between buildings. Moreover, the high vacancy rate of buildings and housing in some cities suggests that some of the housing construction promoted in recent decades was not adequately linked to the needs of the urban economy. Although the rapid provision of new apartments has improved living conditions for middle-income households, the dominance of apartments, at 58.5% of Korea's total housing supply, has been criticised because it has taken away from a sense of place. In addition, the size of housing units needs to be reconsidered for new developments given a sharp increase in one-person households. Overall, the challenge is now to harmonise existing urban facilities, such as green space or parking places, to avoid the negative impact of leapfrog development, and to improve urban amenities, including the landscape and green space.

Korean cities have promoted car-oriented transport networks

During the recent spurt in urbanisation, average commuting distances have dramatically increased, especially in the Seoul Metropolitan Area, from 9.7 kilometres in 1996 to 13 kilometres in 2010. Meanwhile, traffic has increased in the inner-city area, largely driven by a sharp rise in the use of private cars, which elevated the costs caused by the side-effects of traffic congestion such as traffic delay, fuel consumption or pollution emissions in urban areas by 32% between 2003 and 2007, and contributed 2.4% of the national GDP in 2010. The provision of roads almost doubled in the two decades from 1990 to 2012, and in 2012, the road sector occupied about 10% of total urban area. While this could be interpreted as a remarkable improvement in urban infrastructure, it is noteworthy that expansions in road capacity tend to be largely offset by higher demand, and subsequently require further road expansion. A divergence in the layout of roads

increases the need to find a more appropriate form for roads. Wide, car-oriented thoroughfares and huge blocks with few intersections compromise pedestrians' safety, particularly that of children and the elderly, and reduce walkability.

Integrating transport networks could enhance accessibility

A comprehensive analysis of accessibility to public transport in Korean metropolitan areas would shed light on the significance of integrating land-use patterns and transport networks. The level of accessibility varies among metropolitan areas. In Seoul, the share of the population living within five minutes' walking distance of a bus or metro station is 91.2%, but the figure for Daejeon is only 68.1%. Enhancing public transport networks not only affects environmental quality, but helps reduce social inequality. The lowest income group still pays the highest share of its total monthly expenditure on transport. A better understanding of transport networks should include detailed attention to street design, including green areas alongside streets and well-connected pedestrian streets. Unbalanced job densities among cities (e.g. Seoul: 85.96%, Incheon 58.95%) and disparity of local service accessibility in Seoul (e.g. Jung-gu: 0.04, Gangnam-gu: 0.069, Matching Index) require better integrating transport network policies.

Better understanding of socio-economic networks is essential for a sustainable, compact city

An examination of socio-economic networks, showing how cities really support their residents, would allow policy makers to improve overall accessibility to jobs, services, housing and social capital. Regions vary widely in job density (the total number of jobs in a specific area divided by the resident population of working age). Seoul has the highest level (85.96%), as might be expected given its dominance in job opportunities (accounting for 21% of the jobs in Korea). Wide disparities exist in the job density of metropolitan cities (ranging from 58.95% to 85.96%), but the cities with the lowest shares are chiefly located in the Seoul-Incheon Metropolitan Area. These are dominated by residential areas with few job opportunities, as a result of the new town developments. Another key factor in quality of life, accessibility to local services, tends to show a large mismatch in the Seoul-Incheon Metropolitan Area, particularly as regards local service facilities for the elderly. Disparities in housing affordability among regions are also noteworthy. Seoul's housing prices are more than double those of the other metropolitan areas, a potential barrier to achieving diversity of residences. Lastly, discrepancies in the level of social mix, in the distribution of education and age groups across regions, are more evident at neighbourhood level than at the wider administrative level. Examining who lives where is useful data for designing policies to improve urban forms, in particular based on different local contexts at micro levels.

Compact city policies have been introduced to promote urban sustainability

Compact city policy has been suggested as a strategy that could help achieve sustainability in urban areas. The Korean government's Second Revision of the Fourth National Comprehensive Plan and other documents have acknowledged the need to make urban areas more compact, and proposed policy initiatives including high-density

development and building affordable housing near railway stations. However, the compact city strategy has rarely been invoked as an explicit goal of long-term urban policies. Several new town projects in suburban areas have also introduced the concept of the compact city. The central business district of the Dongtan 2 New Town development will include a much higher floor area ratio, as well as a multi-use complex located at a new high-speed railway station. Land-use regulations and greenbelts were introduced to prevent urban expansion, but led to leapfrog development. This resulted in the deregulation of greenbelt areas in seven large metropolitan cities and the demolition of the entire greenbelt areas in seven medium and small-sized cities. The concept of the compact city inspired recent efforts to transform outdated and underdeveloped city hubs into vibrant urban areas, as well as efforts to supply rental housing on railroad sites (e.g. the Happy Housing Project). Such policy interventions are still in the early stages, and it is not clear how successful they have been. Nevertheless, some progress has been made in realising compact city strategies.

A national policy framework for the compact city policies is called for …

Clear understanding of urban policy makers from all levels of government about an integrated concept of compact city policies is needed. Previous approaches to urban development in Korea have tended to focus on high density. Instead, the latest urban development policies, such as Ubiquitous city, should also be designed for synergies with accessibility to services and jobs using public transport. A structured national framework and long-term vision can help institute compact city strategies at the local level. Consolidated strategic policies for the compact city should go hand in hand with giving local cities the authority to drive compact development in their own urban context. Metropolitan cities such as Seoul, Busan and Daejeon, where inner-city decay is an issue, should prioritise strategies for brownfield development and revitalisation of the inner city.

… and urban centres need regeneration to cope with multifaceted changes

The state-led growth process in Korea has focused on industrialisation for the past 50 years, incurring criticism for contributing to monocentric, unbalanced and possibly unsustainable urban development. One of the most serious challenges for Korean policy makers of all levels is to sustainably regenerate declining city centres. A fundamental guiding principle should be urban regeneration policies that focus on integrating social cohesion and environmental sustainability, as well as economic competitiveness. This would involve a comprehensive regeneration package, including more than simply physical redevelopment, which has conventionally been considered the foundation of urban regeneration. Enhancing liveability must be the first priority, since it is so critical to enhancing a city's appeal to potential residents. The national and regional governments' support for this long-term vision is critical in revitalising cities. Individual cities' economies are mainly affected by long-term interaction between support from higher levels of government and cities' own initiatives. A long-term vision could also help avoid the risk that chronic social problems simply move from one area to another.

Mixed land use could help enhance cities' appeal

Preparing an inclusive but clear definition of mixed land use would be one way of enhancing the appeal of Korea's cities. Mixed land use should not be interpreted as high-rise clusters focused on a large-scale vertical mix. The national government could usefully review the current status of mixed land use and develop guidelines for comprehensive types of mixed land use. Performance indicators by sub-regions within a city could be developed for comparisons. Further mixed land use could be promoted if the existing zoning system was given more flexibility. Korea's national government might want to consider structural changes in the national zoning system to respond to increasing mixed land-use demands. Given that a relatively flexible zoning framework is in place, approaches based on urban form, such as form-based code and place-type designation, could optimise the zoning framework. Tax incentives and infrastructure improvements could be used to encourage mixed land-use development.

…and integrate land-use policy with transport policy through TOD strategies

A transport-oriented development (TOD) model reflecting the context of individual cities could help co-ordinate land use and transport. TOD planning could be adapted to diverse scales. The experience of other OECD metro regions shows how vital it is to design TOD at a scale large enough to offer residents a sufficient number of public transport networks. Such strategies could be integrated with much broader regional goals, such as addressing traffic congestion, improving local economies and enhancing public health. Co-operative long-term plans to consolidate urban planning and transport investment could support TOD policies and encourage the involvement of the private sector. Traffic demand management (TDM) encouraging residents to change their travel behaviour and use public transport more frequently would optimise TOD strategies. Accessibility to public transport is essential for reducing the use of private cars and should be the backbone of sustainable urban transport. In particular, TOD could help minimise adverse effects, including raising property values around developing sites. Finally, an estimate of the growth likely to occur around transit sites, and an assessment of potential areas of low-income household displacement for TOD opportunity sites could help identify where to focus TOD.

Improving multi-level governance to achieve compact city goals

As discussed earlier, the compact city model is an integrated multi-dimensional strategy and requires strong governance with coherent networks for its successful implementation. The carefully balanced response that it calls for can be compromised by the economic and environmental pressures upon various stakeholders, and requires co-operation between cities outside their administrative boundaries. Cities like Daejeon should be encouraged to become interdependent rather than self-sufficient, mutually adding value as part of a wider network. Cities' urban planning should be conducted within broader boundaries that reflect a region's real economic structure. Compact city policies tend to be seen as the responsibility of local governments, and decisions on dense development, public transport networks, services and jobs taken within a local jurisdiction. The national government, however, can play a critical role in supporting

local governments to fulfil their tasks. Local governments make urban plans according to the national land plan made by the national government and some of the urban plans (e.g. metropolitan plan) should be approved by the national government. Pricing mechanisms such as congestion charges and road taxes can help local government mobilise existing sources of urban revenue. Partnerships that bring together public, private and community sectors on an equal footing should be encouraged to avoid fragmentation at both the ministerial and local levels. Higher levels of government could introduce incentives to encourage collective working between different tiers of government. Local communities must be actively involved in decision making to enhance neighbourhood planning and inquiry by design, so they can contribute directly. Meanwhile, no serious evaluation of compact city policies has been conducted, to show the extent to which the numerous regulations have been implemented and/or followed. The relevant data at the sub-national level should be the basis for developing strategy and measuring results and potential bottlenecks.

The compact city policies in place leave room for improvement …

Case studies are helpful in shedding light on the challenges of implementation. To illustrate the trends facing Korean cities, case studies of two cities at different stages of development were conducted, one of which (Hwaseong) was in a period of rapid growth and the other in a period of stagnation (Daejeon). The case studies confirm that some policy initiatives could be enhanced to help develop compact city polices at the national level. In Daejeon, the expansion of built-up areas and relocation of town centres have led to a decline in retail businesses in the old downtown, a growing need for new settlements in the suburbs and poor (or uneven) access to local services in the decaying urban centres. Daejeon needs to shift the emphasis of its urban policies to improving living conditions rather than expanding the city, a key aspect of compact city strategies. Establishing an explicit density target to concentrate urban functions could help regenerate urban centres, increasing the viability of Daejeon's urban renaissance projects. TOD concepts could also be usefully applied to urban development strategies, and enhancing public transport should be made a top priority. Major road developments have helped ease traffic congestion, but vehicle ownership has increased in the past decade at a rate even higher than in other metropolitan cities such as Seoul and Incheon.

Hwaseong is a typical instance of a fast-growing city in Korea. Its population doubled between 2005 and 2010, much faster than the national average (0.3%). Its gross regional domestic product (GRDP) growth rate in the same period was 120.1%, much higher than the national average of 5.9%. To keep pace with such growth, Hwaseong needs to improve urban policies to reshape urban form. Residential areas in its eastern district, and the many factories scattered inside its boundaries, raise the risk of attracting more development, due to the pressure of growth and the relatively low land prices. This compels factories to relocate within Hwaseong or move out of the city. A more strategic approach is called for to avoid further scattered development that will exacerbate disparities within the city. In addition, instruments should be designed to protect land resources. The city's TOD plan appears to be oriented toward physical development rather than a strategic plan for enhancing the city's overall competitiveness.

…and a scientific approach is needed to analyse the impact of compact city policy

It has been argued that an apparent disconnect exists between the advanced planning concepts that have been proposed and the current state of spatial planning and territorial governance on the ground. Urban modelling is expected to increase awareness of potential future consequences and support long-term strategic decision making. Such modelling is fundamental for evaluating compact city policies, because it can help identify their impact and the best combination of such policies. After reviewing the methodology of several existing urban models, this study proposes a conceptual framework to develop an integrated urban model to assess economic, environmental and social impacts. In a simulation exercise using the basic models created for this study based on the conceptual framework, forecasts for Daejeon's future urbanisation were conducted on the basis of two scenarios: business as usual and compact development (i.e. promoting redevelopment and high-density development around the old town centre), applying an agent-based urban simulation model. The simulation results for the compact development scenario show that small-scale sprawl is reduced and more development occurs within urban centres. Similarly, the SLEUTH model was applied to assess the impact of compact city policies for Hwaseong.

Chapter 1

Korean cities from the perspective of the compact city

This chapter examines urban dynamics in Korean cities through the perspective of urban form before providing policy suggestions based on compact city policies. The first part addresses the key urban challenges, such as economic, social-demographic and environmental challenges. The second part introduces compact city as an urban form to cope with the challenges and explains how to measure urban forms. The third part assesses the compactness of Korean cities in terms of land-use patterns, transport networks and socio-economic networks.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

Korea's cities face increasing challenges as a consequence of unprecedented urbanisation. The country's real gross domestic product (GDP) has increased about sixteen-fold since 1970, while its share of urban population doubled in the period, from 40.7% in 1970 to 81.9% in 2009 (OECD, 2012e). Moreover, as most of Korea's large metropolitan areas have developed in a piecemeal way in this brief period, the best use of limited land resources has become a major concern of urban policy makers. Rapid change has resulted in cross-sectional urban challenges, whether economic, social or environmental. Wider economic disparities across Korean cities raise the question of how to design policies to boost urban activities sustainably, as a more urgent matter than in other developed countries (OECD, 2011b; World Bank, 2009). The demographic shift towards smaller, ageing households does not necessarily allow for the well-being of urban communities with better mobility and walkability. Lastly, increased environmental challenges, such as intense energy consumption, air quality and water management, require urgent remedies.

Policy makers have developed a wide range of policy initiatives to address these challenges, as the experience of many OECD countries demonstrates. However, no universal panacea exists, and sectoral approaches are not always effective. Instead, it could be helpful to formulate a solution encompassing diverse urban components that reflect different urban contexts. The lens of "urban form" is one way to approach building an effective package of policies. Such urban forms can include how places are planned, how connections between places are laid out and how people are involved in urban activities (OECD, 2013a). Managing these with diverse policy tools has been increasingly adopted by urban policy makers, but which kinds of urban form to use remains controversial. Sustainable development might call for a differentiated approach, reflecting unique local contexts, through in-depth regional case studies. The comprehensive discussions on compact city policies updated by the OECD (2012a) provide food for thought to help countries or cities develop policies to improve their competitiveness through better design of urban form.

This chapter will explore urban dynamics in Korean cities through the perspective of urban form before providing policy suggestions on compact city policies to achieve sustainable growth in Korea. First, Korea's urban challenges are examined, as well as economic, social and environmental trends in general. As one way to address these challenges, the details on why urban form matters and how they can be measured will follow in the second section. Based on this discussion, the components of urban form in Korea will be explored in three major dimensions: land-use patterns, transport networks and social networks [1]

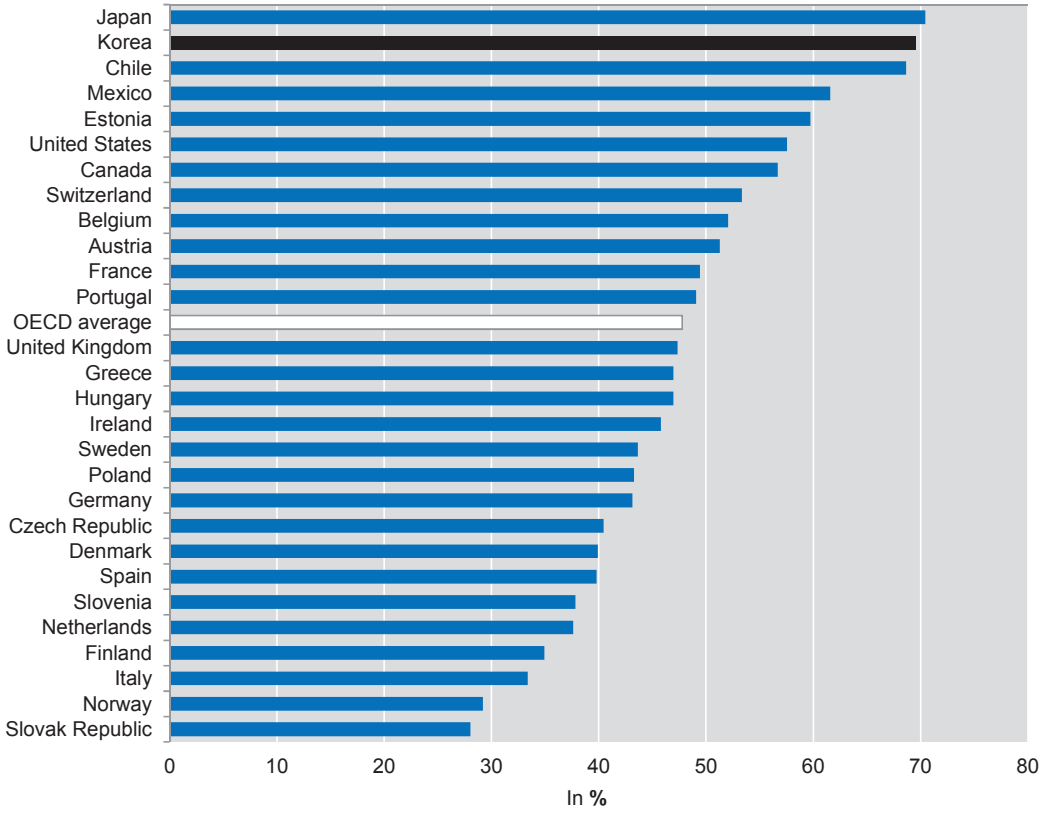
Key urban challenges in Korean cities

Economic challenges

Korea's urban challenges stem from its unusual pathway to economic growth. The sheer speed of industrialisation and urbanisation since the 1960s resulted in extensive economic achievements, but also left significant urban challenges. Korea's metropolitan cities lead its economic growth. The metropolitan areas with a population of over 500 000 account for 69.54% of GDP, which records the second highest among OECD member countries. In particular, the dominance of the Seoul-Incheon Metropolitan Area[2] is exceptional. Seoul-Incheon accounted for the highest share (45.42%) of Korean GDP

in 2008. This is even higher than Tokyo's share of Japan's GDP, at 31.65%, although the total share for Japan's metropolitan areas, 71.46%, is just higher than that of Korea (Figure 1.1). Moreover, the proportion of Korea's population residing in its metropolitan areas is 72.45%, higher than other OECD countries such as France (39.08%), Germany (38.63%) and Japan (67.07%) (Figure 1.2).

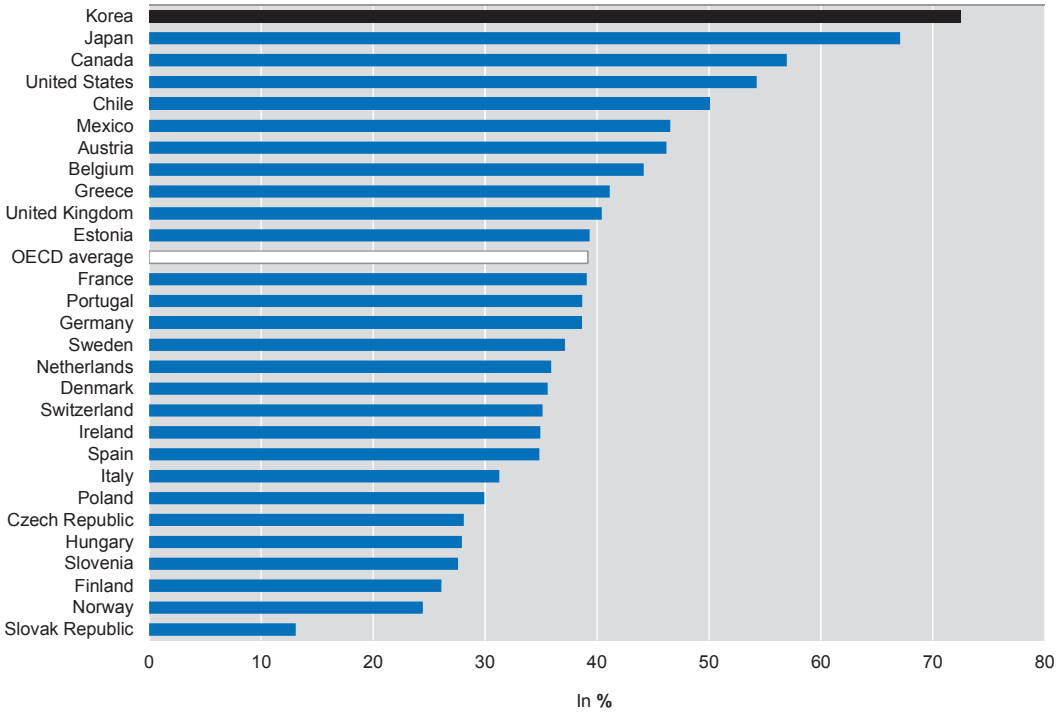
Figure 1.1. **Metropolitan areas' share of GDP in OECD countries, 2008**



Source: OECD (2013c), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en.

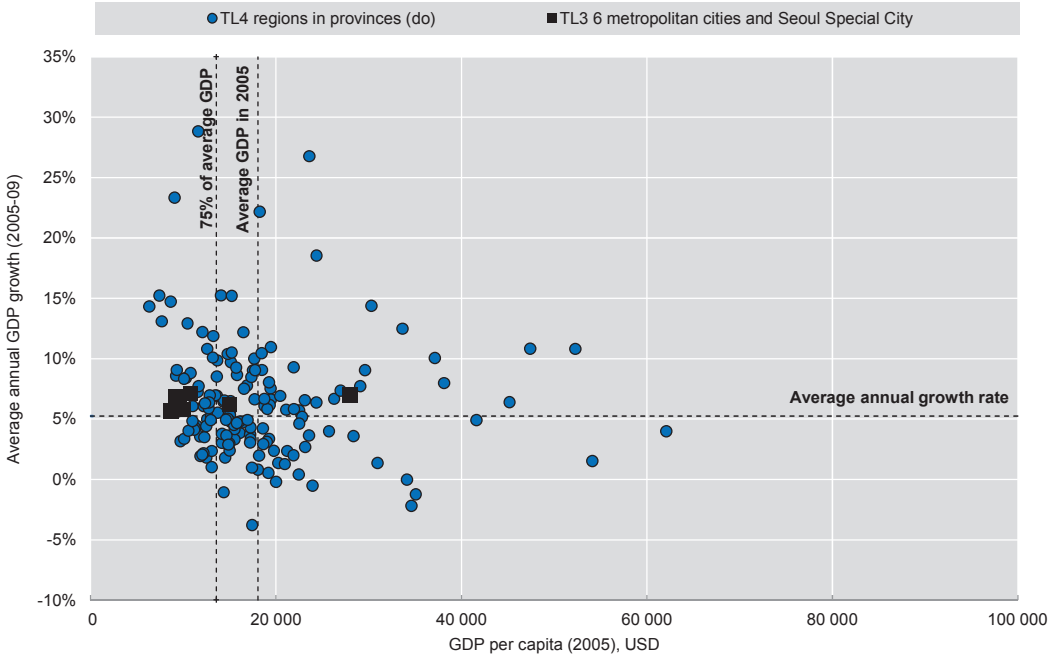
Interestingly, this concentration is only accentuated in an analysis of GDP per capita and GDP growth rate by using different units of analysis (Box 1.1 and Figure 1.3). Among seven metropolitan cities, only Seoul and Ulsan record higher GDP per capita than the national average (USD 12 000). In addition, the annual growth rates of GDP (2002-09) of the three metropolitan cities of Busan (6.9%), Incheon (7.1%) and Ulsan (7.0%) are higher than the national average (6.5%). A similar growth pattern among local cities can also be observed. Specifically, 35.6% of 205 Territorial Level 4 (TL4)[3] regions registered a level of GDP per capita less than 75% of the national average in 2005, while that of the other 36.6% was above the national average.[4]

Figure 1.2. **Metropolitan areas' share of population in OECD countries, 2008**



Source: OECD (2013c), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en.

Figure 1.3. **Rediscovering the potential of cities in different contexts**



Source: Own elaboration based on Korea Statistics Office, Korea Statistical Information Service, www.kosis.kr.

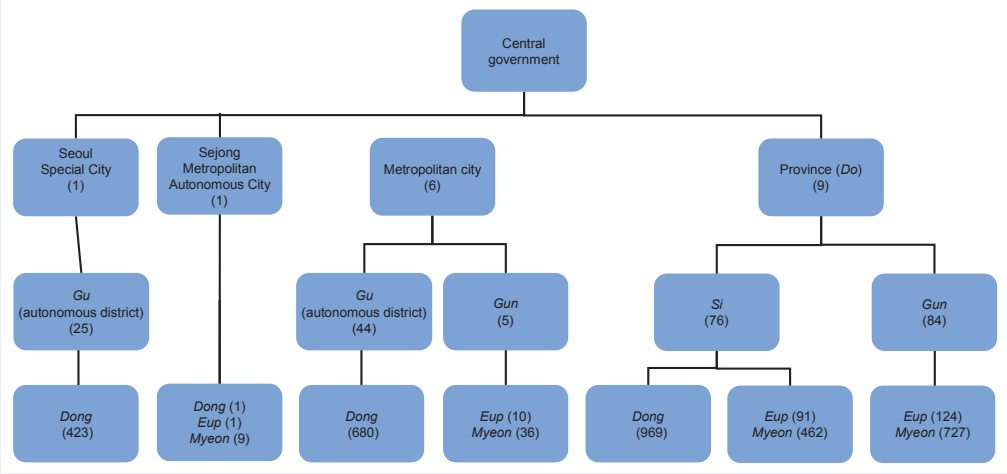
Box 1.1. **Regional administrative units in Korea and functional urban areas**

Administrative units

As a unitary state, Korea has a two-tier system of local government:

1. The upper (or regional) tier (Territorial Level 3 in the OECD typology) includes Seoul Special City, which has the status of a capital city, six metropolitan cities and nine provinces (*do*).
2. The lower (or basic local) tier (TL4 in OECD typology) is composed of 230 bodies, including 75 cities (*si*), 86 counties (*gun*, rural areas) and 69 autonomous districts (*gu*, urban areas that exist only in the metropolitan cities and Seoul). The lower tier of government is further divided into 3 477 administrative sub-branches, which are not legal entities and have no autonomous power: 215 *eup* (defined as the urban division of a county, or *gun*), 1 201 *myeon* (the rural division of a county, or *gun*) and 2 061 *dong* (which belong to cities including Seoul City, metropolitan cities and lower tier cities) (TL5).

Within this institutional framework, the Local Autonomous Act designates the following units as urban: *i) si*, a lower administrative unit at the TL4 level, with a population greater than 50 000, of which at least 60% resides in the urbanised areas; *ii) gu*, autonomous districts in metropolitan cities and in Seoul. Rural areas, known as counties or *gun,* are further divided into two categories: *i) myeon*, a basic subdivision of a *gun*; and *ii) eup*, an urbanised area in a rural unit, with a population of more than 20 000 people, of which at least 40% live in the urbanised area of the unit.



Notes: 1. Figures in brackets represent the number of administrative units in the given category. 2. Lower level cities can have a district (*gu*) if they have more than 500 000 residents, but *gu* do not have administrative power. 3. Jeju Special Autonomous Province, for convenience, is included in the province (*do*) category, while two cities in Jeju province, which have no autonomous power, are counted as lower level cities (*si*).

Source: Adapted from Ministry of Security and Public Administration (2013), *Municipal System and Population (2013)*, Ministry of Security and Public Administration, Seoul.

Functional urban areas (FUAs)

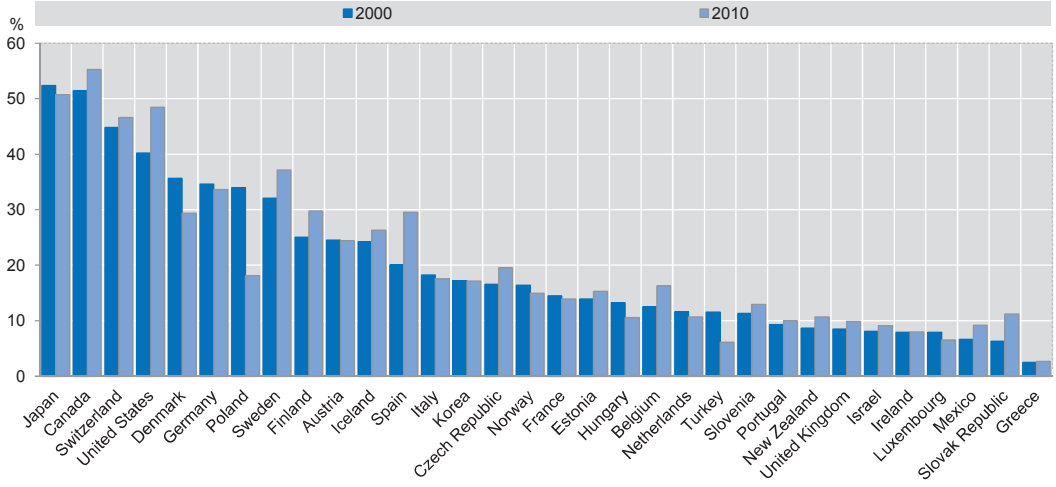
The new OECD methodology to define FUAs, using census data and commuting data at TL5, makes it possible to identify 45 FUAs, which include nearly 86% of Korea's total population. Among them are four large metropolitan areas (Seoul-Incheon, Daejeon, Daegu and Busan), which represent 72% of the total urban population and 62% of the total population. The second category of FUAs, designated as metropolitan areas, include Ulsan, Gwangju, Cheonan, Cheongju, Pohang, Jeonju and Changwon, and together represent 14% of the total urban population. These two categories together make up 11 FUAs of more than 500 000 inhabitants, representing nearly 74% of the country's total population.

Source: OECD (2012d), *OECD Urban Policy Reviews, Korea 2012*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264174153-en.

The local governments' fiscal capacity also accelerates regional disparities in economic growth. On average, sub-national governments account for about 20% of total public revenue in OECD member countries, which represents about 9% of GDP. These averages mask wide disparities: in some countries, sub-national governments receive more than 40% of public revenues, while Korean sub-national governments' revenues represent less than the average in OECD countries. Moreover, in most OECD member countries, the share of sub-central governments in public revenues increased between 2000 and 2010 (Figure 1.4), but there was no change in Korea. However, within this stagnant trend of total sub-national government revenues, disparity across municipalities has increased. The nine *do* (provinces), which have more rural areas and a larger population of the elderly, show lower independence: Jeollanam-do (21.7%), Jeollabuk-do (25.7%), Gangwon-do (26.6%), Gyeongsangbuk-do (28.0%), Jeju-do (30.6%), Chungcheongbuk-do (34.2%), Chungcheongnam-do (36.0%) and Gyeongsangnam-do (41.7%), Figure 1.5. The 90% out of 244 TL4 regions is less than the average of 51.1% (percentage of financial independence) in total, which fell from 53.9% in 2007. Only a few TL4 regions, such as Gangnam (75.9%), Seocho (70.9%) in Seoul and Seongnam (65.2%) in Gyeonggi-do are above the average. This may threaten the sustainability of the municipalities, given that sub-national governments can be key actors in regional development, especially in public investment.

Figure 1.4. **Total consolidated sub-national government revenues, 2010**

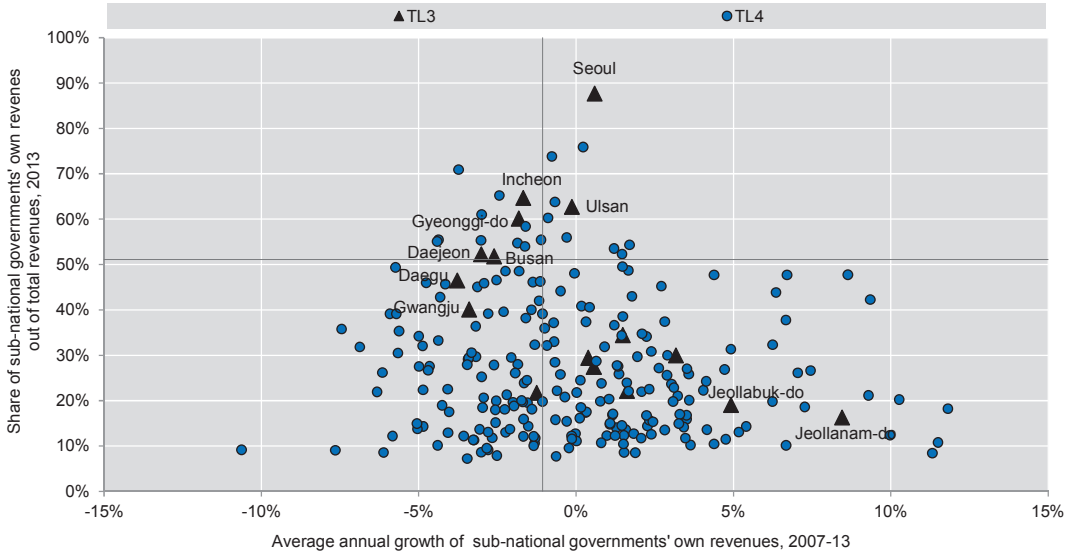
As a percentage of total government revenues



Source: OECD/Korea Institute of Public Finance (2012), *Institutional and Financial Relations across Levels of Government*, OECD Fiscal Federalism Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167001-en.

Nevertheless, some local cities show higher growth potential than metropolitan cities.[5] As can be seen in Figure 1.3, 18.5% of the total of 205 TL4 regions represent not only higher GDP per capita than the national average, but also a higher than average annual GDP growth rate. Among these local cities, Hwaseong performs very well, recording economic growth of 26.76% from 2005 to 2009, and about USD 23 000 per capita in 2005, while the national average is 5.23% and about USD 18 000. Moreover, 30.3% of local cities are growing faster than the national average and metropolitan cities, even if they have lower GDP per capita at present (Figure 1.3).

Figure 1.5. **Distribution of sub-national governments' own revenues, 2007-13**



Source: Own elaboration based on Korea Statistics Office, Korea Statistical Information Service, www.kosis.kr.

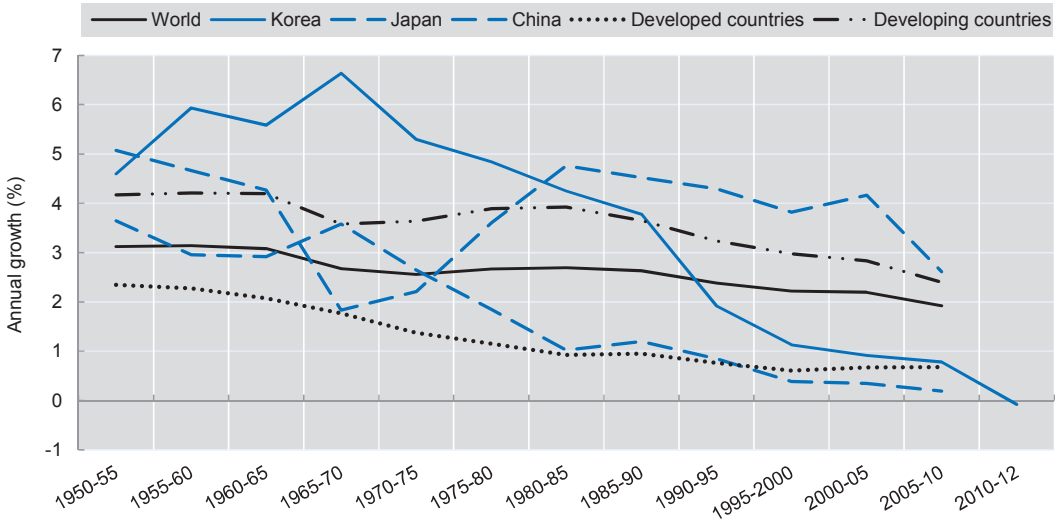
The regional disparities and the growth potential observed in some local cities could have important implications for urban policies in Korea. If the goal is to reduce the regional gap between cities while activating the growth potential of local cities, it is important to establish a differentiated growth or urban management strategy based on the status of the various regions. Urban policies should not be applied indiscriminately to every city without full consideration of the cities' different circumstances. First, a mega-city like Seoul requires special policy attention to boost its global competitiveness, by improving the cityscape and transport network (OECD, 2012e). Second, urban spatial policies should be designed to support or enhance the cities' potential for growth, and more importantly, to avoid the unplanned urban expansion that several large metropolitan areas have experienced. Third, the lagging regions urgently require the regeneration of their urban areas to promote economic development and regional competitiveness, without duplicating urban problems such as declining central business districts (CBD) and leap-frog developments. Policies should pay particular attention to the local context, for instance by examining a different urban form for each city, since a region's decline is caused by different bottlenecks. For example, Daejeon is working on an adequate policy response to revitalise its old CBD. Meanwhile, Hwaseong is focusing on integrating its old and new urban areas, since the development of its new town has increased the gap between its western and eastern districts (for further details, see Chapter 3).

Social-demographic challenges

Drastic demographic challenges in Korea have also been noted. After a recent slowdown in the growth rate of the urban population, a new population shift from urban to rural areas was seen in 2012. From 1960-70, the urban population grew faster than the global average, at an annual growth rate of 5.84% (Figure 1.6). However, since the early 1990s, this has declined significantly, to less than the global average. The annual growth rate from 2005 to 2010 (0.62%) fell into negative territory, to -0.08%, in 2012.[6] The non-urban population, which had fallen continuously since the 1960s, increased for the first

time in 2012, by 1.4%. This may be related to the ageing trend and an increased preference for living in rural areas (Ministry of Land, Industry and Transport, 2012).

Figure 1.6. **Annual urban population growth rate, 1960-2012**



Notes: 1.The vertical axis represents the annual average growth rate (%) of the urban population within a five-year time span. 2. The definition of developed and developing countries is defined by the United Nations' *Population Database*.

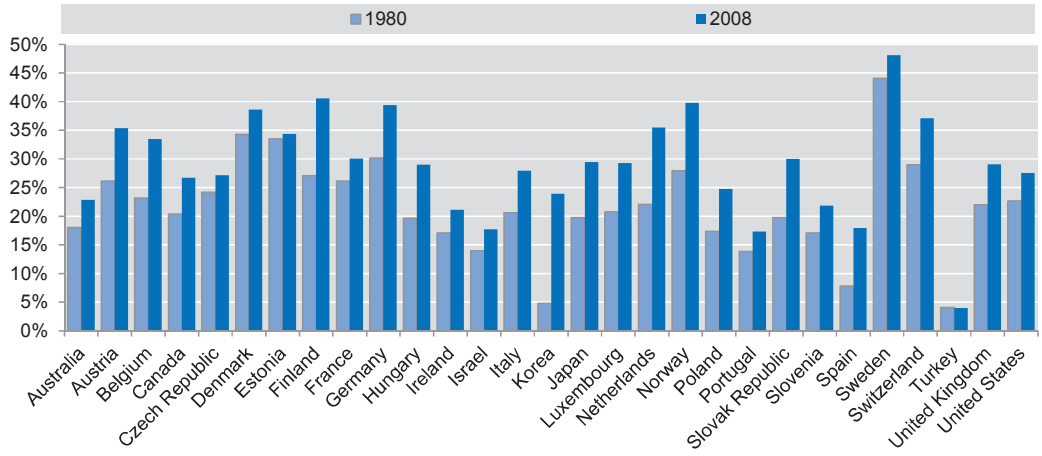
Sources: Own computations based on United Nations Department of Economic and Social Affairs (2010), *World Urbanization Prospects: 2009 Revision*, UN Department of Economic and Social Affairs, New York; Ministry of Land, Industry and Transport (2012), "2012 Urban Statistics", Ministry of Land, Industry and Transport, Sejong, Korea.

Meanwhile, the number of one-person households has dramatically increased in Korea, as it has in other OECD countries. The share of single-occupancy households rose sharply, from 5% to 24%, over the period 1980-2010, as compared with the rise from 22% to 29% in OECD countries (Figure 1.7). This trend is likely to continue at an even faster pace. OECD countries' experience suggests that this is occurring in both urban and non-urban areas (OECD, 2012a). However, a dramatic decrease in average household size is even more conspicuous in several *do* (provinces) including Jeollanam-do (where the average number of occupants per household was 1.88 in 2035), Gyeongsangbuk-do (1.89), Gangwon-do (1.95), Chungcheongnam-do (1.98) and Chungcheongbuk-do (1.98), all areas without metropolitan cities (Figure 1.8). This rapid change in household size has attracted the attention of policy makers and academics, and housing policies are now required to reduce the size of housing units and combine urban services more effectively.

At the same time, a rapid ageing trend has been noted for decades in Korean cities. In OECD countries, the elderly population has doubled or even tripled over the last 60 years. The OECD estimates that the number of people over 65 will exceed that of those under 15 years old in 2020, a process that could be replicated globally over the long term (OECD, 2012c). Korea is no exception, but its population is ageing more rapidly than that of other OECD countries. In 2010, it had the third-youngest population, but by 2050, it is expected to have the second-oldest, based on the elderly dependency ratio (Figure 1.9). The average age, which was 25.9 in 1980 and 38.9 in 2012, is expected to rise to as high as 49.7 in 2040.

Figure 1.7. **Percentage of one-person households in a selection of OECD countries, 1980 and 2008**

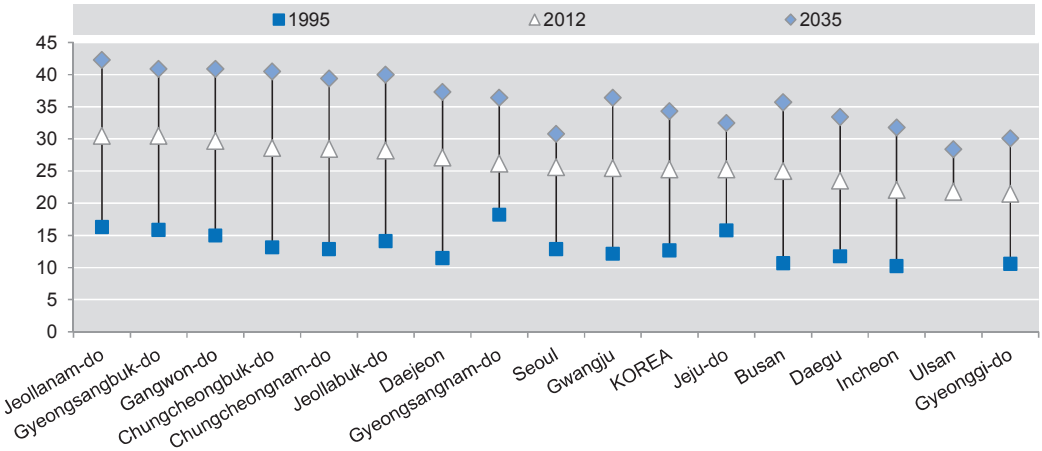
One-person households divided by the total number of households



Source: OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Figure 1.8. **Share of one-person households in Korea, 1995-2035**

In %



Note: The figures for 2035 are estimated based on current trends.

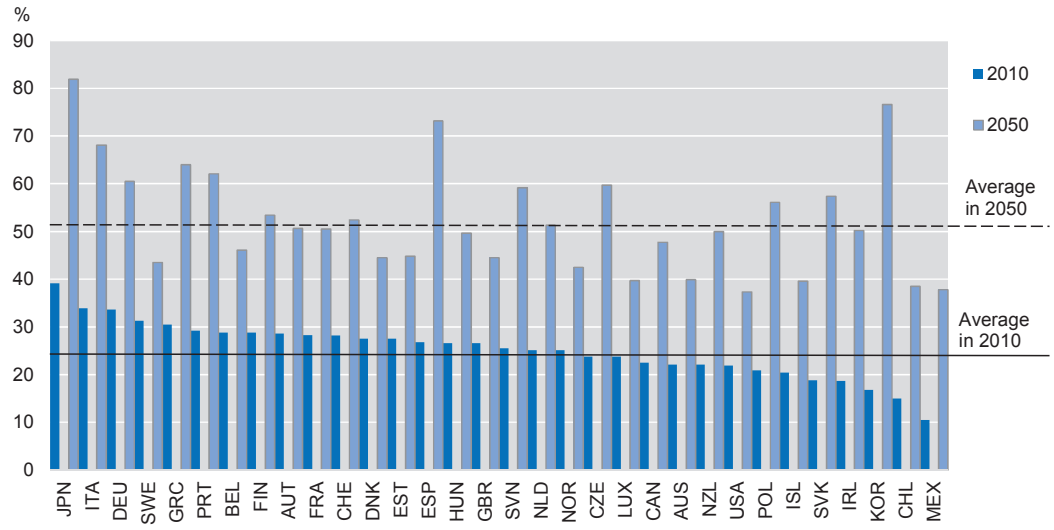
Source: Adapted from Korea Statistics Office, Korea Statistical Information Service, www.kosis.kr.

Korea's elderly population also tends to suffer from economic poverty. In 2010, Korea's Gini coefficient, which measures the income distribution within a country, was higher than in other OECD member countries (Figure 1.10). This tendency is worse among the elderly, in contrast to other OECD member countries, where the "silver economy" shows a lower Gini coefficient for the elderly. The implication here is that promoting age-friendly urban policies is crucial for maintaining social cohesion (OECD, 2012e). Moreover, the rapidly ageing population in non-metropolitan areas could also threaten the sustainability of cities. The ratio of age dependency shows a clear division between metropolitan and non-metropolitan areas (Figure 1.11). The population of metropolitan areas in Korea is younger than that of non-metropolitan areas. This might be

because non-metropolitan areas are less attractive to the younger generation, because there are fewer job opportunities for them there. This threatens sustainability, given the relatively weak economic situation of the elderly.

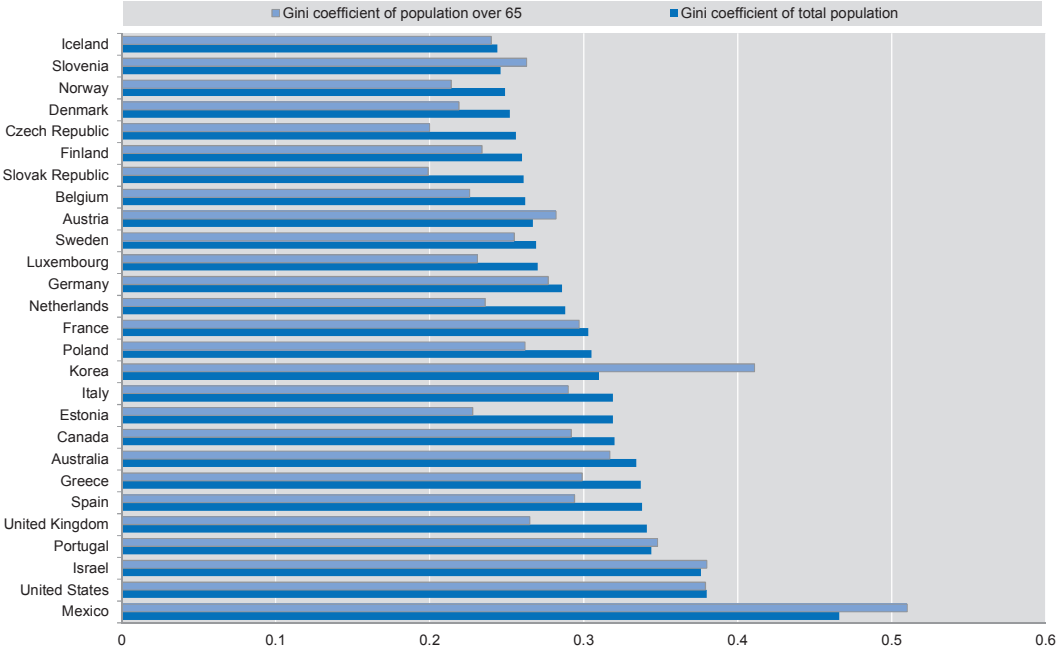
Figure 1.9. **Ageing trend in Korea projected to be the fastest in the OECD area**

Population aged 65 and over as a share of the population aged 20 to 64



Source: OECD (2012b), *OECD Economic Surveys: Korea 2012*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-kor-2012-en.

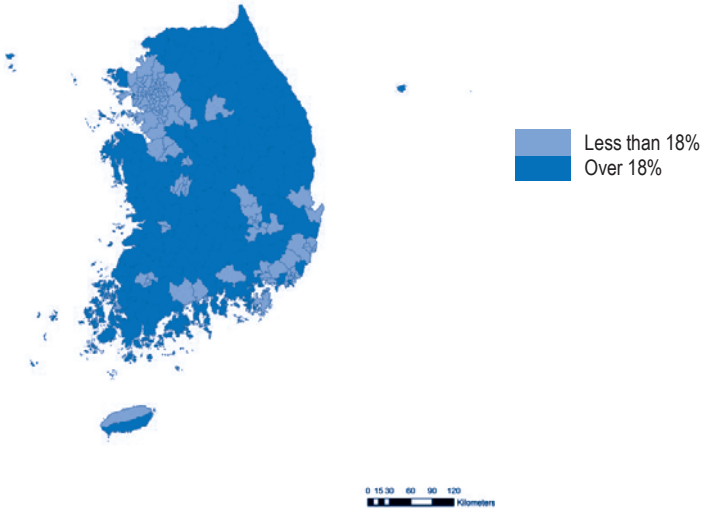
Figure 1.10. **Gini coefficient by age group in OECD countries**



Note: The Gini coefficient is calculated based on net-adjusted disposable income.

Source: OECD (2013c), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en.

Figure 1.11. **Age dependency in Korea, 2010**

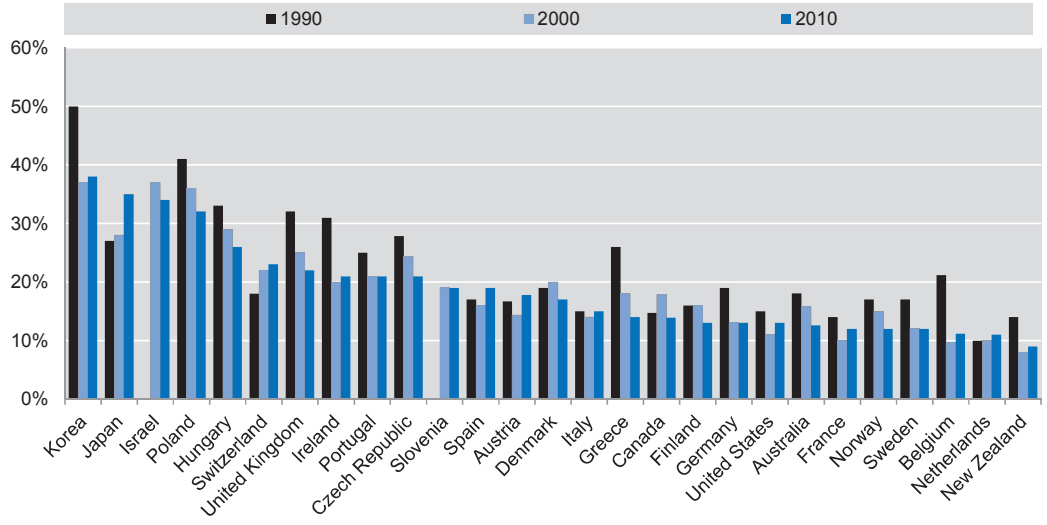


Note: Age dependency is defined as the ratio of the population aged 65 and over to the population aged 20-64 years old. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Service, www.kosis.kr.

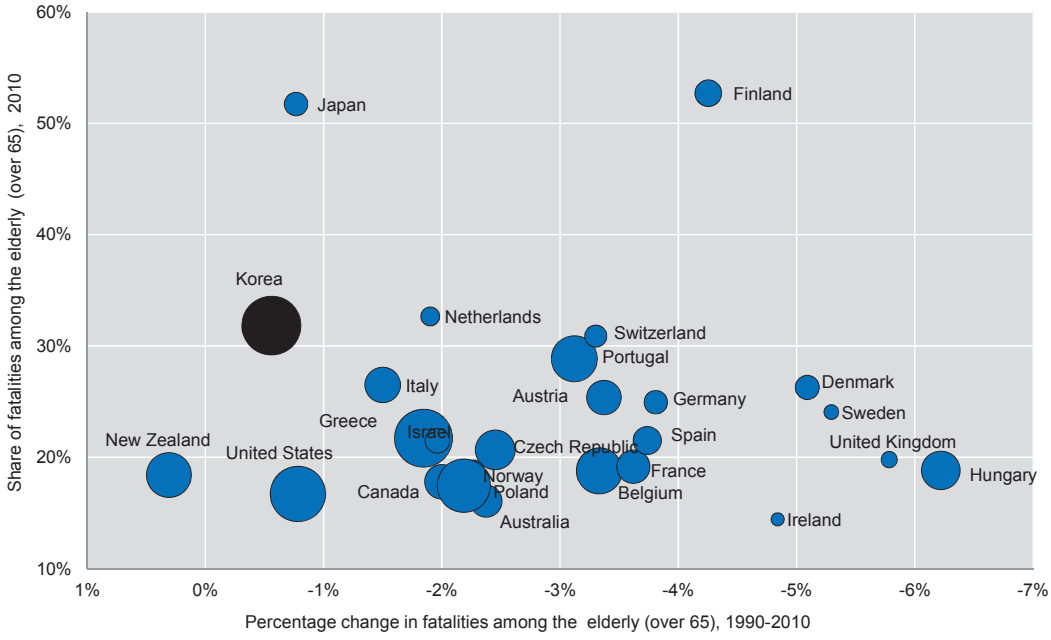
Given that the elderly tend to live in rural areas and suffer from relative economic poverty, their mobility has been singled out as a critical factor that can help Korea better prepare for an ageing society. Land-use and transport planning play a key role in allowing the older generation to retain their independence and to reduce their needs for costly support from the state in more developed regions or for alleviating poverty and isolation in some lagging regions (Frye, 2011). Korea's high rate of road fatalities also highlights the importance of land-use and transport planning for vulnerable social groups. The pedestrian fatality rate in Korea for 1990-2010 is the highest among OECD countries (Figure 1.12). While this rate declined over the period, it was still the highest in 2010, at 38%, double the average in OECD countries (19%). Moreover, the elderly over 65 years old are more vulnerable to traffic accidents (Figure 1.13). In 2010, fatalities for those over 65 were 31.83%, higher than the average of 24.51%, at a time when the rate in other OECD countries was improving. The figure for Korea (11.3%) was also higher than that for Greece (21.72%), Poland (17.45%) and the United States (16.70%), which have similar numbers of fatalities per 100 000 inhabitants (11.1, 10.2 and 10.6 respectively). Meanwhile, fatality rates for the elderly in OECD countries decreased by 2.93% from 1990 to 2010, while Korea's fell by only 0.56% during the same period. Surprisingly, pedestrians account for 54% of total road fatalities in the elderly. This road safety rate may influence walkability. Walking offers significant health benefits, and safe and attractive walking conditions (e.g. safe sidewalks and connectivity) are essential to attract walkers (Frumkin, 2002).

Figure 1.12. **Pedestrian road fatality rates in OECD countries, 1990-2010**



Source: Adapted from OECD (2012e), *Road Safety Annual Report 2011*, OECD Publishing, Paris, http://dx.doi.org/10.1787/irtad-2011-en.

Figure 1.13. **Trends in transit accident fatalities among the elderly in OECD countries**



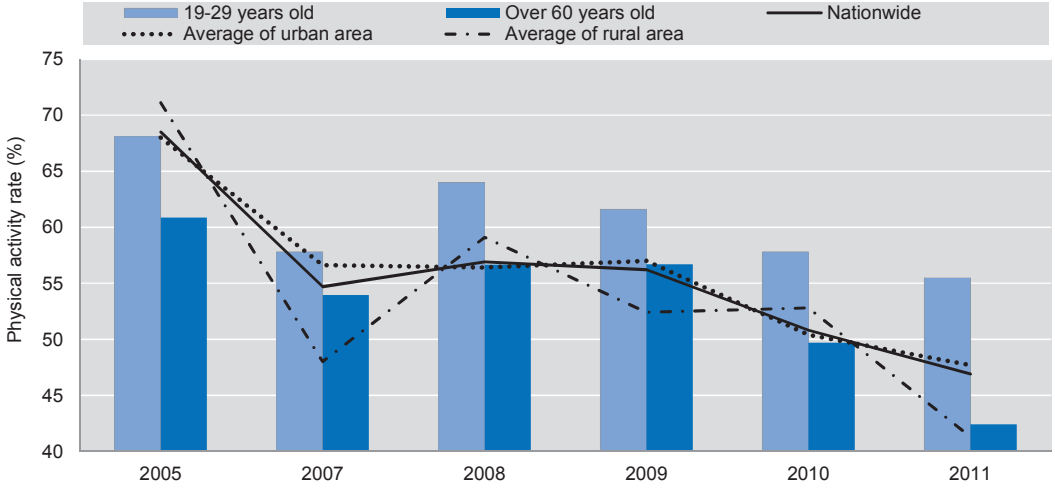
Note: Bubble size shows the number of fatalities per 100 000 inhabitants in 2010.

Source: Adapted from OECD (2012e), *Road Safety Annual Report 2011*, OECD Publishing, Paris, http://dx.doi.org/10.1787/irtad-2011-en.

A decrease in physical activity is a cause for concern. Physical activity, including walking, is a crucial means of minimising poor health, and helps the elderly both by reducing the risk of falls and improving social cohesion and mental well-being (Donovan and Munro, 2013). However, people of all ages in Korea now are less likely than they were before to engage in physical activity (Figure 1.14). Moreover, the drop in the rate of

physical activity in rural areas is steeper (from 71.1% in 2005 to 41.3% in 2011) than in urban areas (68.0% to 47.7%). The physical activities rate varies by age group as well. For the elderly, it has decreased from 60.85% to 42.4%, while for the younger generation it has fallen from 68.1% to 55.5%. This seems to be related to the fatality rates of the elderly, as discussed earlier. The share of people who are in the habit of walking regularly[7] has also decreased, from 51.1% in 2008 to 40.1% in 2012. The average annual change from 2008 to 2012 is -2.17%. This is closely related to car use share in the modal split (all purposes). Residents of metropolitan cities walk more, and use cars less, whilst TL4 regions in *do* (provinces) walk less and use cars more. This trend may also be affecting communities' sense of place and well-being. Urban policies could encourage physical activity, including walking. For example, a number of studies have found that people who live in walkable communities report walking about 30 minutes more a week and doing more total physical activity than those who live in less walkable suburban communities (Frank et al., 2006a).

Figure 1.14. **Decrease in physical activity, 2005-11**



Notes: 1. The physical activity rate refers to the share of population who engage in vigorous physical activities for longer than 10 minutes at a time, and longer than 20 minutes per day for more than 3 days a week; or engage in middle-level activities for longer than 10 minutes at a time, and longer than 30 minutes per day for more than 5 days per a week; or walk for longer than 10 minutes at a time, and longer than 30 minutes per day for more than 5 days a week. 2. Urban area refers to *dong* areas, while the rural areas are *eup/myeon* areas based on administrative categories.

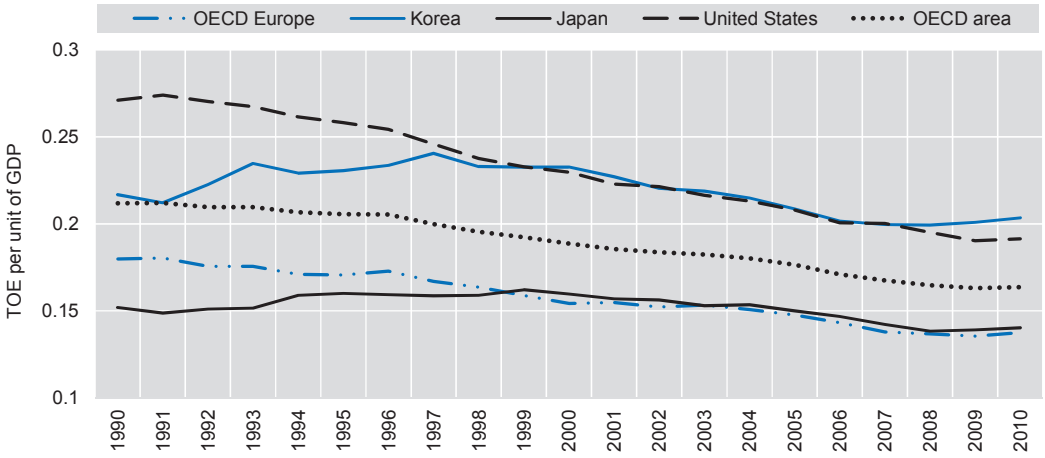
Source: Adapted from Korea Statistics Office (2013), Korea Statistics Information Service, www.kosis.kr.

Environmental challenges

Continuous efforts to address environmental concerns have helped create a cleaner, greener working environment in Korea in the last few decades. An increased overall rate of satisfaction with environmental conditions, rising from 19.8% in 2005 to 25.1% in 2010, supports this trend (Korea Statistics Office, 2013). In recent decades, higher living standards, rapid urbanisation and industrial growth have made Korea one of the most energy-intensive economies among OECD countries. By concentrating in energy-intensive industries, Korea's energy intensity has been higher than the average for OECD countries (Figure 1.15).[8] The Korean government has established Green Growth Goals to reduce energy consumption and attain energy independence, but the issue remains a concern for urban policy makers.

Figure 1.15. **Energy intensity in Korea compared to other OECD member countries**

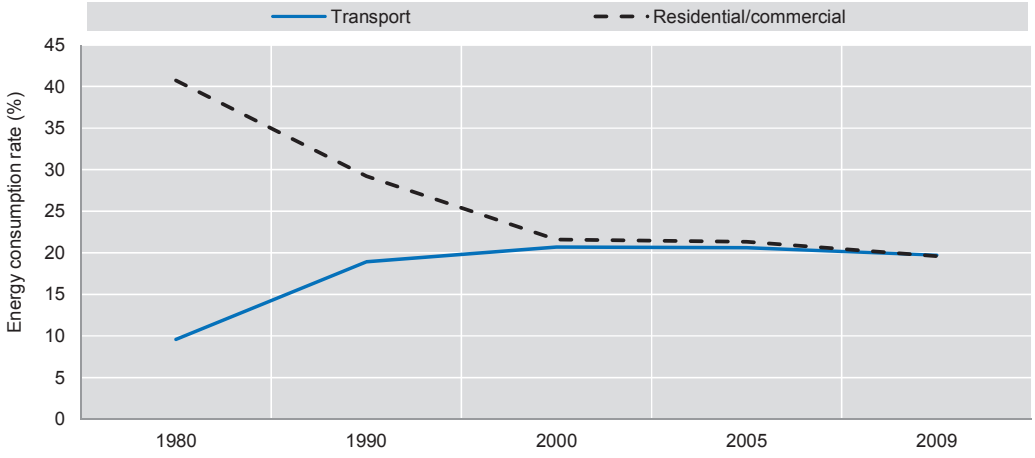
Tonnes of energy (TOE) per unit of GDP in thousands 2000 USD, using PPP exchange rates



Source: OECD (2012b), *OECD Economic Surveys: Korea 2012*, Figure 7, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-kor-2012-en.

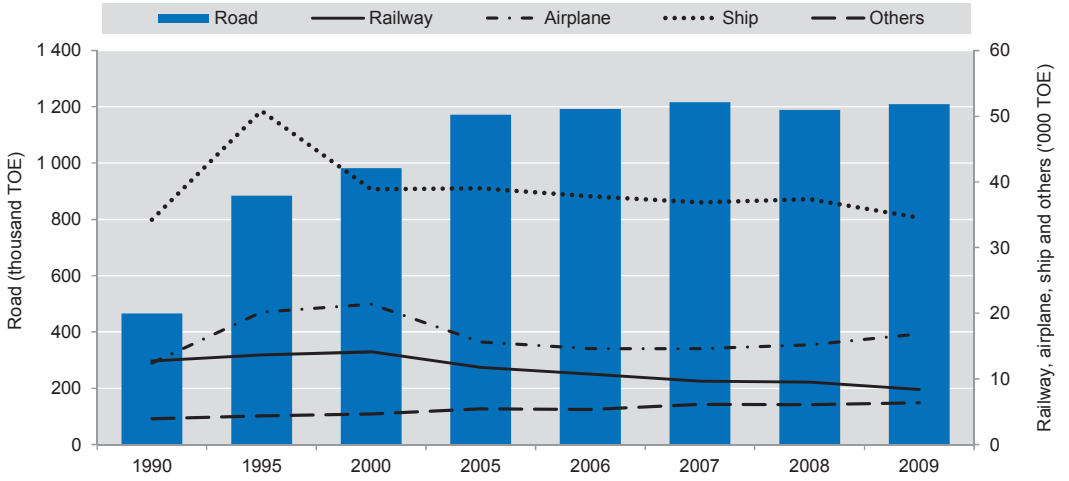
This heavy energy consumption is mainly caused by increases in the housing and transport sectors. Interestingly, energy consumption on transport increased by 10.10% between 1980 and 2009, whereas building energy consumption decreased by about 20% over the same period (Figure 1.16). Moreover, the share of energy consumption by the road sector is the highest among transport modes and rose steadily from 1990 to 2009 (Figure 1.17). Encouraging the use of public transport to counteract this tendency could generate positive effects for the environment.

Figure 1.16. **Energy consumption rate in the transport and building sectors in Korea**



Source: Own elaboration based on Korea Energy Economics Institute (2011), www.keei.re.kr/main.nsf/index.html (accessed 18 June 2011).

Figure 1.17. **Energy consumption by different transport modes**

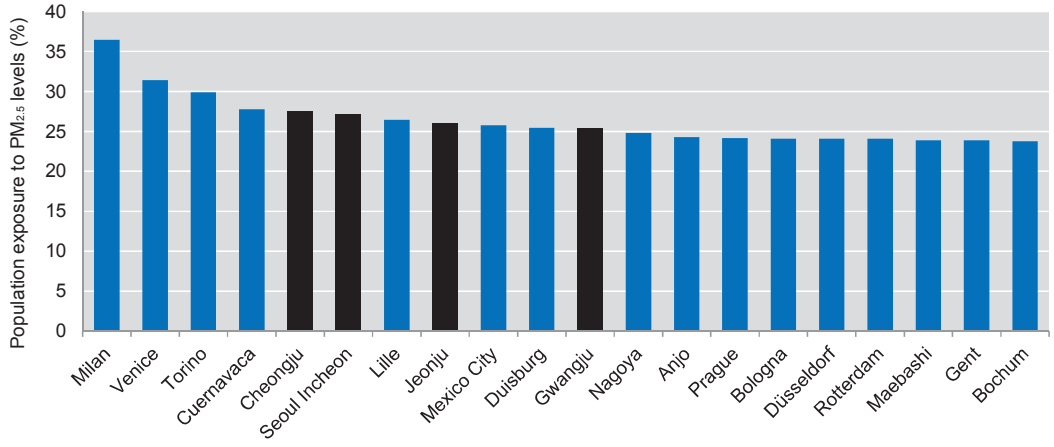


Source: Adapted from Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

This intensive energy use has increased air pollution in Korea. Four metropolitan areas, including Cheongju, Seoul-Incheon, Jeonju and Gwangju,[9] are ranked among the top 20 most polluted areas in OECD countries (Figure 1.18). More than 89% of the rise in Korea's greenhouse gas (GHG) emissions from 1990 to 2005 occurred between 1990 and 2000. Given Korea's rapid economic expansion and per capita income growth, per capita emissions also rose by 71.6% from 1990 to 2005, far higher than the OECD average of 2.1% (OECD, 2012e).

These growing environmental concerns underscore the need for Korean policy makers to target intervention in the transport and building sectors, two key components that affect urban form. Managing GHG emissions in the transport sector is critical, since it accounted for 20% of total energy-related CO_2 emissions in 2007 (Ministry of Land, Transport and Maritime Affairs, 2009). The road sector has registered the highest percentage of GHG emissions since the late 1990s. This sector tends to be more sensitive to economic variation, because emissions greatly decreased during the economic crisis in 1998, while other sectors do not display the same distinctive patterns. Complementary policy actions such as reducing commuting distances and promoting public transport could save energy in the transport sector, as developing high-tech vehicles could.

Figure 1.18. **The 20 OECD metropolitan areas with the worst air quality**



Source: Adapted from OECD (2013c), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en.

Urban flooding is another serious and growing urban environmental challenge. Floods are one of the most frequently occurring natural disasters globally. In 2010, they affected 178 million people, and total losses from 1998 and 2010 exceeded USD 40 billion worldwide (Abhas et al., 2012). Similarly, the frequency of storms has doubled since 1970 in Korea, and the number of times rainfall exceeded 50 millimetres per hour was 12.3 times per year in 2000, up from 5.1 times a year in 1970 (Sim and Choi, 2012). Since vulnerability to urban flooding increases with inadequately maintained infrastructure, low-quality shelters and lower resilience of the urban poor, managing runoff is critical for social inclusion (Abhas et al., 2012). Urban runoff from stormwater, one of the main causes of urban flooding, is becoming an important issue not only in environmental policies, but also in urban planning and infrastructure management. Runoff increases with impervious surfaces (roads, buildings) that do not absorb surface water (Wheater and Evans, 2009). Some researchers argue that runoff generated in areas of urban sprawl is approximately ten times greater than that in more dense and infilled urban areas (Public Health Advisory Committee, 2010; Frank et al., 2006b). Specifically, large parking lots and wider roads cause higher levels of runoff (Fischer et al., 2000). In the case of Seoul, an unusually rapid increase of impervious surfaces, from 7.8% in 1962 to 47.8%[10] in 2010, has been noted, while forest and green areas have been reduced, from 43.7% in 1976 to 24.5% in 2010, and the runoff rate has doubled, to 50.0% in 2010 (Sim and Choi, 2012).

This calls for a well-designed urban land-use strategy incorporating green infrastructure, rather than expanding hard-engineered drainage facilities. The increase both in the number of heavy rainfall days and impervious surfaces from new development means that the existing drainage systems can no longer cope with the rise in runoff. Improving green infrastructure in urban areas is critical to reducing the reliance on "end-of-pipe" treatment systems. Examples of urban flood prevention through land-use planning can be found in a number of major cities (Box 1.2). The integrated strategic planning in Paris provides for better integration of stormwater management in urban decision-making processes. Similarly, New York and London also promote strategic plans aiming to maximise the use of green infrastructure and other urban facilities to avoid urban floods. Seoul has attempted a number of initiatives, such as building 77 more drainage facilities with the capacity to retain 554 054 m² of water, but there is room to improve urban planning (Lee, 2012).

Box.1.2. **Urban runoff issues in Paris, New York and London**

In Paris, as runoff issues increase, several policy approaches have been adopted. In terms of infrastructure development, the Department of Wastewater and Storm Water Treatment for the Paris Metropolitan Area (*Syndicat Interdépartemental pour l'Assainissement de l'Agglomération Parisienne*, SIAAP) has put in place a strategy based on demographic changes and the expansion of damp-proofing urban surfaces. This includes investment in new infrastructure (10 watersheds and 4 tunnels) to store 1.02 million m^3 of water, at a total cost of EUR 1.3 billion by 2027. Meanwhile, integrated strategic planning has also been set up. For example, the Storm-Water Zoning Plan aims to: *i)* limit the amount of stormwater discharge into the River Seine; *ii)* minimise the stormwater that overflows wastewater control plans; and *iii)* prevent flooding in the city. The purpose of the Zoning Plan is to provide urban planners and construction operators with recommendations and guidelines on new "alternative" techniques. These will include green roofs, gardens, lagoons and other green spaces, to encourage reuse and filtration of stormwater and to co-ordinate decision making in urban stormwater management processes.

In New York, under the Protection Strategic Plan 2011-2014 formulated by New York City's Department of Environmental Protection (DEP), the goal is to maximise green infrastructure and control other sources to enhance water quality and reduce runoff from existing and newly developed areas. The aim is to collect the first inch of rainfall on 10% of the impermeable areas over the next 20 years. When it rains in New York City, the most densely developed city in the United States, a vast amount of runoff from rooftops, streets and other impervious surfaces is produced. If the key cause of runoff, impervious surfaces, is not kept in check, the DEP will have to spend more on tanks and tunnels to store stormwater flows, which will further swell with climate change. The New York City Green Infrastructure Plan requires USD 2.4 billion of investment from the public and private sectors, in swales, green roofs and other source controls to manage runoff. This will have further benefits, including cooler temperatures, improved air quality, more green space, lower energy bills and higher property values. New York City's Green Infrastructure Plan will change the city form and reduce combined sewer overflows (CSOs) by 12 billion gallons per year, 2 billion gallons more than the existing grey strategy, at a savings of more than USD 2 billion over the 20-year implementation period.

London's Mayor's Water Strategy aims to control the increasing intensity of rainfall in the city. Research into rainfall records from a weather station in east London indicates that before 1960, only a single day of rainfall of over 40 millimetres was recorded annually, whereas there have been ten such days annually since then. Before 1960, a day with 45 millimetres of rainfall fell only once every 30 years, but this now occurs in as little as every in 6 years. Rainfall in greater volume and frequency and increasing impervious surfaces from development suggest that existing surface water drains are no longer adequate to control runoff, leading to a greater risk of flooding. The increase in impermeable surfaces of concrete and tarmac puts too great a strain on the drainage systems, which are governed by many separate entities, including water and sewerage companies, the London boroughs, Transport for London, the Highways Agency and private landowners. This fragmentation of responsibility and recognition of the short-term risk of surface water flooding encouraged the Mayor to bring together key stakeholders to mitigate the risk.

Sources: Mairie de Paris (2012), "Le Livre Bleu 2012", Mairie de Paris, Direction de la propreté et de l'eau, Paris, France, www.paris.fr/pratique/environnement/eau/le-livre-bleu/rub_134_stand_121837_port_3119; SIAAP (2011), "La gestion des eaux pluviales dans l'agglomération parisienne", SIAAP Press Folder, Paris, www.siaap.fr/fileadmin/user_upload/Communiques_de_presse/DP_SIAAP_eaux_pluviales_220311.pdf; Nezeys, A. (2010), "Le zonage pluvial pour Paris", www.adopta.fr/fiches/conf_nezeys.pdf.

Urban form as a means of achieving urban sustainability

Why urban form is important for policy makers

Today's urban challenges have prompted a search for systematic and integrated policy packages. While a number of urban policies have evolved to promote sustainability, it is becoming increasingly difficult to address the increasing interdependence of issues that cities must address. It is now recognised the cities are not simply centres of economic growth, but need to consider concerns over quality of life, including environmental issues, issues of equity, access to open space and access to services and facilities (OECD/ECMT, 2007). Although sectoral policies for economic growth, social development and environmental improvement can help enhance quality of life, a focus on integrated policy development is a vital way of unravelling urban challenges.

Korea is a rapidly changing country with a wide range of urban challenges, which makes thorough diagnoses and policy responses imperative. A more thorough examination of current urban form may help to identify a new model for the urban policy agenda. This must be rooted in a place-based perspective that takes into account different local contexts and phases of development. Urban form is a durable social asset that is difficult to change once it has been set up. In developed cities, the priority is management, while for developing cities, the priority is planning and new urban strategies. This has particular implications for Korean urban policy makers given the rapid expansion of Korea's urban population. Attention must focus on how existing urban areas attract young people, enhance the living environment and integrate diverse elements of the population, including immigrants. Given urban expansion and the migration to suburban areas, an appropriate urban form must be found to avoid the uncontrolled development Korea has recently experienced.

A wide range of national policies and research have considered urban form, which shapes residents' living conditions and affects their choice of lifestyle as a fundamental factor for managing urban issues. "The way that urban areas are planned and laid out" (Public Health Advisory Committee, 2010) influences where residents live, how they commute, how air and water are managed, and what facilities are put in place. Since individuals by themselves can hardly create walkways, accessible green spaces or safe roads, this responsibility falls largely on the public sector (Box 1.3).

"Desired" urban forms are embedded in cities' visions, while key priorities shift as circumstances and places change. Urban forms should be coherent with the economy, a vital society that is inclusive and fair, and healthy, with a high quality of life and environmental quality (OECD/ECMT, 2007).[11] However, priorities differ across cities at varying stages of growth or local context. At times of incipient or expanding economic growth, "hard" infrastructure, including housing and roads, are the main instruments for managing urban forms. At a certain level of development, "soft" infrastructure, such as "equity" or inclusion/social cohesion is critical. Most recently the focus has been on health (especially walkability) and environmental issues (especially natural disasters caused by climate change), along with other quality of life issues (Searle and Fillion, 2011).

Box 1.3. **Defining urban form**

The definition and elements of "urban form" are subjects of some debate. Jabareen (2006) argues that "the core of many approaches is the management of the city" and that rather than any specific form in the physical shape of a city and its built environment, it is how the urban society is organised and managed that is important. Jabareen uses a range of ideas and elements of urban design, such as compactness, sustainable transport, density, mixed land uses, diversity, passive solar design and greening, to suggest four models of sustainable urban form: neotraditional development, urban containment, the compact city and the eco-city.

Donovan and Munro (2013) define urban form as the "physical shape and settlement and land-use patterns of cities and towns" and propose different urban form attributes: local accessibility (the density and mix of immediate land uses), jobs-housing balance (the ratio of jobs to residents within an area), regional centrality (i.e. proximity to regional population and employment opportunities), the street network (i.e. the structure, block size and amenities of the street network) and land-use engagement (i.e. the degree to which adjacent land use meshes together).

Song and Knaap (2004) propose several measures of urban form street design and circulation system systems, density, land-use mix, accessibility and pedestrian access. In a case study of two neighbourhoods in Portland, Oregon examining urban form, they came to an interesting conclusion: such neighbourhoods were becoming denser, more internally connected, but somewhat homogeneous in land use. In addition, they identified that either market forces or the many growth management policies in the Portland metropolitan area were generating significant changes in urban form.

Sources: Jabareen, Y.R. (2006), "Sustainable urban forms: Their typologies, models and concepts", *Journal of Planning Education and Research*, Vol. 26, No. 1, Association of Collegiate School of Planning, pp. 38-52; Donovan, S. and I. Munro (2013), "Impact of urban form on transport and economic outcomes", *Research Report 513*, New Zealand Transport Agency, Wellington; Song, Y. and G.-J. Knaap (2004), "Measuring urban form: Is Portland winning the war on sprawl?", *Journal of the American Planning Association*, Vol. 70, No. 2, American Planning Association, Chicago, pp. 210-225; Daisa, J.M., T. Kloster and R. Ledbetter (1998), "Does increased street connectivity improve the operation of regional streets? Case studies from the Portland Metro Regional Street Design Study", conference proceedings paper, American Society of Civil Engineers, Portland, pp. 199-207.

All these views on urban forms are based on the assumption that urban form affects the quality of life in cross-sectional areas. The interdependent impacts of urban forms on a range of socio-economic outcomes have been much discussed. In terms of social impact, for example, research suggests that properly designed urban form can be an effective tool to increase sense of place, physical activity, improve air quality, reduce road traffic injuries, increase social cohesion and promote well-being among residents of urban areas (Frumkin, 2002; Donovan and Munro, 2013; Public Health Advisory Committee, 2010; Sung, 2010). This implies that the discussions need to extend beyond existing sectoral policies, such as physical urban development, health services and environmental movements, towards integrating such policies into "urban form". This trend has informed recent debates. For instance, the World Health Organization (WHO, 2003) recommends placing health-related issues at the centre of urban planning priorities and in designing urban form. OECD/ECMT (2007) argues that if the urban forms are combined with sympathetic design at neighbourhood levels, high-quality and inclusive urban areas can be created. Both Australia and the United Kingdom have explicitly incorporated such considerations in their urban policy framework (Box 1.4).

Box 1.4. **International initiatives to create healthy urban forms**

Many of the world's cities have promoted campaigns for a wholesome, social and active life: Florence with its abundant cafés that motivate walking and social interaction, Copenhagen with its cycling-friendly environment to support commuters, and New York City, with its efficient public transport network, which carries countless passengers every day and with its green spaces, where citizens can relax and escape from the crowds.

Florence and New York City have built on their historic legacy, whereas other cities have deliberately shifted the urban shape and form. Urban leaders have understood the benefits for the environment, tourism, business, health and society that accrue from alternative modes of transport, opportunities for walking and cycling, and mechanisms for social interaction. For example, Copenhagen and Portland, Oregon, have shown this kind of leadership.

In Denmark, bicycle commuting sharply decreased in the period between 1950 and 1975. However, in response to the oil crisis of the 1970s, the government began to introduce environmentally friendly policies for cyclists, such as cycle lanes and paths, modified intersections and traffic signals, and also to invest in infrastructure for cycling and public transport. On the other hand, the use of private cars was discouraged by higher parking fees, taxes and stringent driving tests. One-third of Copenhagen's residents now cycle to work, and there has been a significant drop in cycle accidents. USD 16 billion will be spent on high-speed intercity trains, light rail and city bicycle lanes, with the aim of increasing the proportion of Copenhagen commuters who cycle to work to 50% by 2020.

In the 1970s, Portland, Oregon, was suffering from a declining urban centre, poor housing and polluted air. Planning for urban regeneration was prioritised by both the city and state governments, including the expansion of public transport, walking and cycling infrastructure, and integrated urban development with transport. City authorities substituted a light rail and mass transport-oriented development for a highway bypass plan once they recognised that this would significantly reduce the number of vehicle miles travelled and the levels of congestion. Such changes have had a positive effect on health, the environment and the economic growth of the city. In the United States, Portland is now rated as one of the best environments in the country for walking and cycling. In addition, greenhouse gas emissions dropped by 13% per year from 1990 to 2003. Retail spending increased and the city was revitalised, with an influx of new businesses, skilled workers, residents and tourists.

International campaigns to modify urban form and create Healthy Cities, Eco-Cities and Smart Growth have been adopted by the cities of Waitakere, Manukau, Christchurch and Tauranga in New Zealand, which have promoted public transport-oriented development (TOD). Wellington City has established an urban growth "spine" as a part of those efforts. A series of government plans and initiatives set up urban design protocols, growth plans and regional strategies to achieve high-quality, co-ordinated urban growth. New Zealand has steadily pursued research on the relationship between urban form and health. Surveys indicate that many parents in New Zealand are reluctant to let their children walk and cycle to school because of safety issues and practical obstacles, yet on the other hand, widespread support exists for a changed urban form, and for protecting the environment even at the expense of economic growth. Sweden's Vision Zero is a road safety policy, restricting the speed limit in all urban areas, reducing road traffic and redesigning urban spaces to reduce risk of injury, with a goal of zero fatalities and disabling injuries. Design codes in many cities worldwide promote the development of compact, walkable form. Investment in infrastructure for walking and cycling can also produce healthcare savings. Australian research suggests that cycling, both for recreation and commuting, can conservatively be estimated to save over AUD 220 million per year in health costs. The cost benefit of eliminating 150 "black spots", streets or intersections with high accident rates, has realised savings of almost 5:1 in Western Australia. In Finland, studies indicate that deaths from coronary heart disease could decline by 3-7% if another 8% of the working population switched to walking or cycling to work. The economic savings of infrastructure expenditure for cycling yields a return of 20:1, as compared with 3:1 for investments in road and rail.

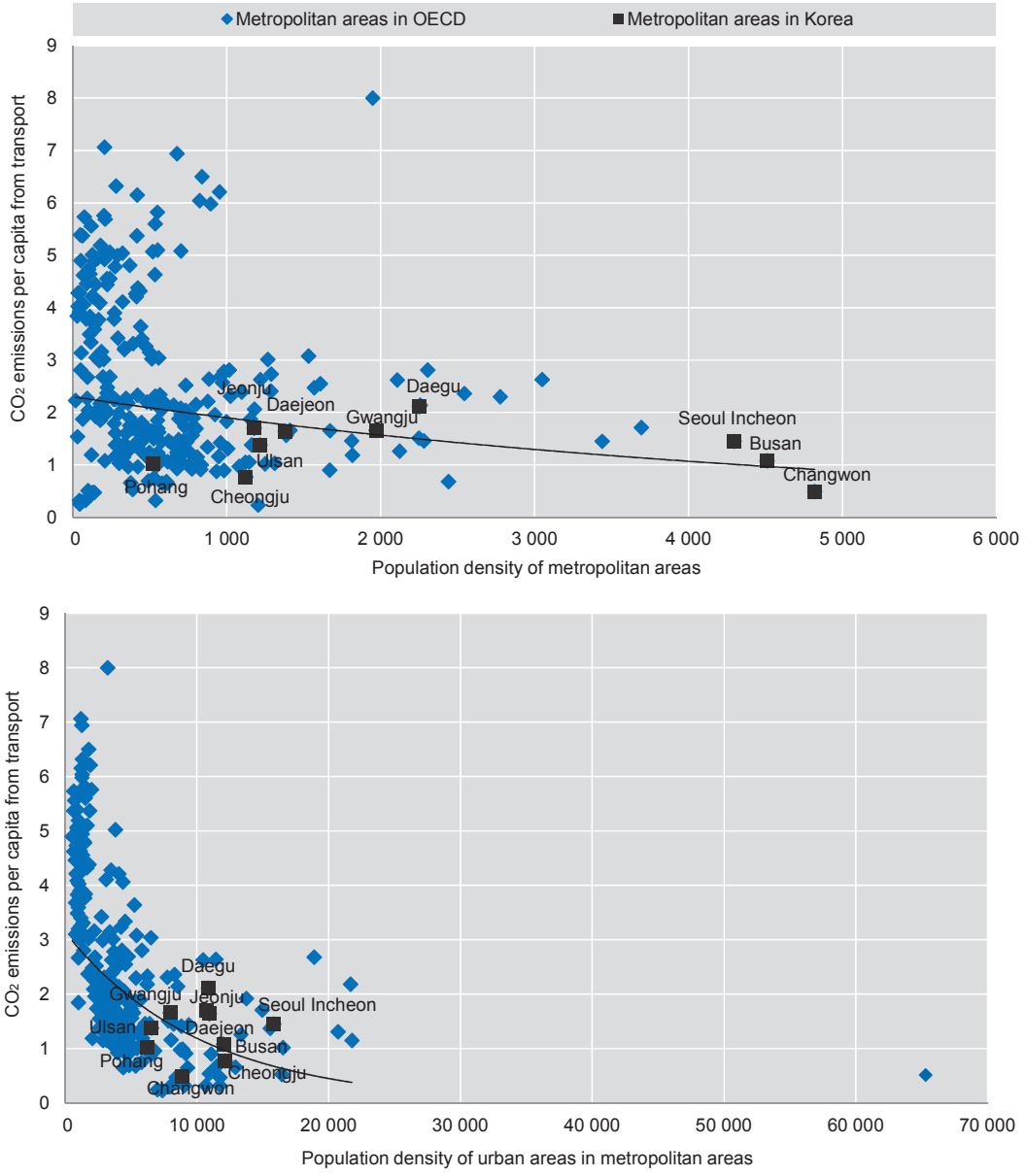
Sources: Public Health Advisory Committee (PHAC) (2010), *Healthy Places, Healthy Lives: Urban Environments and Well-being*, *A Report to the Minister of Health*, PHAC, Wellington; Rogers, S.H. et al. (2011), "Examining walkability and social capital as indicators of quality of life at the municipal and neighborhood scales", *Applied Research Quality Life*, Vol. 6, No. 2, The International Society for Quality of Life Studies, Springer, Dordrecht, The Netherlands, pp. 201-213.

The social benefits of urban form link to economic outcomes in both direct and indirect ways, as has been amply documented in the literature. In terms of narrowly defined economic indicators such as productivity, land values and wages, one of the most frequently cited issues is the agglomeration effect, which demonstrates the external economies of scale created by spatial concentration of economic activities. Knowledge spill-over effects have been associated with this, especially in the current knowledge and service-based industries (Horner and O'Kelly, 2007; Donovan and Munro, 2013; Cervero, 2009). Some debate remains over the optimal size of a city to maximise agglomeration economies. Arzaghi and Henderson (2008) found that in the case of advertising companies in New York, the expected agglomeration effects were limited to the distance that people are willing to walk. In a similar context, doubling in density of population in a city would increase economic productivity by 6-7% in New Zealand (Maré and Graham, 2009). Moreover, the economic outcomes can be observed at neighbourhood scale as well. The availability of urban amenities, including public transport, have been considered a key factor in delivering optimal economic outcomes, as this can attract people and firms and create more opportunities for employment (Donovan and Munro, 2013). Song and Knaap (2003) argue that residents are willing to pay 15.5% more for properties of a particular urban form that also offer a certain level of well-being. More specifically, accessible street networks in commercial areas are associated with these areas' vitality (Enström and Netzell, 2008). The studies imply that the impact of urban form on economic outcomes can range as widely as from regional agglomeration to the street network at the neighbourhood level.

Urban form is also correlated with environmental impact. Mixed land use, higher density and greater street connectivity are associated with significantly lower emissions of NOx and Volatile Organic Compounds (VOC) per capita (Frank et al., 2006a). Population density is also key. Figure 1.19 shows how it is influential in reducing CO_2 emissions in OECD metropolitan cities. This inverse relationship is stronger in the case of urban population density. Emissions per capita are likely to be higher in low-density urban areas. Kennedy et al. (2005) also showed a negative relationship between energy use for transport and urban population density in ten world cities; the same relationship applies to GHG emissions and urban population density (OECD, 2012a). More specifically, Lim (2013) points out that the relationship between urban form and CO_2 emissions can depend on the level of urbanisation.

Despite the importance of urban form, debate remains over whether urban expansion is beneficial. This debate is often characterised as an opposition between "free marketeers" and "smart growthers" (Box 1.5).[12] This polarisation can clarify the issues, but runs the risk of overlooking or distorting the details. This debate is invariably inconclusive, because the research uses different variables at different scales (Schwanen, et al., 2001). Any relevant policy to influence urban form should be comprehensive enough to manage a complex urban system, as individuals' circumstances, and those of cities are far more complex than the simplified models. For instance, it is difficult to find perfectly efficient examples of "compact cities" without urban sprawl, or a "sprawled city" based on its residents' reasonable choices (Lim, 2013). As noted earlier, urban form should be discussed not simply from the perspective of concentrations of population, but as a way of promoting urban activities, such as walkability, that can help enhance the attractiveness of a city. The desired or appropriate urban form will necessarily vary according to the local context. Analysis should help show what may be missing in the existing urban structure, and how to encourage synergies by reviewing the local context in depth.

Figure 1.19. **Population density and CO_2 emissions**



Source: OECD (2013d), "Metropolitan regions", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en.

Among several types of urban forms, the compact city has been presented as a way of encouraging urban sustainability, such as walkable, eco-friendly urban forms (OECD, 2012a). Various compact city definitions have been examined over the decades (Box 1.6), and the OECD (2012a) has proposed a comprehensive set of key characteristics for compact cities: dense and proximate development patterns, built-up areas linked by public transport systems and accessibility to local services and jobs. It also highlights a range of environmental, social and economic benefits of the compact city, which can lead to urban sustainability (Figure 1.20).

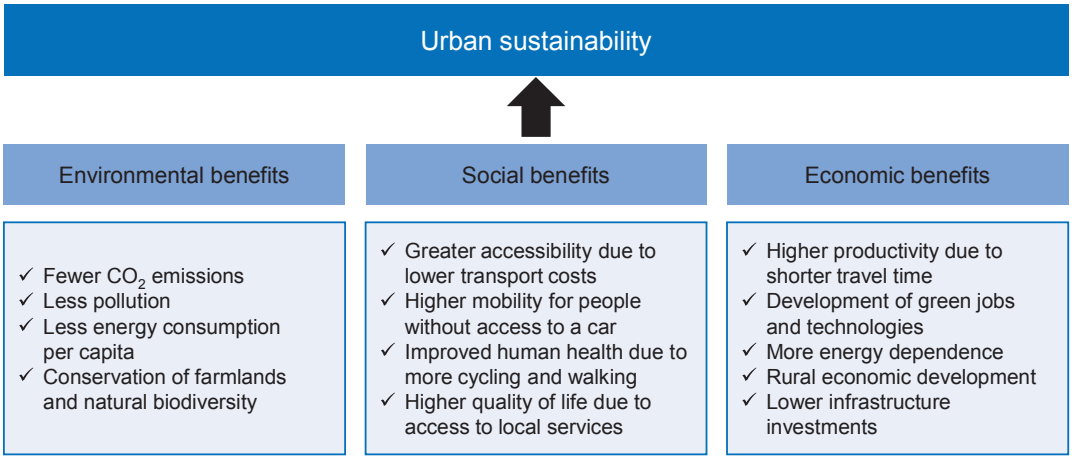
Box 1.5. **The debate on urban expansion**

Debate remains over the economic force of urban expansion. OECD/ECMT (2007) notes that experts tend to fall into two different camps on this issue: "free marketeers", who advocate urban expansion without regulations and "smart growthers", who support government intervention to curb urban sprawl. A thorough understanding of both positions can be instructive. Free marketeers tend to overlook the fact that land use and transport markets are severely distorted in reality. Subsidies for car travel can prove that urban expansion surpasses the economic efficiency threshold; they lead to excessive urban expansion. Suggesting that it is possible to reverse this expansion at a later stage is not reasonable: once urban expansion has occurred, it is not possible to reverse the trend. A free marketeer's stance on urban expansion is likely to end in suboptimal levels of urban sprawl, which can prove inimical to efficient products in the long run.

Meanwhile, smart growthers need to realise that support for government intervention will be limited if there are distortions in transport and land-use markets. The optimum solution would be to use a calibrated pricing policy, such as parking pricing and time-of-use road pricing, to address transport and land-use distortions. To cope with these issues, smart growthers are required to establish policies that aim to rectify the negative effects, and to explain through detailed analysis that the policies are the most effective way to achieve that outcome. Market failure is a necessary but insufficient premise for policy intervention. For example, if more compact development helps reduce infrastructure costs, these savings might not be reflected in development contribution policies, and rather might be reflected in stricter curbs on urban development. Contribution of more precise assessed development would guarantee development on the urban periphery and entail the full marginal costs of providing infrastructure. Again, incentives can make intensification more difficult to resist. External effects of urban expansion, including aesthetic/conservative influences and traffic congestion, may be better controlled through so-called "Pigouvian taxes", or transferable development instruments, avoiding many of the traps related to "hard" regulations. Councils should try to avoid causing distortions in land-use development, to prevent a variety of unintended and undesirable consequences such as distorted land values.

Source: OECD/ECMT (2007), *Transport, Urban Form and Economic Growth*, ECMT Round Tables, No. 137, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789282101650-en.

Figure 1.20. **The contribution of compact city policies to urban sustainability**



Source: OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Box 1.6. **Defining compact city policies**

Dantzig and Saaty (1973) are recognised as being the first to have made use of the term "compact city", meaning a circular city with a diameter of 8 840 feet and a terraced perimeter. The city includes 8 levels, or platforms, 30 feet apart, and its central core contains commercial, industrial, entertainment and service centres. The city can house 250 000 people and its population can be expanded to 2 million by doubling its diameter and height. A large recreational park is located on the top level, and residential areas of apartments and houses surround the city core. The "mid-plaza", a circular ring, runs through the middle of the residential area and offers neighbourhood facilities such as schools, clinics, retail shops and playgrounds. The city also has 256 elevator systems at expanded size and a mass-transit system running along the radials and the mid-plaza. Residents can use shared electric cars. The aspects of a compact city are:

- urban form: high, dense settlements; less dependence on automobiles (as a result of high density); a clear demarcation from surrounding areas
- spatial characteristics: mixed land use; diversity (as a result of mixed land use); clear identity
- social functions: social fairness (as a result of high-density settlements); self-sufficiency of daily life; independent government (a function of clear boundaries).

Thomas and Cousins (1996) argue that a "decentralised concentration" settlement pattern would be more environmentally sustainable and publicly acceptable. In addition, it also could satisfy the demands of economic forces and hence be politically supported. They define the fundamental aspects of the compact city as compactness in scale; accessibility for all on foot, by bicycle and on public transport; and greater respect for wildlife.

Churchman (1999) outlines the goals of compact city policies as a combination of higher residential density and centralisation, to intensify urban land use, mixed land use and impose limits on development outside a designated area.

Burton (2002) proposes three characteristics of the compact city: high density, mixed use and intensification. The first two aspects are linked to the urban form, while the third focuses on more compact development. These characteristics are multi-faceted: a high-density city includes high average population density, high-density sub-centres, high density of built form, high-density forms of housing and density values; a mixed-use city suggests a varied and plentiful supply of facilities and services and both a horizontal and vertical mix of uses; an intensified city means an increase in population, density of sub-centres or nodes, new development and a mix of uses.

Neuman (2005) offers the following 14 aspects of a compact city: *i)* a high density of residents and employment; *ii)* mixed land uses; *iii)* fine grain of land use (proximity of varied uses and relatively small land parcels); *iv)* strong social and economic interaction; *v)* adjacent development (some parcels or structures may be vacant or abandoned or include surface parking); *vi)* regulated urban development with clear territorial limits; *vii)* urban infrastructure, especially sewerage and water mains; *viii)* multi-modal transport; *ix)* a high degree of local and regional accessibility; *x)* a high degree of street connectivity (internal/external), including sidewalks and bicycle lanes; *xi)* a high degree of impervious surface coverage; *xii)* low open-space ratio; *xiii)* unitary or closely co-ordinated control of planning of land development; *xiv)* sufficient government investment in urban facilities and infrastructure.

Sources: Dantzig, G.B. and T.L. Saaty (1973), *Compact City: A Plan for a Livable Urban Environment*, W.H. Freeman & Co., San Francisco, California; Thomas, L. and W. Cousins (1996), "A new compact city form: Concepts in practice", in M. Jenks, E. Burton and K. Williams (eds.) (1996), *The Compact City: A Sustainable Urban Form?*, E & FN Spon, Oxford; Churchman, A. (1999), "Disentangling the concept of density", *Journal of Planning Literature*, Vol. 13, No. 4, Sage, London, pp. 389-411; Burton, E. (2002), "Measuring urban compactness in UK towns and cities", *Environment and Planning B: Planning and Design 2002*, Vol. 29, No. 1, Pion, London, pp. 219-250; Neuman, M. (2005), "The compact city fallacy", *Journal of Planning Education and Research*, Vol. 25, No. 1, Sage, London, pp. 11-26.

Such overall benefits of the compact city have important implications for Korean urban policy makers. For instance, reducing energy consumption and goods use without a strategic plan could dampen economic activity and sap the vitality of a society (Hanaki, 2012). To avoid this, compact city strategies highlighting sustainable urban form could be complementary with energy policies. The following section assesses the "compactness" of Korea's existing urban forms, stressing the importance of better understanding of "hard" urban forms, such as density and built-up areas across cities, as well as "soft" urban forms in line with the "healthy, walkable urban forms" already mentioned. Identifying the "compactness" of Korean cities is key for Korean policy makers before they can introduce compact city policies to achieve urban sustainability.

How to measure urban form

As noted earlier, a voluminous literature describes the various definitions and components of urban form. The most commonly accepted characteristics are the size and distribution of built-up areas, population density, accessibility to local services, street network and building form. The discussion of the components of urban forms is also complex, covering not only the physical attributes but also social elements, such as urban activities. An overall definition for urban forms might be summed up as "the present outcome of how place, people's activities and the connection between place and people have been shaped". Given the range and number of these urban form components, it can be helpful to break them down into categories: patterns of land use, transport networks and social networks, for an intuitive overview. In each category, decisions affecting urban forms take place at all levels. At the level of national and regional policy, the chief concerns are the location of new development in relation to existing towns, inter-city transport infrastructure, the size and density of new developments and the type of land use. The focus is on urban expansion and polycentric or monocentric urban structures, the traditional topics of discussion on urban forms. At the local or neighbourhood level, physical building forms, accessibility to local services and to public transport are planned, to improve the quality of life. The nature of urban forms at the local or neighbourhood levels can be succinctly summed up: "A place-based city tends to rely on tight and dynamic land uses that weave density, design and originality into the fabric of its neighbourhoods and public spaces, including in particular street networks" (Donovan and Munro, 2013). In this sense, measuring urban forms in their diverse dimensions can be helpful to policy makers in examining the current urban space and establishing urban development strategies.

Selecting the proper indicator to measure each component of urban forms is crucial. OECD (2012a) proposes that these be selected according to policy relevance, analytical soundness and measurability. This report will largely make use of key compact city indicators and add several more to explore three key components: land-use patterns, transport networks and social networks (Table 1.1). The unit of analysis will be based on functional urban areas in principle, but administrative units will also be used according to the availability of data.

Table 1.1. **Features of urban form**

Category	Components of urban form	Analysis indicator	Unit of analysis
Land-use pattern	The size and distribution of urban areas*	Share of built-up areas in a metropolitan area	Functional urban area
	Population density on urban land*	– Population over the surface of urban land within a metropolitan area – Population growth rate over decades	Functional urban area
	Mixture of different land uses	Entropy-based Index of residential, commercial and industrial areas	Functional urban area
	Urban park form	Urban park area per person	TL4, urban parks in TL3
	Parking lot form	Growth rate of parking lots	TL4
	Building forms	– Floor area ratio – Share of high-rise buildings – Vacancy rate	TL3, TL5
	Housing forms	– Share of multi-family houses in total housing units – Rooms per person	TL3
Transport network	Commuting distance/time*		Functional urban area
	Transport choices	– Modal share – Car ownership	Functional urban area
	Accessibility of public transport	Physical accessibility of public transport stations	Functional urban area
	Street network	– Share of road area – Density of intersections	TL3
Social interactions/ network	Job density*	Job density/residents	TL4
	Accessibility* of local services	– Matching Index of employees in service sectors – Accessibility of facilities for the elderly	TL4
	Housing affordability	Share of expenditure on housing in total household expenditure	TL3
	Social mix	Entropy-based Index of primary, secondary and tertiary education	TL4

Notes: 1. Indicators marked with an asterisk (*) are analysed in *Compact City Policies: A Comparative Assessment* (OECD, 2012a). 2. Units of analysis in this report are primarily based on functional urban areas (FUA), the new OECD methodology for defining economically functioning urban areas, using census and commuting data. If no data relating to FUA are available, territorial levels (TL) in the OECD typology are used instead: TL3, including Seoul Special City, six metropolitan cities and nine provinces; TL4, including *si, gun* and *gu*; and TL5, consisting of *eup, myeong* and *dong*.

Source: Own elaboration based on Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

Land-use patterns

Urban land cover shows built-up areas, and how cities have expanded. In particular, many cases of the development of new towns in Korea are explored here. Population density refers to the residential population within urban areas. The trend of population density shows how regions interact with each other and gives a rough picture of how regions grow and decline. The mixture of economic land uses, whether residential, commercial or industrial, is also examined. While the mixture of land use is closely correlated with accessibility to urban amenities, the indicator here focuses on how lands are designated or planned.[13] The disposition of green areas and parking lots is another critical element, since the accessibility of green space is important for recreational use and to adjust the urban microclimate (Gehl, 2010). Parking is an essential component of sustainable urban form to permit a viable mobility strategy (Manville and Shoup, 2010).

The building forms provide a multi-dimensional view of density, in comparing floor area ratios and the average building heights. The vacancy rate can help to show how these buildings are actually used. Housing forms reveal the share of multi-family housing in total housing units and the number of rooms per person.

Transport networks

Transport networks are an important characteristic of urban form because they help to shape cities and contribute to reducing social inequality. For a comprehensive view of transport networks, commuting time/distance can help show how economic activities and transport development interact. Vehicle distance travelled is a key determinant of the built environment (OECD/ECMT, 2007). Choice of transport mode provides another perspective on how people move, as does physical accessibility of public transport, since physical distance to the nearest station is a fundamental determinant of public transport use. Street networks, including road forms across regions, and intersection density, a measure of walkability, are also examined.

Social networks

Social networks can help capture how people actually shape cities. This can give policy makers an expanded view, from physical density to overall accessibility issues, to job, services, housing and social capital. Indicators used include job density, which indicates the level of a city's self-sufficiency. Accessibility to local services is analysed by using the Matching Index (MI) of employees in service sectors. Housing affordability over decades reveals possible barriers to living in urban areas. Lastly, the level of education and age mix reflect the social mix.

Assessment of "compactness" in Korean cities

Land-use patterns

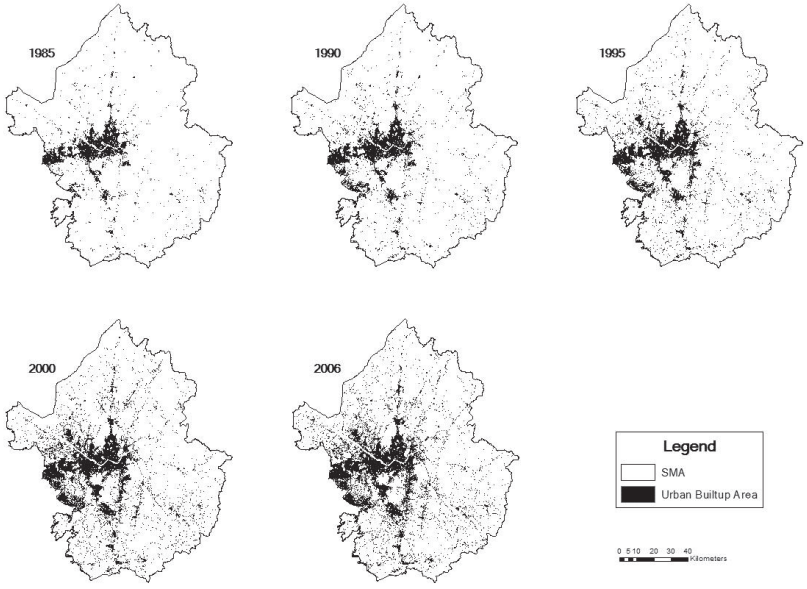
Urban land expansion: Built-up areas exhibit sprawl, especially in the Seoul Metropolitan Area

Between 1975 and 2009, in the process of rapid urbanisation, the urban area in Korea doubled, in general replacing agricultural areas (OECD, 2012e). Built-up areas in Korea expanded by 171% between 1950 and 2010, although in OECD countries, built-up areas increased only by 104% and population by 66% over that period (OECD, 2012a). Similar tendencies can be observed in other large cities in Korea, as the administrative areas of the large cities have been extended in recent decades. This indicates the need to conserve land resources in Korea, since few developable areas remain. While the administrative areas are not necessarily contiguous with built-up areas, cities clearly tend to expand to promote economic and demographic growth. For example, since 1980, the area of Busan has grown by 176% and that of Daejeon by as much as 617%. This expansion does not necessarily correspond to population growth, which actually decreased in the case of Busan (Ministry of Land, Transport and Maritime Affairs, 2012). This often generates tensions between development-oriented policy and environmental protectionism. Demand for land to develop the urban area persists, but the availability of land appears to have virtually reached its limit.

The scattered development pattern can be also observed in the large metropolitan areas, in particular in the Seoul Metropolitan Area [14] (hereafter SMA). The SMA's total built-up area has significantly increased over the decades, from approximately 5.7% of

the total in 1985 to 15.2% in 2006. It is continuously increasing, consuming available open space and damaging the natural environment. In addition, a pattern of scattered urban development has become more noticeable since 2000 (Ministry of Land, Transport and Maritime Affairs, 2009). Rapid urban growth and recent sprawl in the SMA has resulted in diverse urban problems, such as higher costs of infrastructure and a damaged environment (Figure 1.21).

Figure 1.21. **Change in urban land use in the Seoul Metropolitan Area**

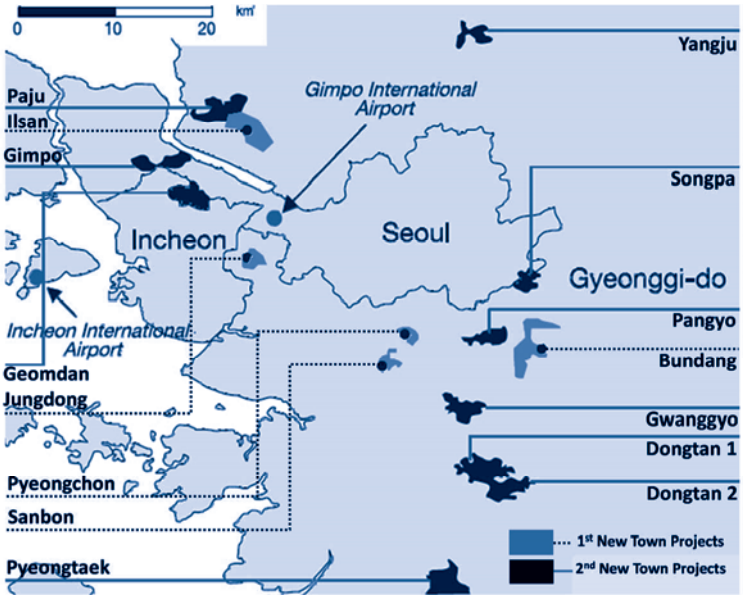


Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own calculation based on *EGIS database* (Environmental Geographic Information System).

This trend is due to a number of new town developments in suburban areas around the SMA, and a policy framework facilitating land development in areas where demand for development was high. In the 1960s and 1970s, urbanisation and concentration in Seoul was the norm. By the 1990s and 2000s, suburbanisation had become a key feature of development. Figure 1.22 shows the expanded locations of new towns developed in this period, which were planned to accommodate about 3 million people in total. In the meantime, the planned size and population density of the new towns around Seoul have been larger and lower respectively over this period. The new towns developed in the 2000s are larger and of lower density than those of the 1980s to 1990s, as shown in Table 1.2. This trend developed in response to a concern to provide more green areas in the new towns, while in fact more green areas have been replaced by built-up areas in the 2000s (Korea Forest Service, 2010). This is also a notable trend given that many cities are pursuing intensification/urban consolidation policies in line with the strategy of green growth and urban sustainability. For example, in the case of Portland, Oregon, the average density of new developments has risen, from 5.5 to 10.7 units per acre from 1995 to 2006 within the metro's built-up areas, following the adoption of the 2040 Growth Concept (OECD, 2012e).

Figure 1.22. **The location of new towns in the Seoul Metropolitan Area**



Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Adapted from Ministry of Land, Transport and Maritime Affairs (2013), "The guidebook for Korean urban policy", Ministry of Land, Transport and Maritime Affairs, Gyeongi-do, Korea.

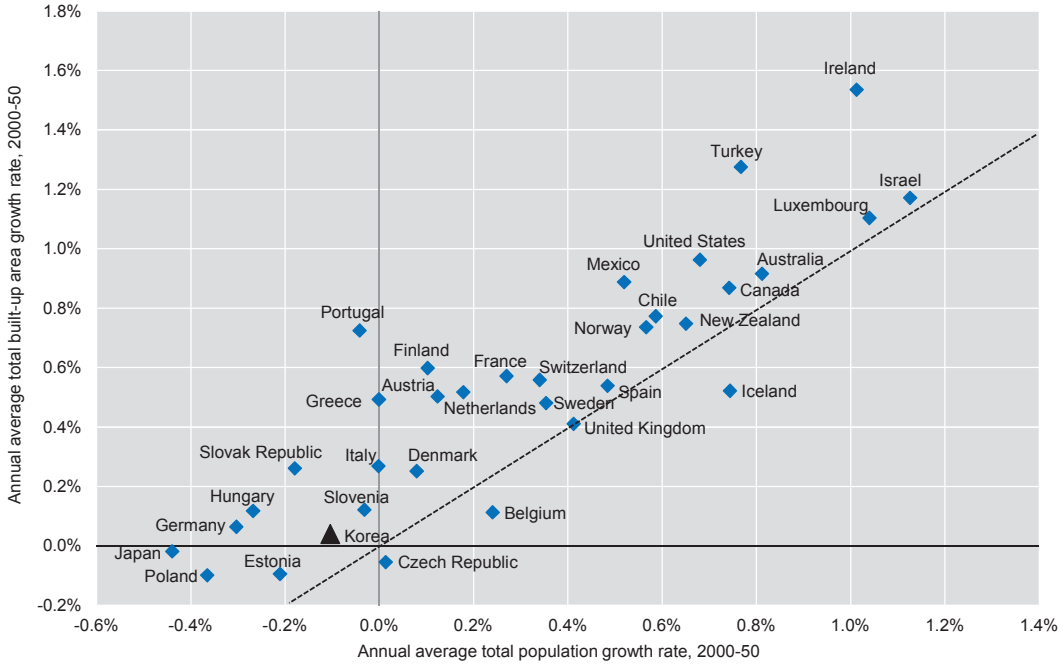
Table 1.2. **New town developments in the Seoul Metropolitan Area**

New town	Period of planning and development	Planned population	Planned size (km^2)	Density (person/km^2)
Bundang	1989.8-1996.12	390 320	19.64	19 873.73
Pyeongchon	1989.8-1995.12	168 188	5.116	32 939.29
Sanbon	1989.8-1994.12	165 588	4.20	39 397.57
Jungdong	1989-1996.12	170 000	5.45	31 181.22
Ilsan	1990.3-1995.12	276 000	15.74	17 534.94
Average (A)	1990s	234 019	10.03	28 185.35
Dongtan 1, Hwaseong	2001-08	124 000	9.04	13 716.81
Pangyo, Sungnam	2003-10	88 000	9.22	9 544.469
Gimpo	2002-12	165 000	11.73	1 4066.5
Paju	2003-14	205 000	16.5	12 424.24
Gwanggyo, Suwon	2005-11	78 000	11.3	6 902.655
Yangju	2007-13	165 000	11.42	14 448.34
Dongtan 2, Hwaseong	2008-15	278 000	23.97	11 597.83
Weerye	2008-15	115 000	6.79	16 936.67
Goduk	2008-13	136 000	13.52	10 059.17
Gumdan, Inchon	2009-16	230 000	18.12	12 693.16
Average (B)	2000s-2010s	158 400	13.16	12 238.98
B/A		0.68	1.31	0.43

Source: Jeong, Y. and J. Lee (2013), "A study on current status and prospects of compact city policy in Korea", Korea Research Institute for Human Settlements, Anyang, Korea.

This trend seems likely to continue in Korea, as in most OECD countries. The consumption of land for built-up areas is expected to increase more rapidly than the total population in 30 out of 34 OECD countries between 2000 and 2050 (Figure 1.23). In particular, in the case of the United States, an area approximately equivalent to the size of the state of Pennsylvania could be eaten up by urban development from 2000 to 2050. Korea is no exception. While the population is projected to decrease, the consumption of land will tend to increase. In this context, the need to conserve land resources has been made a priority in most OECD countries (OECD, 2012a).

Figure 1.23. **Urban population growth and built-up area**

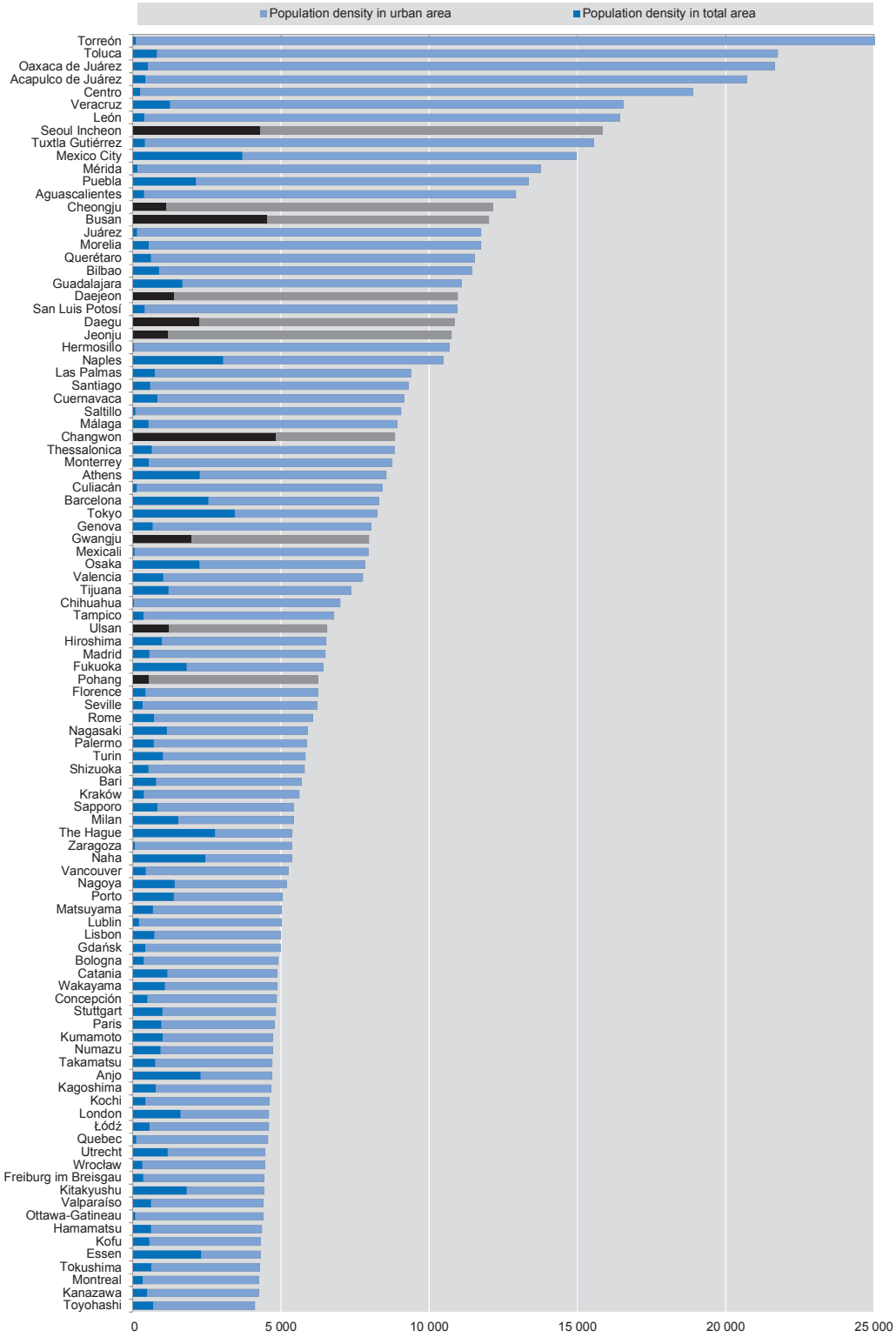


Source: OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Population density: High density but dispersed population in metropolitan areas

Korean metropolitan areas have some of the highest population densities among OECD metropolitan areas. Figure 1.24, showing population density in urban area and total area of 100 OECD metropolitan areas, includes Korea's nine metropolitan areas in the top 50 in terms of population density. The Seoul-Incheon urban area's population density is more than 15 000 persons/km², ranking 8th out of 268 OECD metropolitan areas. The population density of Pohang, the lowest of the 10 Korean metropolitan areas, is also over 5 000 persons/km², ranking 51st.

Figure 1.24. **Population density in urban land and in total land**

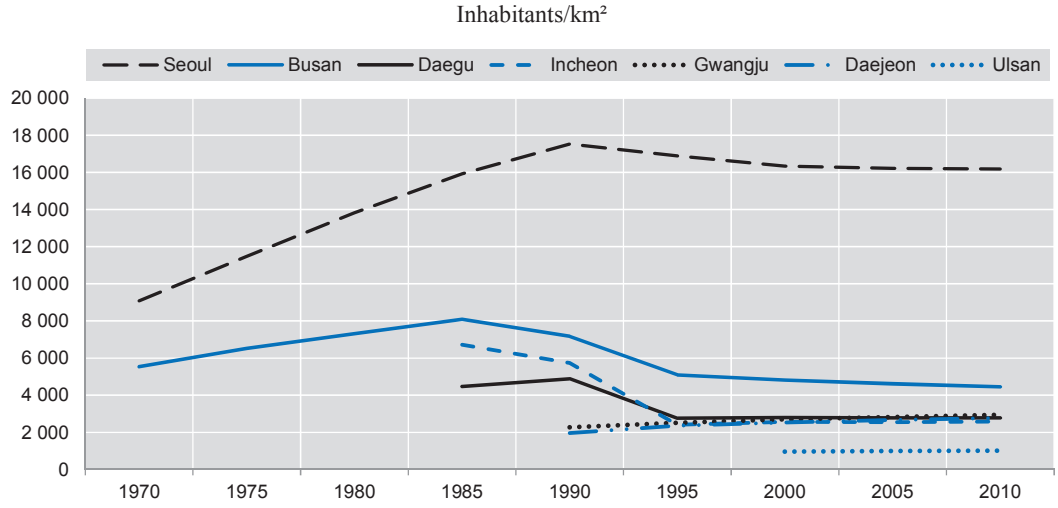


Note: Population density refers to the residential population divided by the area (person/km^2).

Source: OECD (2013d), "Metropolitan regions", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en.

The trend in change of population density in Korean cities shows some interesting developments. The population density of Seoul and Busan, the two largest cities in Korea, has been decreasing since the 1990s, while that of other metropolitan cities is growing. Seoul's population density rose steeply until 1990, when the new towns began to be developed around the capital, and has declined slightly since then. Busan also shows a similar tendency, peaking in the period 1980-85, and then declining significantly.[15] Incheon and Daegu, however, experienced an opposite trend. Between 1985 and 1995, Incheon's population density declined, but since 1995, it has been increasing. One of the main reasons for this might be the Songdo and Gumdan New Towns developed in Incheon[16] (Figure 1.25). Furthermore, the high population densities in most of Korean metropolitan cities tend to be dispersed across cities. The population density at neighbourhood level shows the maximum population density in the Seoul-Incheon and Daejeon Metropolitan Areas as 80 550 inhabitants/km^2 and 39 982 inhabitants/km^2 respectively, whereas those of Vancouver and Portland are 11 413 inhabitants/km^2 and 35 524 inhabitants/km^2 respectively.[17] However, the high-density urban areas in Seoul show a more dispersed pattern than in cities such as Vancouver, Paris and Portland (Figure 1.26). On the other hand, the high-density urban areas in Seoul-Incheon are more dispersed over the metropolitan area than in those cities. Specifically, Figure 1.27 shows that Seoul-Incheon has higher percentages of "very high" and "high"-density areas at any location in the metropolitan area. This is a unique characteristic, given that the OECD (2012a) found Paris and Portland to have obvious monocentric urban structures, while Vancouver is mostly covered by medium-density areas.[18]

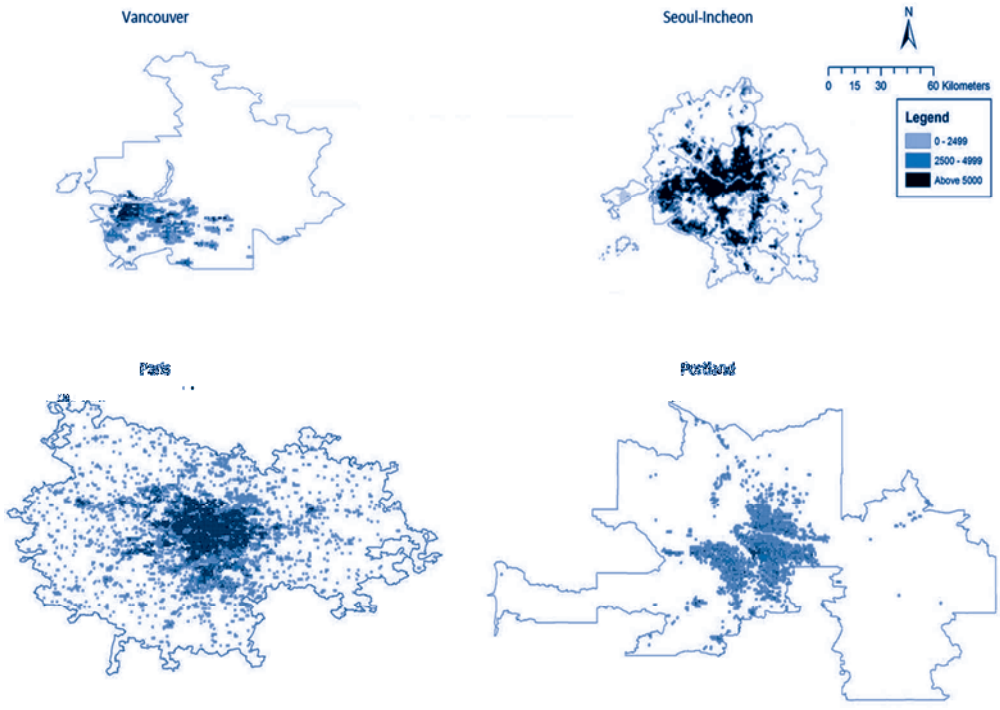
Figure 1.25. **Change in population density in metropolitan cities in Korea**



Source: Adapted from Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

The impact of new town developments can also be observed in the rate of population growth. For example, the population of Seoul and Daejeon, which are now surrounded by a number of new towns, has decreased enormously, especially in the urban centres, in the past decade. The detailed change from 2000 to 2010 (Figure 1.28) at TL5 level explains how people have moved to the outskirts of the region. This suburbanisation led to an increase in the commuting distance, as well as a decrease of vitality in the urban core, one of the main problems in cities.

Figure 1.26. **Urban land density in selected metropolitan areas**



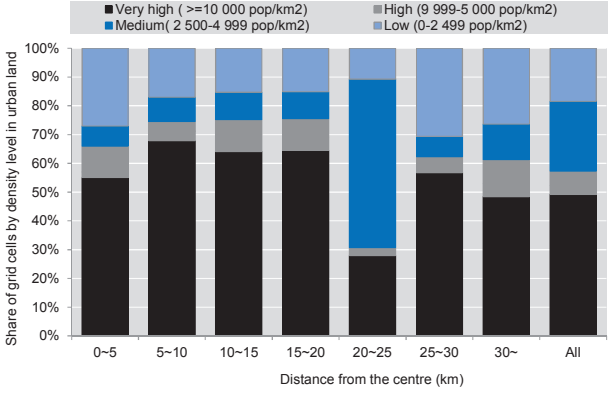
Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: OECD (2013), *Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en.

Figure 1.27. **Urban density map and density gradient graph of the Seoul-Incheon Metropolitan Area**

A. 3-D density map

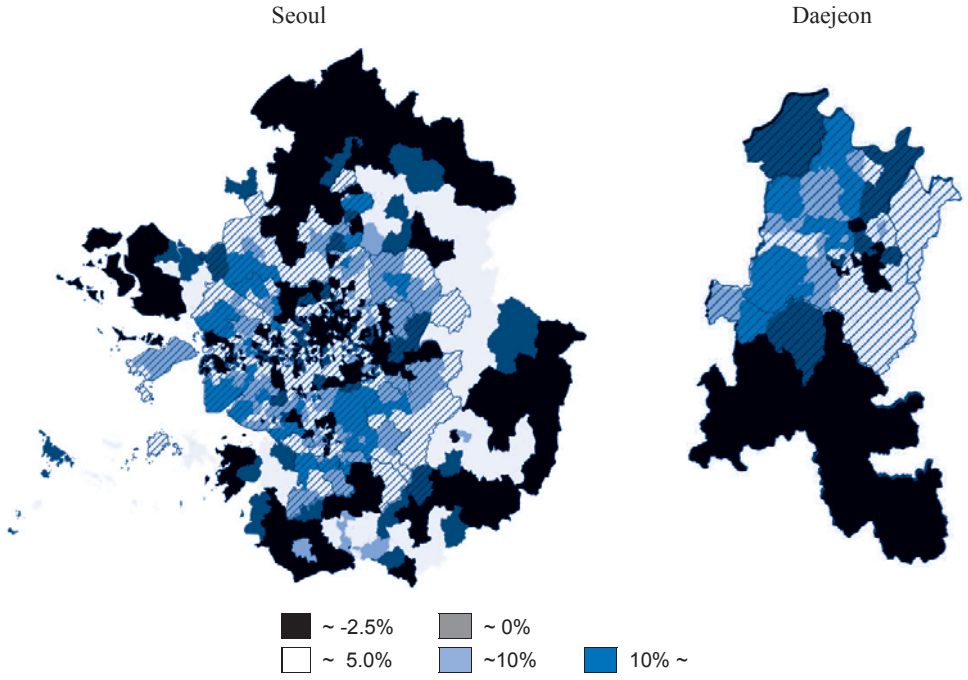
B. Density gradient graph



Notes: The centre is considered to be the densest cell in the metropolitan area. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own calculations based on LandScan *Global Population Database* 2009.

Figure 1.28. **Population growth in Seoul and Daejeon**



Notes: Hatched sections refer to urban core areas in a metropolitan area. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

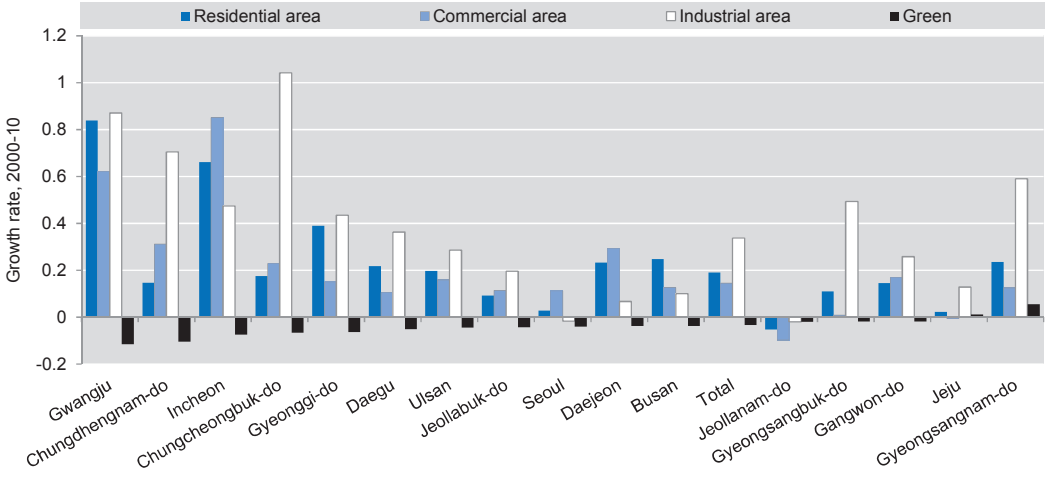
The mixture of key land uses is different across local levels, but mostly dominated by residential areas

In areas exhibiting urban sprawl, land use is a critical way of managing growth and quality of life. While residential, commercial and industrial land use has increased, urban green areas have consistently decreased in most regions (Figure 1.29). Examining land-use patterns at local levels is fundamental for setting urban policy, since land uses in urban areas are closely correlated with walkability and could provide a solution for utilising limited land resources (Duncan et al., 2010). In theory, the principle of mixed use tends to focus more on the neighbourhood (micro)-scale land use: "Mixed land use is defined as a mixture of commercial, residential and industrial land uses within a specified geographical area, as opposed to the segregation of residential land uses from non-residential uses" (Aurand, 2010). In this context, the analysis below examines a specific index, the Mixed Land Use score (or MLU score) by adopting the Entropy Index, which explicitly includes three key land uses, including industrial, residential and commercial land uses at TL4 levels (Box 1.7).

The MLU score at TL4 level within a metropolitan area offers meaningful information (Figure 1.30). All in all, the Seoul-Incheon Metropolitan Area records a high level of mixed land use, while Chungcheongnam-do, Chungcheongbuk-do and Gangwon-do show the lowest MLU score. Particularly in Seoul-Incheon, land uses in the urban core are highly mixed,[19] because land-use regulations have been relaxed so that urban cores can accommodate various functions flexibly (see Chapter 2), and sometimes

mix different functions. For example, Guro-go in Seoul, full of industrial facilities, has the highest MLU score, and Gapyeong in Gyeonggi-do, with one of the lowest MLU scores in Korea, has the highest share of residential areas. This basic understanding of land-use combinations underscores the importance of developing more advanced discussions among governments and academics to develop comprehensive guidelines for mixed land use. The objective of mixed land use, increasing accessibility to urban functions and walkability, can only be achieved with a continuous effort to develop more realistic measurements at a reasonable scale.

Figure 1.29. **Growth rate of land uses within urban areas in Korea**



Note: Due to the data available, the analysis unit refers to the administrative borders in this graph.

Source: Adapted from Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

Box.1.7. **Mixed Land Use score**

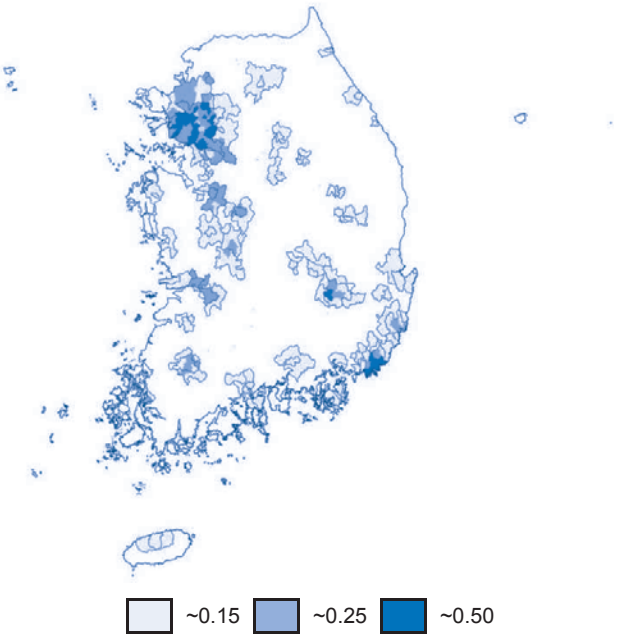
The Mixed Land Use (MLU) score at TL4 level provides an elementary grasp of key land-use patterns at the local level. This is the formula for the index, where k refers to the category of land use, p is the share of the specific land use within a TL4 and N is the number of land-use categories.

$$-\sum k\ (p_k \ln p_k)/\ln N$$

MLU scores range from 0 (no mixture, single land use) to 1 (all the land uses evenly appear). The index measures the heterogeneity of three land uses (residential, commercial and industrial/institutional) and is referred to here as the original MLU score. The ‘‘residential’’ land use contains non-private facilities such as hotels. All sizes and types of retail outlets, such as shopping centres and restaurants, are categorised as ‘‘commercial’’, as well as local post offices and business services. The ‘‘industrial/institutional’’ category includes utilities and heavy and light industry, in addition to public service institutions such as libraries, schools, hospitals and other government institutions. To correct for geographical size differences between TL4 regions while keeping MLU on a 0-1 scale, the size of each TL4 in square kilometres was divided by the size in square kilometres of the smallest TL4 in the sample, to produce a ratio indicating relative size of each TL4. The original MLU score for each TL4 was then divided by the TL4 size-specific ratio to create an area-corrected MLU score + land use per person to represent actual land uses per person.

Source: Brown, B.B. et al. (2009), “Mixed land use and walkability: Variations in land use measures and relationships with BMI, overweight and obesity”, *Health & Place*, Vol. 15(2009), Elsevier, pp. 1 130-1 141.

Figure 1.30. **Mixed land use score at TL4 in functional urban areas**



Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on Ministry of Land, Industry and Transport (MOLIT) (2012), "2012 Urban Statistics", Ministry of Land, Industry and Transport, Sejong, Korea.

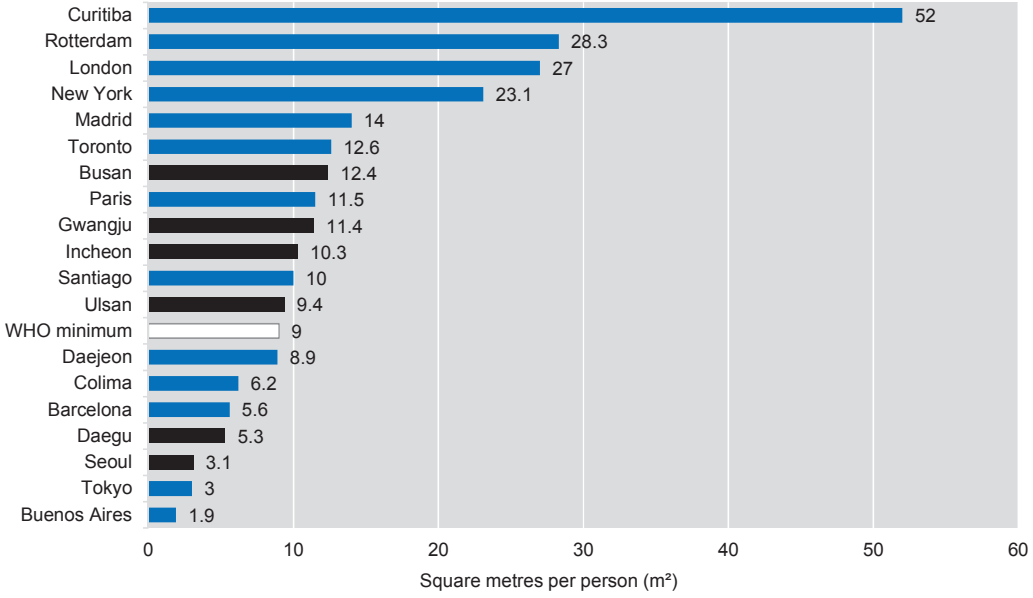
Urban park form: Potential for more urban green space

Open space also requires a more sophisticated approach, as its significance has evolved beyond the traditional view of urban parks as being simply for "recreational use". The statistically significant link between property values and proximity to green space including urban parks and urban forested areas has been noted in numerous studies (Chris, 2004; Konijnendijk et al., 2013). This link between urban parks and neighbourhood quality has received renewed attention from urban policy makers and private developers eager to enhance neighbourhoods' appeal. Another unique role of parks is building better social capital, which will be discussed below in connection with social networks. Research on low-income housing developments has found that park-like public spaces encourage people to leave the isolated atmosphere of their apartments to socialise with one another. Urban parks are now considered to play a key role in achieving wider urban policy objectives, including job opportunities, public health and community building, by strengthening the neighbourhoods where they are located (Chris, 2004).

Housing supply has been a priority in urban policies in Korea, and urban green space has been neglected. The Korea Forest Service (2010) noted that accessible green space in Korea is only 7.76 m²/person, two-thirds of the international standard,[20] while the total area of urban forest is about 1.1 million hectares. This indicates that the green space is hardly well-designed enough to utilise Korea's resources of green space (Figure 1.31). Moreover, half of all regions have less than 9 m² of green space per person across all ranges of population density. Of TL4 regions (Figure 1.32), 124 have less than 9 m², and high-density regions have as little as 1 m²/person. While it might be expected that

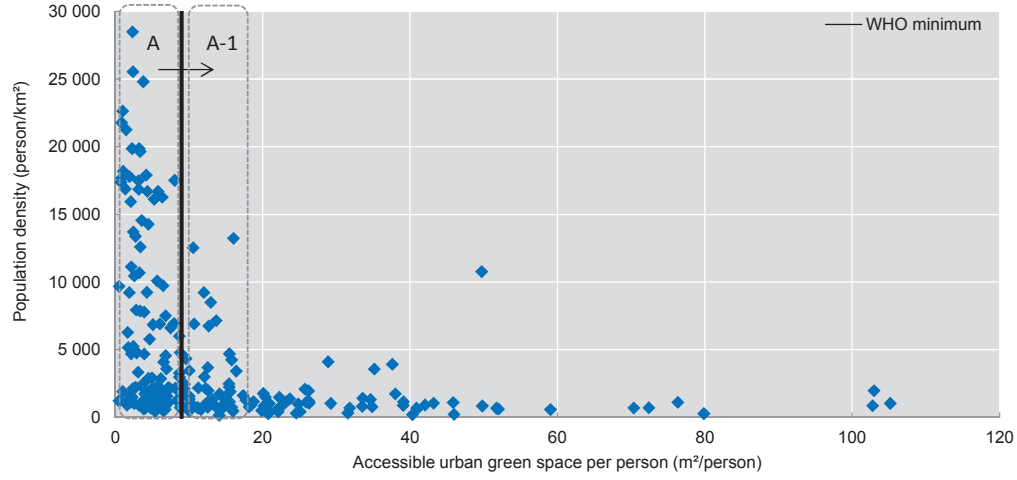
population density and accessible green area have a negative relationship, some green area must be guaranteed, especially in highly populated areas (Figure 1.33) to improve quality of life and raise measures of life satisfaction. In dense mega-cities, it is hard to create new big parks, so maximising the utility of existing urban facilities, such as parceled areas, roads, parking lots and so on, is important. A well-managed urban plan is critical. According to the Korea Forest Service, the Korean government aims to increase accessible green areas per person to 10 m² by 2017. However, there are few ways of reaching this objective without integrating it with land-use policies.

Figure 1.31. **Green space per person in selected cities**



Source: Own elaboration based on World Health Organization (2012), *Global Health Observatory Data Repository* (database), http://apps.who.int/gho/data/node.imr and, www.forest.go.kr/newkfsweb/cop/bbs/selectBoardArticle.do?bbsId=BBSMSTR_1036&mn=KFS_09_02&nttId=404776, (accessed 25 June 2012).

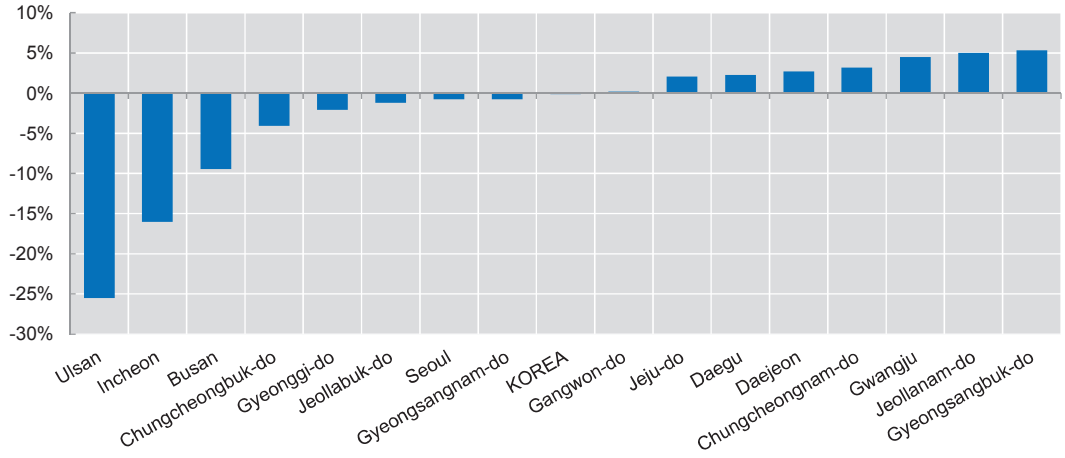
Figure 1.32. **Accessible urban green space per person at TL4 level in Korea**



Source: Own elaboration based on Korea Forest Service (2010), "National Urban Forest Statistics", www.forest.go.kr.

The trend toward a shrinking area of green space requires the urgent attention of policy makers. The annual rate of decrease in urban green areas is 3.5%, a striking contrast to the total forest area (0.1%) at national level (as shown in Figure 1.32). So far, urban development has been driven by economic considerations, and the value of green areas has been overlooked. As in Figure 1.33, the denser regions experience a steeper decrease in urban green areas, highlighting how important it is to integrate land-use policies.

Figure 1.33. **Rate of change in urban green area in TL3 regions, 2005-09**



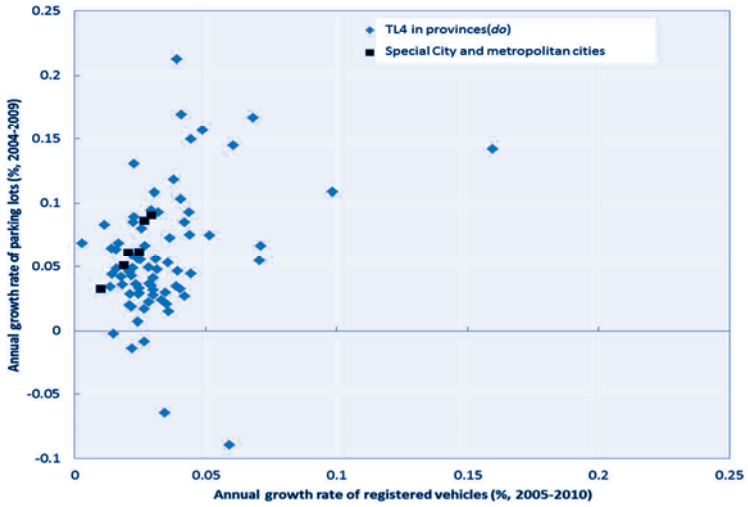
Source: Korea Forest Service (2010), "National Urban Forest Statistics", www.forest.go.kr.

Parking lot forms: Paved areas for vehicles have increased

The question of parking lots is seldom discussed in terms of their relevance for urban form by affecting land use and transport. From the perspective of transport-demand management (TDM), parking management is a critical element. It has been argued that the size of parking spaces should be determined at the earliest stage of planning (Manville and Shoup, 2010). The University of Washington, Seattle, for example, reduced the number of parking spaces on campus just as the campus population rose by 8 000 students, by subsidising public transport. This obviated the need to build 3 600 parking spaces, and saved an estimated USD 100 million (Davis et al., 2010). Similarly, the city of Portland, Oregon, enacted measures that decreased parking ratios from 3.5 to 1.95 spaces per 1 000 square feet. This helped increase use of public transport to 41% in 2005 from 21% in 1997, and to reduce the number of commuters. The savings in parking development costs were estimated at over USD 35 million (Davis et al., 2010).

In the late 2000s in Korea, the size of parking lots increased even faster than the rate of car registration. In nine *do* (provinces), two-thirds of the TL4 regions analysed have a higher growth rate in parking lots than in cars (Figure 1.34). Metropolitan cities also show a similar trend. For example, parking lots in Naju-si (located in Jeollanam-do) and Hanam-si (in Gyeonggi-do) increased by 43% and 21% between 2004 and 2009 while registered vehicles increased by 3% in both cases. A similar tendency has been observed in metropolitan cities. While the numbers of vehicles in Gwangju and Busan have increased by 2.93% and 2.66% respectively, the increases in parking lots for the same period were 9.1% and 8.65%. In Seoul, parking lots increased by 3.27%, while the number of vehicles increased by only 0.99%. This rapid increase may help reduce the lack of urban parking lots, but could increase traffic.

Figure 1.34. **Comparison between the growth rate of parking lots and registered vehicles**



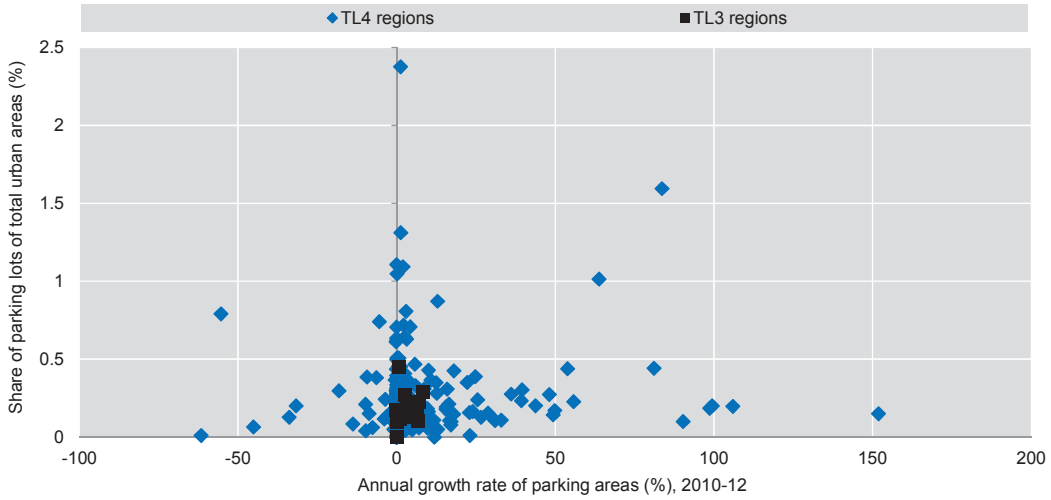
Source: Own elaboration based on Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

Among various types of parking lots,[21] off-street parking lots are an important element, as they directly affect urban forms. Off-street parking lots take up as much land as a development itself, with a 1:1 ratio between spaces used for off-street parking and floor area. Some studies show that a single parking space for a car requires approximately 30 m² of gross floor area (GFA), taking into account the space for access and manoeuvring (Manville and Shoup, 2010).[22] In Korea, the total area of off-street parking lots is about 10% of total urban forest areas. In the Seoul Metropolitan Area, the average area of off-street parking lots is 0.34% of the total urban area, similar to that of Tippecanoe County, which has one of the biggest areas of parking lots in the United States (0.44%), while the national average is 0.12%. In Korea, the area taken up by off-street parking lots expanded by more than ten times from 1990 to 2012 in Korea at regional levels (Figure 1.35). In addition, the total area of mass-transit stations partly used as parking lots is about the same as half the total of off-street parking lots.

Building forms: Densely developed, but not necessarily high-rise nor intensively used

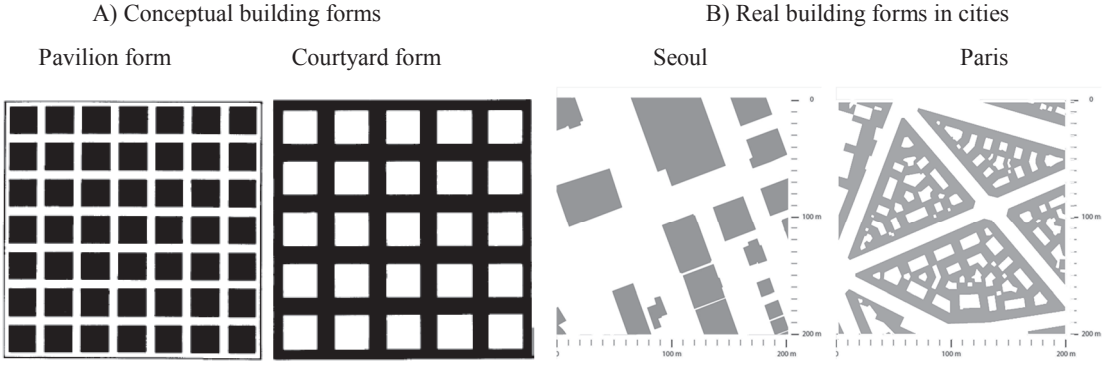
A building form is the architectural dimension of urban forms. As thoroughly studied in *Compact City Policies: A Comparative Assessment* (OECD, 2012a), the variation of building forms with the same value of total floor space can provide different cityscapes, street views and size of green areas. Figure 1.36A illustrates the conceptual difference between two types of building footprints: pavilion forms, where buildings are developed individually in a block and courtyard forms, where buildings alongside roads have interior public spaces. The older districts in European cities have traditional courtyard forms, while newly developed cities have pavilion forms. For example, Jacquet et al. (2010) show that a Parisian "Haussmannian" district of 6 to 7 stories is denser than a 20-story building neighbourhood in Hong Kong, China, calculating density based on floor area ratio (FAR), the ratio of floor to land area. Korean cities reinforce this point. The density of Paris (FAR=5.75) is greater than that of Seoul's Gangnam district[23] (FAR=5.03), a 13-story neighbourhood, and also in City Hall district in Daejeon (FAR=5.01), a district of about 9 stories (Figure 1.36B).

Figure 1.35. **Off-street parking lots in Korea**



Source: Adapted from Ministry of Land, Transport and Maritime Affairs (2012), "2012 Urban Statistics", Ministry of Land, Transport and Maritime Affairs, Gyeonggi-do, Korea.

Figure 1.36. **Different building forms in cities**



Note: Shaded parts show the area of buildings.

Source: Own elaboration based on *KSIC database* for Seoul; for Paris: Jacquet, P., R.K. Pachauri and L. Tubiana (2010), "Regards sur la terre 2010. L'annuel du développement durable: Villes: changer de trajectoire", SciencesPo, Paris.

Different options for building forms show that high-rise buildings are not necessarily dense. Raman (2010) argues that some of the negative social impressions of high-density urban development, especially of areas with high-rise buildings, can be addressed by enhancing the design of neighbourhoods. Typology and physical form of development, and not density alone, influences social capital at neighbourhood levels. To achieve sustainable development, compact city policies can work properly when the choice of building typologies is well thought through, with appropriate inclusion of open spaces (Raman, 2010; Ratti et al., 2003).

Comparing perceived density (average height) and actual density (floor area ratio) at TL5 levels in Korea provides a clear difference. Figure 1.37 shows the cases of Seoul and six metropolitan cities. At a city level, Seoul has more high-rise buildings with more floor space, while its high-rise buildings are concentrated in the south area. Daejeon has a

clustered pattern in the districts (*gu*) with high values of FAR, and a dispersed distribution pattern in the districts where the average height of buildings is higher. While population density represents the number of residents in a specific area, building density can help to capture the physical built-up cityscape of cities, and the capacity of spaces that can accommodate urban activities. A multi-dimensional perspective on density, such as FAR and building heights, is critical to accommodate people and control density effectively.

Figure 1.37. **Comparison of floor area ratio and average building height of major cities in Korea**

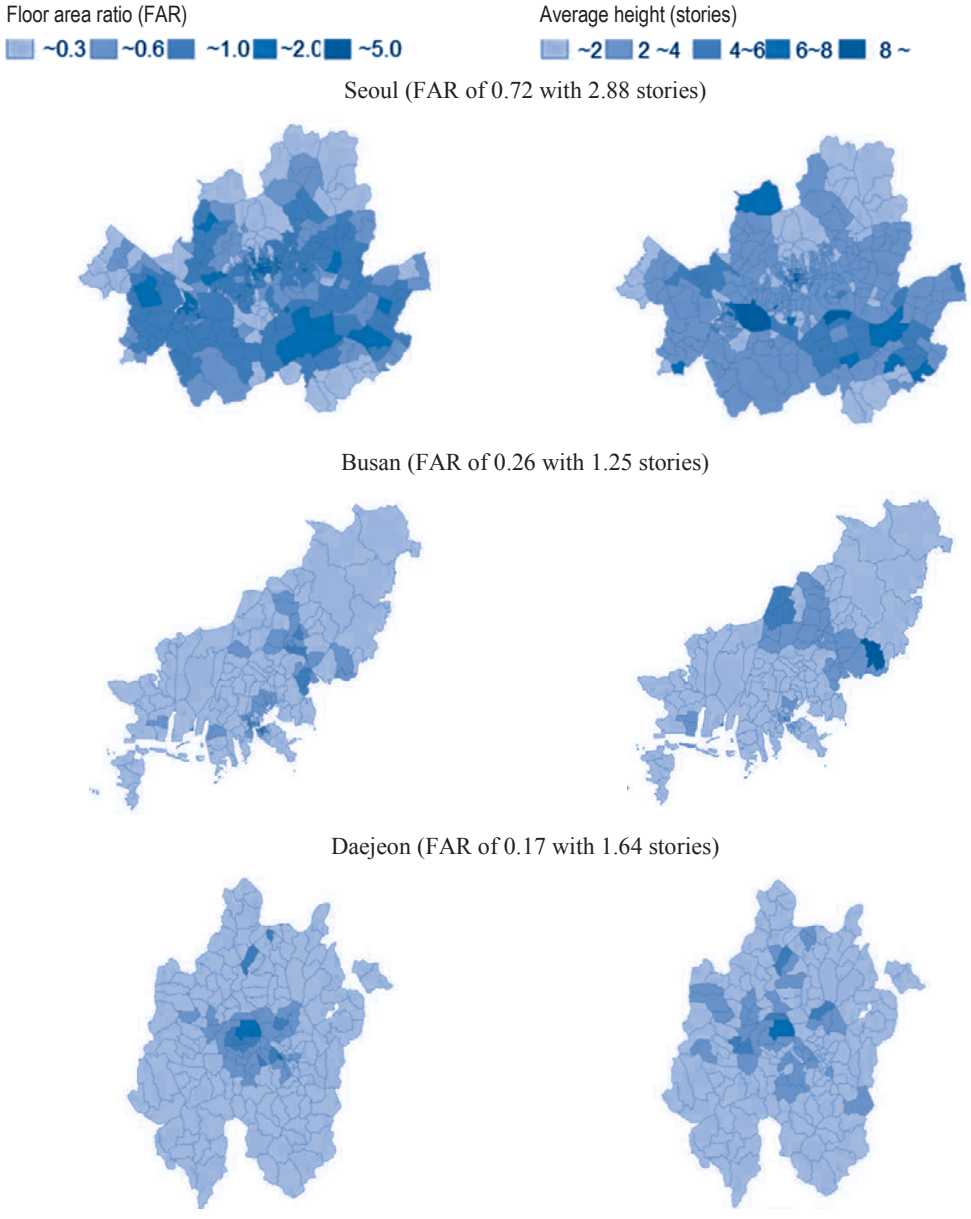
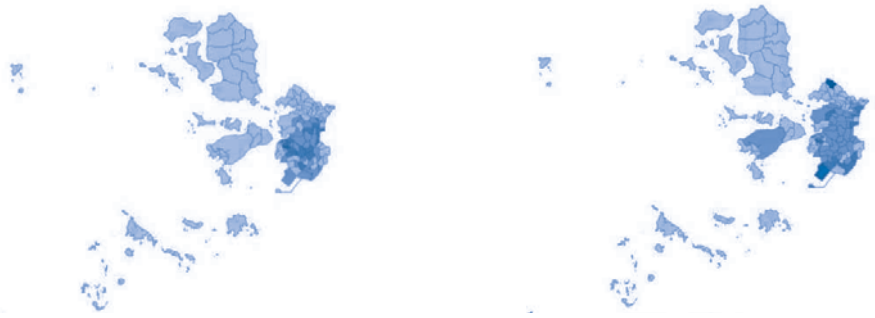


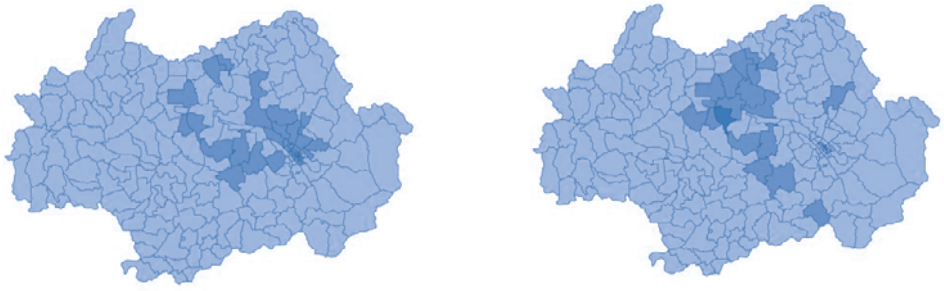
Figure 1.37. **Comparison of floor area ratio and average building height of major cities in Korea** (*cont.*)

Incheon (FAR of 0.36 with 2.25 stories)

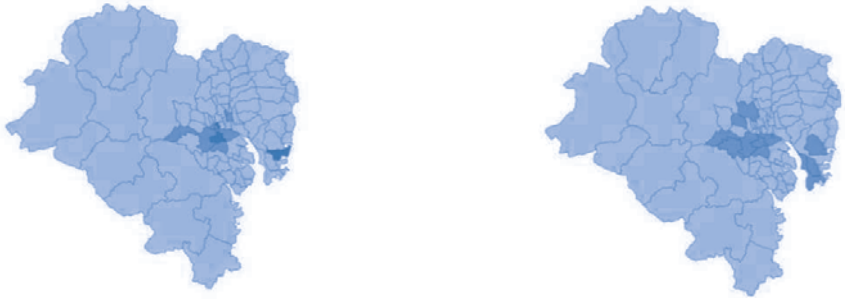


Daegu (FAR of 0.40 with 1.84 stories)

Gwangju (FAR of 0.15 with 1.17 stories)



Ulsan (FAR of 0.11 with 0.90 stories)

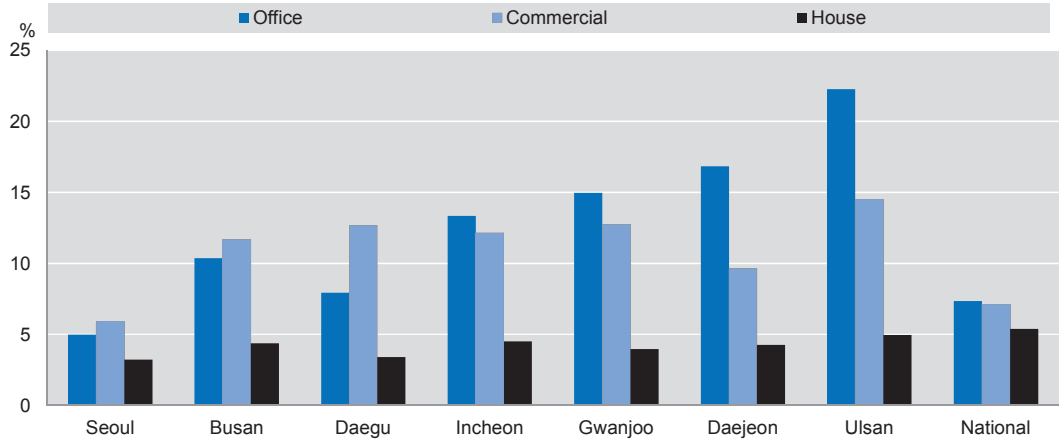


Notes: Floor area ratio (FAR) refers to the total built-up spaces in TL5 divided by the specific area. Average height refers to the average height of buildings in a specific TL5. The left-hand images show the distributions of FAR by the district (*gu*) and the right-hand images show average heights. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on *NGIS database* (National Geographic Information System).

On the other hand, buildings, in particular office buildings, could be used more intensively in metropolitan cities. In fact, the average vacancy rate of office buildings at national level is 7.35%, which is moderate compared to the United States (15.3% in 2013) and the European Union (10% in 2012). The metropolitan cities show big differences; Ulsan (22.3%), Daejeon (16.8%), Gwangju (15.0%), Incheon (13.3%), Daegu (7.9%), Busan (10.4%) and Seoul (5.0%) (Figure 1.38). The vacancy rate of office buildings could be severely affected by factors including the economic situation, change in industrial mix and economically active population, but may also be the result of supply exceeding demand or because developers cannot satisfy the needs of existing or potential tenants (Money Today, 2013). Market demand should be studied carefully before constructing new office buildings, and policies developed to maximise use of existing office stock.

Figure 1.38. **Vacancy rate of metropolitan areas by building type**

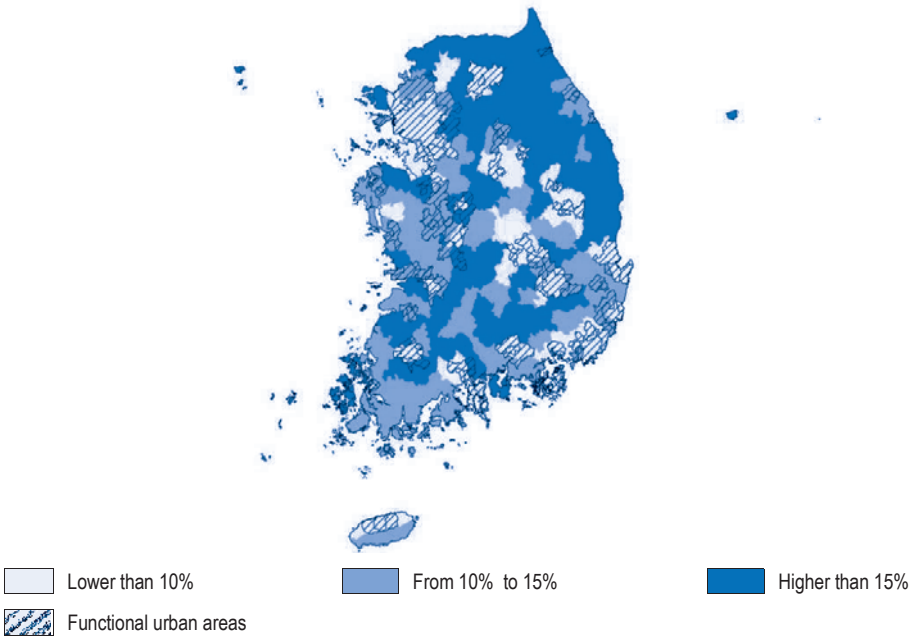


Note: Office and commercial figures are the annual average from 2002-12, and housing is an average of 2000, 2005 and 2010.

Source: Own elaboration based on Korea Statistical Information Service, www.kosis.kr.

Interestingly, housing vacancies in non-metropolitan cities are higher (Figure 1.39). Between 2000 and 2010, the average vacancy rate of houses in most non-metropolitan (FUA) areas was over 10%, while the national average was 5.4%. The highest rate in a non-metropolitan region was in Pyeongchang-gun in Gangwon-do (26.6%), and the lowest was in Bucheon in Gyeonggi-do (1.6%). This might be because development-oriented housing projects have been promoted for decades, with little consideration for the demand side, especially in small areas, and even those with inadequate urban facilities. The rural new-town projects (Danyang, Jangsu, Gochang, Jangseong and Hwasoon) intended to bring the younger generation back to rural areas have extremely high rates of vacancy. Only 53.8% of the total houses are now occupied (350 houses out of 650) (Newsis, 2013). In Germany, by comparison, the highest vacancy rates are in the towns of Salzgitter (11.7%) and Schwerin (9.9%) (REFIRE, 2013). A high vacancy rate can make a location unattractive, and should be avoided at virtually any cost, through the use of existing building stock.

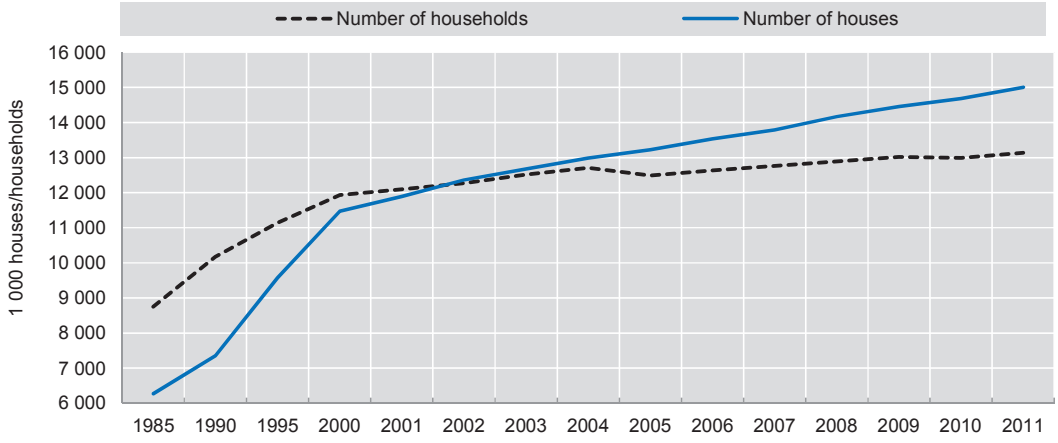
Figure 1.39. **Vacancy rate across regions in Korea**



Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Adapted from Korea Statistics Office (2013), *KOSIS database,* Korea Statistical Information Service, www.kosis.kr.

Figure 1.40. **Increase in housing supply and demand in Korea**



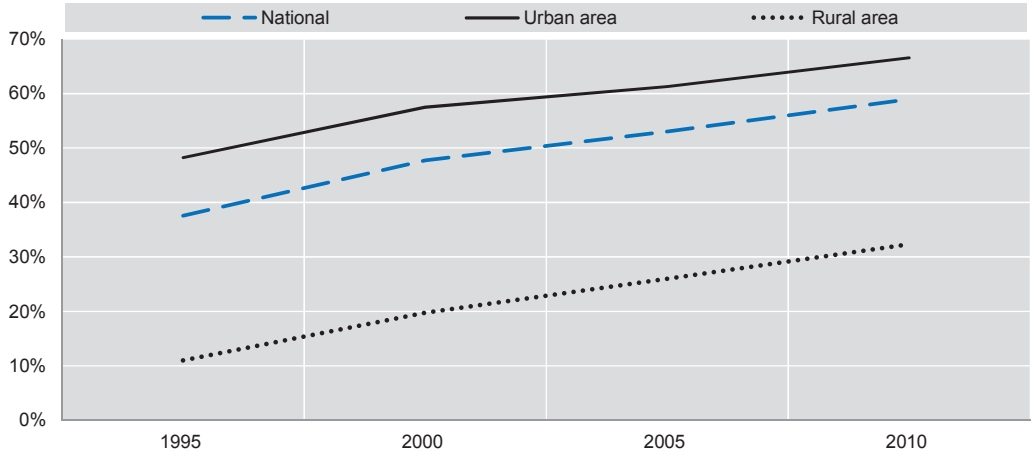
Source: Adapted from Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr.

Housing forms: More high-rise apartments of larger size

Along with rapid urbanisation, the supply of houses has steadily increased. Governments strongly drove housing development, including new town developments, starting in the 1990s, as explained in Figure 1.40. Among the housing provided, high-rise apartments make up the dominant share, which made up 58.43% of total housing in

Korea in 2010. Rural areas are no exceptions to this trend; the share of apartments reached 11% in 1995, but increased to 32.29% in 2010 (Figure 1.41). While the supply of apartments can be seen as an effective tool of intensification policy in other OECD cities (Box 1.8.), the increase of apartments in Korea is noticeable. For example, the share of apartments in total housing in Sydney and Toronto was only about 20% and 40% respectively in 2005, but that of Seoul was 54.3% (Table 1.3). Of course, as Lim (2010) argues, the apartment-oriented housing supply has helped raise living conditions among middle-income households in a short period. In addition, most apartments in Korea have been developed as a bundled complex containing not only houses but also local services, urban parks and sport facilities within a complex, to support the swiftly rising demand for houses and a better quality of life in the short term. Nevertheless, the dominance of apartments has come in for criticism. First, a sense of place can be compromised by monotonous high-rise building stock. The higher housing prices are also an issue. The extreme density of apartment construction reduces neighbourhood satisfaction and quality of life. High-rise buildings with poor urban design in unsuitable locations have generated the impression that density is undesirable in pursuit of a better quality of life (OECD, 2012a).

Figure 1.41. **Increase in the number of apartments in Korea**



Source: Adapted from Korea Statistics Office (2013), *KOSIS database*, Korea Statistics Information Service, www.kosis.kr.

Box 1. 8. **Intensification policies in other OECD countries**

Intensification of urban form in Sydney and Toronto has been achieved through high-rise residential structures, which facilitate maximum land use, with considerable accessibility and varied urban and natural amenities. The examples of Sydney and Toronto suggest that the effectiveness of urban intensification policies depends on the co-ordination with crucial contextual factors: an urban rail network, community constituency, existence of inner-city brownfields with high amenities, government tax incentives and environmental concerns about growing greenhouse gas emissions.

The local government of Rotterdam suggests the importance of inner-city densification. Studies indicate that synergy is critical: synergy between the enterprising inhabitants of inner cities and employment as well as culture and meeting points. An innovative inner city is an indication of the resilience of the city as a whole. The definition of urban consolidation can be summed up thus: "increasing density of dwellings or population, or both. It does not refer to one single policy, but rather a number of related land-use measures and housing initiatives that can increase residential densities."

Source: Searle, G. and P. Fillion (2011), "Planning context and urban intensification outcomes: Sydney versus Toronto", *Urban Study*, Vol. 48, No. 7, pp. 1 419-1 438.

Table 1.3. **Change in housing type in Seoul, Sydney and Toronto**

		1995 (A)	% in total	2005 (B)	% in total	B/A
Korea	Total	9 204 929	100	12 494 827	100	1.4
	Detached houses	4 337 105	47.1	3 984 954	31.9	0.9
	Apartment	3 454 508	37.5	6 626 957	53	1.9
	Row/town multi-household houses	1 070 528	11.6	1 684 563	13.5	1.6
	Others	342 788	3.7	198 353	1.6	0.6
Seoul	Total	1 688 111	100	2 242 149	100	1.3
	Detached houses	561 947	33.3	443 806	19.8	0.8
	Apartment	716 251	42.4	1 217 308	54.3	1.7
	Row/town multi-household houses	353 326	20.9	552 203	24.6	1.6
	Others	56 587	3.4	28 832	1.3	0.5
Sydney	Total	1 297 010	100	1 423 536	100	1.1
	Detached houses	855 715	66	905 634	63.6	1.1
	Apartment	294 817	22.7	339 783	23.9	1.2
	Row/town multi-household houses	132 781	10.2	168 433	11.8	1.3
	Others	13 697	1.1	9 686	0.7	0.7
Toronto	Total	1 485 695	100	1 800 525	100	1.2
	Detached houses	646 035	43.5	750 235	41.7	1.2
	Apartment	612 750	41.2	760 845	42.3	1.2
	Row/town multi-household houses	222 615	15	286 915	15.9	1.3
	Others	4 295	0.3	2 530	0.1	0.6

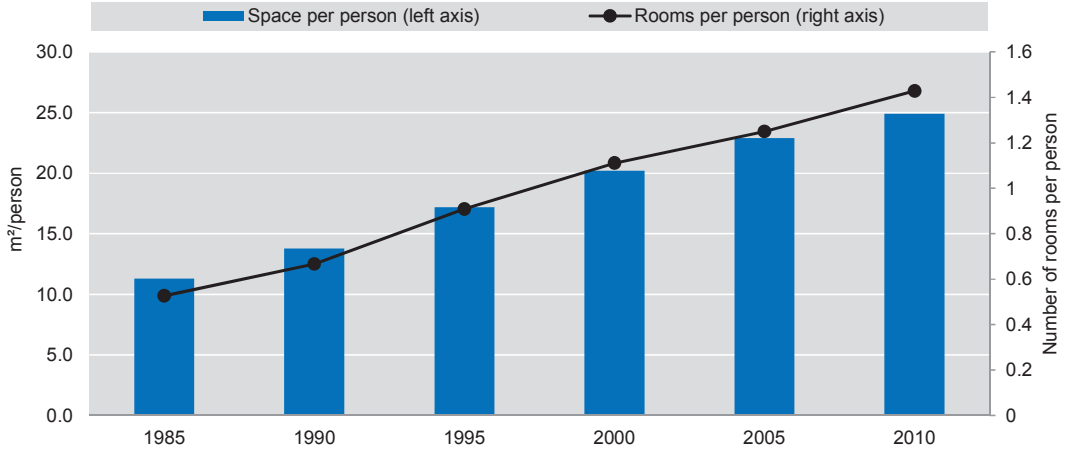
Sources: Adapted from Korea Statistics Office, *KOSIS database*, Korea Statistical Information Service, www.kosis.kr); Searle, G. and P. Fillion (2011), "Planning context and urban intensification outcomes: Sydney versus Toronto", *Urban Studies*, Vol. 48, No. 7, pp. 1 419-1 438.

In time, this effort to supply housing has helped to improve housing conditions in Korea. The share of households below the minimum standards[24] for residential accommodation has fallen, from 34.4% in 1995 to 13.3% in 2005 and to 10.6% in 2010 (Kim et al., 2007; Ministry of Land, Transport and Maritime Affairs, 2011). Similarly, in 2005, the Korea Research Institute for Human Settlements conducted a study investigating the minimum standards for residential accommodation announced in June 2004 after the amendment of the Housing Act (Jeong and Lee, 2013). The research found that households falling short of the minimum standards for residential accommodation were estimated to account for 21.1% of the total households. Among them, households that fell below the standards for the use of facilities (standards for essential installation) accounted for 11.3%; those for the usage of bedrooms (number of rooms by usage) about 9.8%; those for size (minimum residential area for each household) about 4.0%; and those for all three standards about 0.7%.

Although housing conditions have improved, another housing trend has attracted attention. Along with an increase in the amount of housing in urban areas, the size of each house also seems to be growing. For instance, the space per person has doubled, from 13.8 m² to 24.9 m² per person between 1990 and 2010 (Figure 1.42).[25] This, however, increases concerns that a further increase in larger housing units[26] might be filling up cities but provide less public space and green areas. It may also fail to meet most recent trends, given the increase in one-person households in Korea. This calls for flexible housing policies supplying small units of housing suitable for one-person households.

Adapting to demographic trends and preferences can help allocate houses more efficiently within limited land resources. Goduk, one of the new town areas, reflects this trend. It had been planned to provide a total of 568 houses, including 20.1% of houses of less than 60 m², 40.1% of medium houses between 60 m² and 80 m², and 39.8% of houses larger than 85 m². However, it was modified to include more medium-sized houses and reduce the number of large houses (26.2% of small houses, 57.9% of medium houses and 5.8% of big houses) (Gangdong-gu, 2013).

Figure 1.42. **Dramatic changes in housing conditions in Korea**



Source: Korea Statistics Office (2013), Korean Statistical Information Service, www.kosis.kr.

Moreover, since the lack of housing seems to have abated since the early 2000s, the challenge is now to harmonise the existing houses and high-rise apartments, and to improve urban amenities, including landscape and green space (Figure 1.43). If urban facilities prove insufficient, a high vacancy rate and decline seem inevitable, as indicated by the high vacancy rate in rural areas. From the perspective of the compact city, locating fragmented residential areas of this kind is critical, since they are associated not just with insufficient green space but also greater negative impacts from leapfrog developments.

Figure 1.43. **Isolated residential areas in Korean local cities**

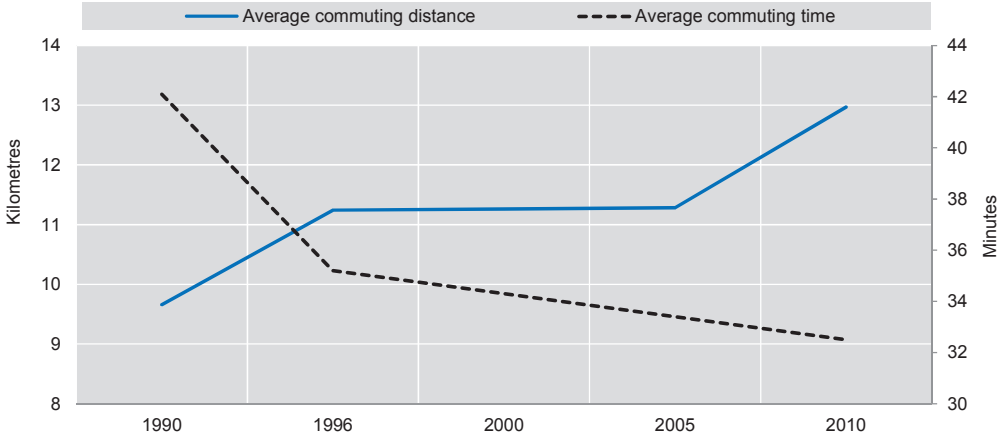
Source: Korea Research Institute for Human Settlements (2010), "An approach on policy improvement for an impact fee area considering smart growth", Korea Research Institute for Human Settlements, Gyeonggi-do, Korea.

Transport networks

Road-oriented transport

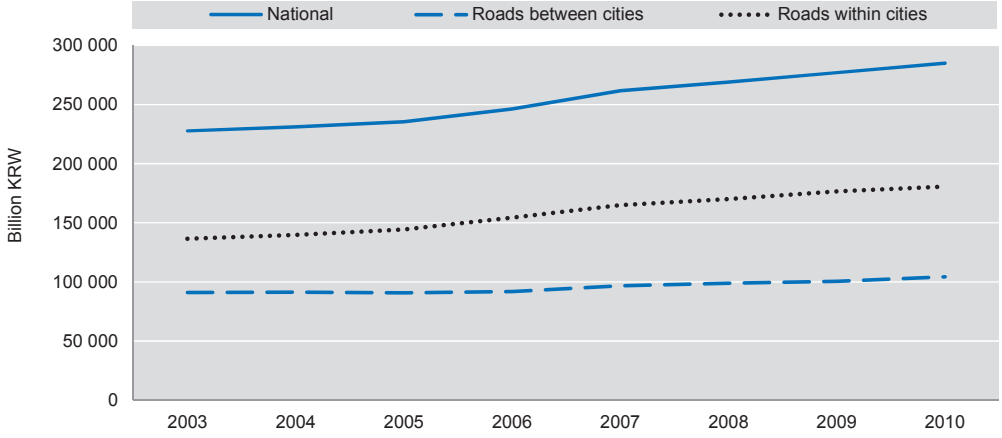
Given rapid urbanisation, average commuting distances have increased enormously, especially in the SMA, from 9.66 km in 1996 to 12.97 km in 2010 (Figure 1.44). The maximum commuting distance increased by over 50% from the 1990s to 2010, reflecting new town developments around Seoul (OECD/ECMT, 2007). However, the average commuting time has fallen, from 42.1 minutes in 1990 to 32.5 minutes in 2010, despite the longer commuting distances (Figure 1.44). This is partially due to expansion of the public transport network and road facilities around Seoul to support new town developments. Similar trends have been observed in other countries. In a period of extensive decentralisation, increase in travel distances has been counterbalanced by faster travel, resulting in a net reduction in travel time for commuting (OECD/ECMT, 2007). Meanwhile, traffic volume has increased in inner-city areas, largely driven by far higher use of private cars, elevating congestion costs in urban areas by 32% between 2003 and 2007, and accounting for 2.4% of national GDP in 2010 (Figure 1.45).

Figure 1.44. **Average commuting distance and time in Korea, 1990-2010**



Source: Adapted from *Korea Transport Institute Database* (2013), www.koti.re.kr.

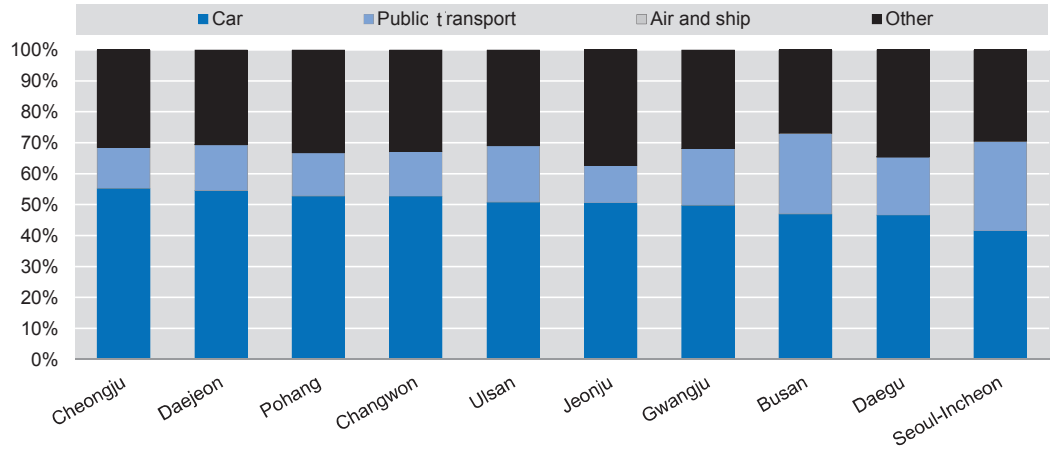
Figure 1.45. **Traffic congestion costs in Korea, 2003-07**



Source: Korea Transport Institute (KOTI) (2011), "The trend and evaluation of congestion costs in Korea" (in Korean), KOTI, Gyeonggi-do, Korea.

To address this problem, the Korean government has promoted public transport, which has resulted in an increase in the use of public transport at the national level. However, public transport in some metropolitan cities and small cities has room for improvement, as has connecting the transport network within cities. This effort has focused on larger metropolitan areas, and less effort has been spent in medium-sized cities, as evident in the huge discrepancy in the use of public transport in the different metropolitan areas (Figure 1.46). The share of public transport use in Busan and Seoul-Incheon is 26% and 29% respectively, almost double that in Cheongju and Daejeon, which have the lowest level of public transport use (13% and 15% respectively) and the highest level of car use (55% and 54% respectively). Without extending the public transport network, they may have difficulty responding to the growing volume of traffic as a result of their urban development plans.

Figure 1.46. **Modal share of Seoul and metropolitan cities**



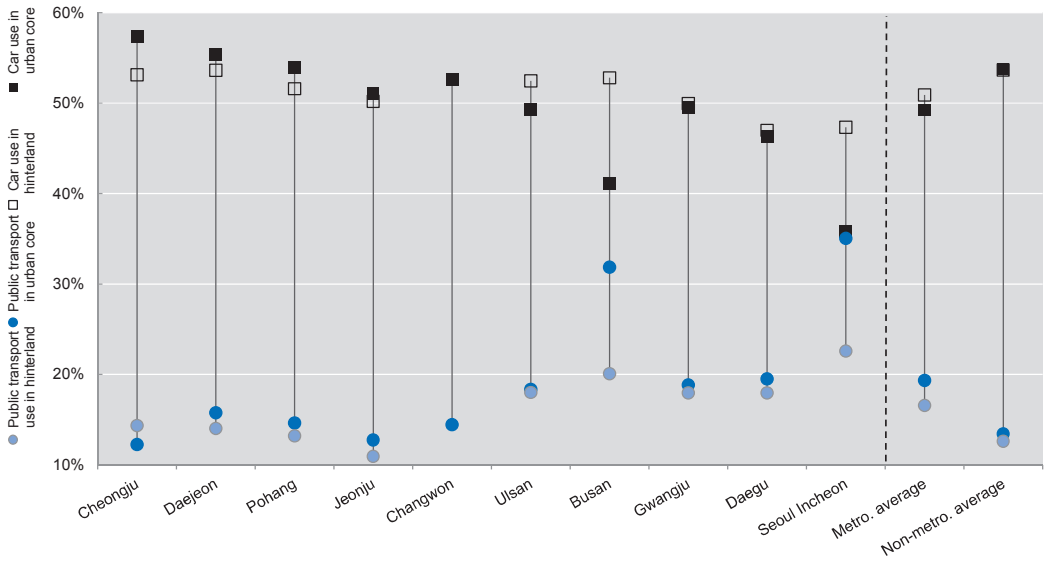
Source: Own elaboration based on *Korea Transport Institute Database* (2013), www.koti.re.kr.

Traffic flow within cities merits examination. A large discrepancy is noted in gaps between urban cores and hinterlands within metropolitan areas (Figure 1.47). In some metropolitan areas, including Ulsan, Busan, Gwangju, Daegu and Seoul-Incheon, which have a high public transport modal share, the urban core uses public transport more and cars less than the hinterlands. Public transport is well provided in urban centres with active economic activities. By contrast, in Cheongju, Daejeon, Pohang and Jeonju, which have a lower public transport share, public transport use in urban cores is no higher or even lower than in the hinterland. This implies that private car use overwhelmingly dominates traffic in urban centres. Seoul and Busan have lower private car use per capita, more public transport and fewer vehicles per capita than Daejeon and Cheongju, which have higher private car use and lower public transport (Figure 1.48).

Public transport accessibility

Accessibility to public transport is considered a key factor in encouraging the use of public transport. The physical distance from home to the nearest bus stop and railway station is frequently considered a critical consideration in indicating accessibility to public transport (OECD, 2011a). People living close to a railway station are five times more likely to use the metro or train to commute, and one of the strongest influences on using buses is proximity to a bus stop. If distance from a home to a public transport stop

Figure 1.47. **The gap of modal choices between the urban core and hinterland in metropolitan areas**



Source: Own elaboration based on the *Korea Transport Institute Database* (2013), www.koti.re.kr.

Figure 1.48. **Car ownership in functional urban areas**

Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on *Korea Transport Institute Database* (2013), www.koti.re.kr.

increases by 400 metres, the likelihood of using public transport decreases by 16% (OECD, 2011a). WHO recommends that all new residential areas be located within 400 metres of bus stations, and that new offices, retail outlets and leisure facilities be located within 300 metres of public transit. Proximity to public transport is an essential component of reducing car use, and public transport-oriented neighbourhoods are associated with higher walking and cycling rates. Other components of public transport accessibility include affordability, reliability, frequency and convenience for all population groups (Box 1.9).

Box 1.9. **Methodology on accessibility to public transport**

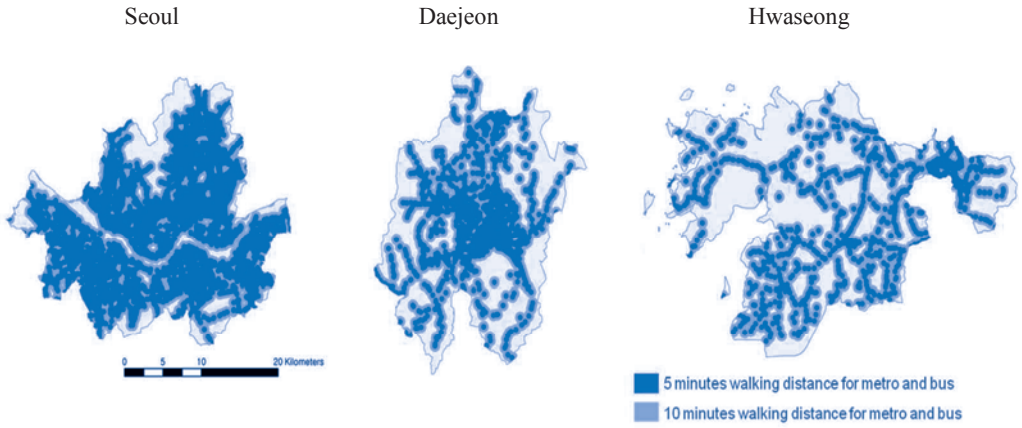
The OECD has introduced a methodology for measuring accessibility to public transport as part of a joint project with the Directorate for Regional Policies of the EU (DG Regio). The methodology uses three steps, depending on data availability: *i)* identifying the service areas of public transport; *ii)* evaluating accessibility in terms of frequency of service; and *iii)* calculating the proportion of the population living in accessible areas.

In a first step, the transit access areas are calculated based on pedestrian street network data. Using a threshold of 5 minutes' walking time for reaching bus stops (or trams and other modes of transport) and 10 minutes for metro (and rail) stations, mode-specific access areas are identified based on an average walking speed of 1.1 metres a second (about 4 kilometres an hour). In a second step, the service level of accessibility is calculated, using frequency data, measured as the average number of public transport services per hour. Based on these calculations, different service levels are determined, classifying mode-specific accessibility into high (more than ten services/hour), medium (between four and ten services/hour) and low frequency areas (less than four services/hour). Areas beyond walking thresholds are considered as null, i.e. without access. To obtain an overall indicator for public transport accessibility, the mode-specific service areas are combined, resulting in five service-level classes: very high, high, medium, low and null. Overlaying these created service areas with grid population data makes it possible to determine and classify the share of urban residents with access to public transport. This methodology is being tested for a set of metropolitan regions in Asia (Korea, Japan), North America (Canada, United States), Oceania (Australia) and Europe.

Source: OECD (2012f), "Towards sustainable urban form: Opportunities and challenges for public transport indicators", 24th Session of the Working Party on Territorial Indicators, 3 December 2012, OECD, Paris.

The consistency of accessibility to and use of public transport in Korean metropolitan areas sheds light on the significance of integrating land-use patterns and transport networks. The level of accessibility seems to vary among metropolitan areas. In Seoul, the share of population living a 5-minute walk from a bus or metro station is 91.17% of the total population, as compared with 68.07% in Daejeon. Figure 1.49 further illustrates the level of accessibility in the case cities. While most areas of Seoul are within walkable distances from public transport, in Daejeon, only the urban centre is covered. This may explain the modal share of Seoul, whose public transport use is the highest, and Daejeon, which has the highest car use among Korean metropolitan areas. As another example of the imbalance of public transport service within a city, in Hwaseong, the area accessible to public transport is concentrated in the eastern side, where the Dongtan New Towns are located. This leaves some question as to how to connect the two sides.

Figure 1.49. **Service area of public transport (bus and metro)**

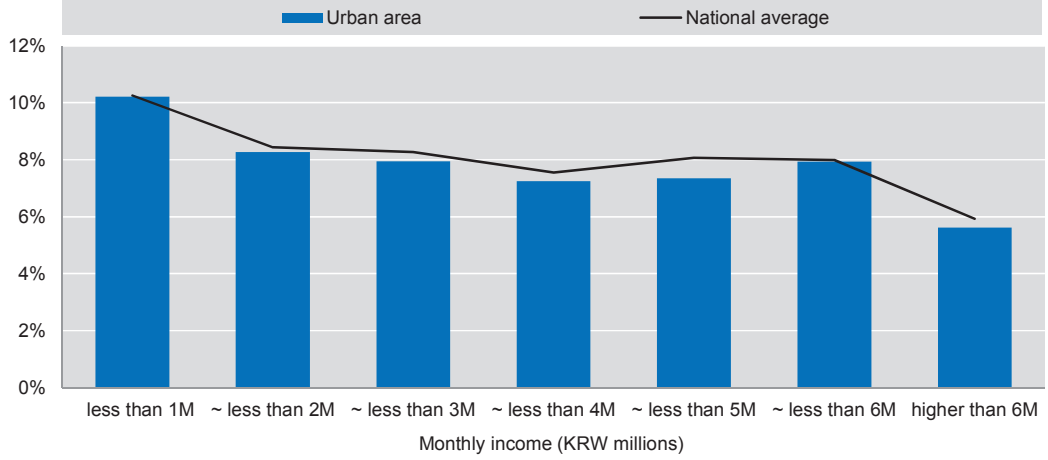


Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on National Geographic Information System Data, www.ngic.go.kr, and on Korea Statistics Information Service, www.kosis.kr.

Such issues of the public transport network are critical not only because of the environmental implications, but because these issues are associated with reducing social inequality. Lewis (2011) restates a linkage between accessibility and economic disadvantages identified in a 2003 UK study on transport and social exclusion. While the urban public transport system in Korea has been actively promoted, residents in the lowest income group still pay a high percentage of their total monthly expenditure for transport. This could cause inequalities not only in transport mobility but also in economic activity (Figure 1.50).

Figure 1.50. **Share of expenditure on transport by different income groups**

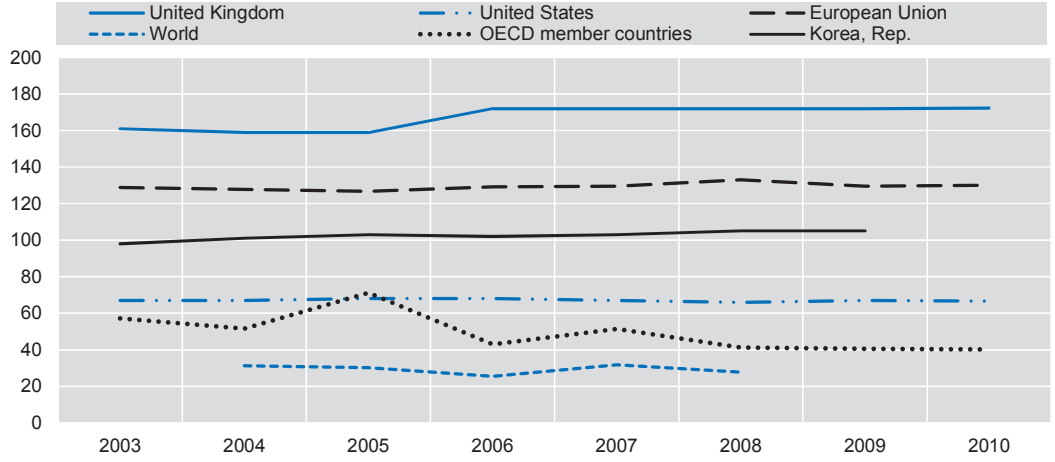


Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Service, www.kosis.kr.

Street networks

Street networks have a significant influence on urban land use. In Korea, the road network almost doubled in the two decades from 1990 to 2012. The length of roads in Gyeongsangnam-do, Gwangju and Daejeon has been extended by 3.3, 2.3 and 2.2 times respectively, especially due to the extension of roads of over 50 metres wide. According to the World Bank Database, road density in Korea for the period 2003-10 was relatively high in global terms (Figure 1.51). In terms of total urban areas, the road sector took up about 9.2% in Korea in 2012 (Figure 1.52). Among metropolitan areas, Seoul's road sector is huge, at 14.5%, while Busan's is 5.6%. Although pedestrian roads have increased recently as the issue of walkability has emerged, the current share leaves room for improvement. Despite this remarkable improvement in infrastructure, the expansion in road capacity often tends to be offset by higher demand. In the long term, certain types of road infrastructure may change the urban form, which is sometimes not helpful in improving mobility. Large cities and towns would do well to consider the impact on urban form and the environment in the provision of road networks (Donovan and Munro, 2013).

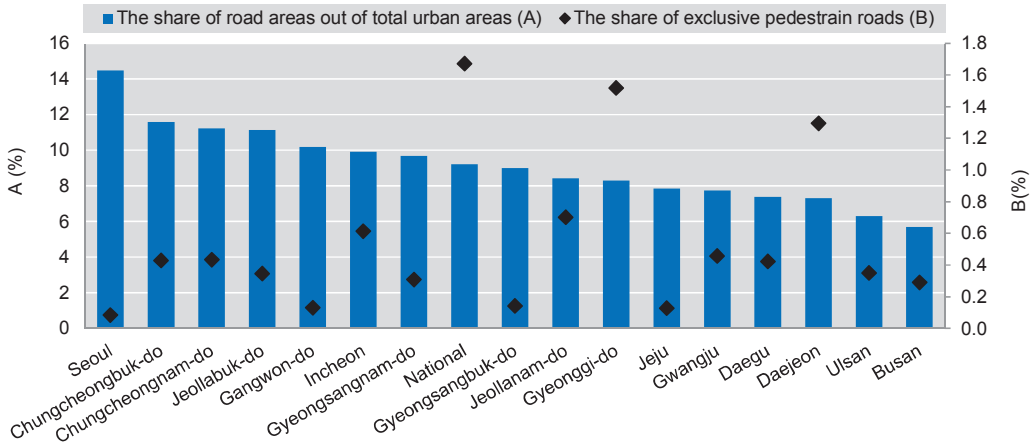
Figure 1.51. **Road density comparison**



Note: Road density refers to the length of roads divided by total area.

Source: Adapted from *World Bank Data indicators*, http://data.worldbank.org/indicator/IS.ROD.DNST.K2?display=graph (accessed 7 August 2013).

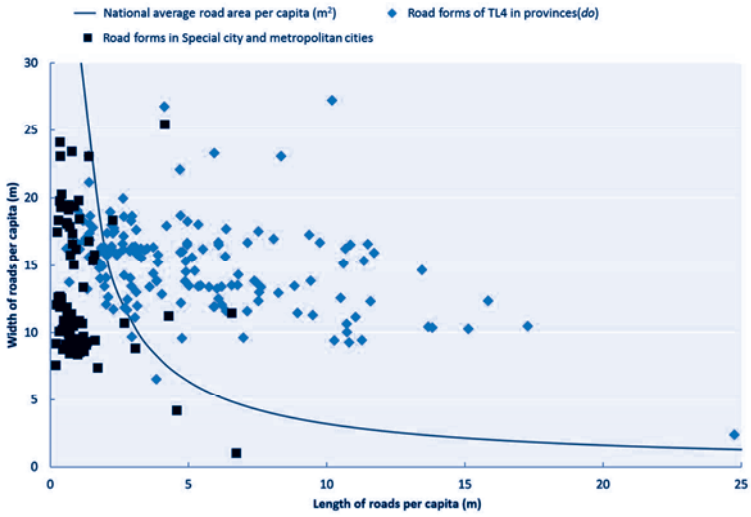
Figure 1.52. **Share of road area in total urban areas**



Note: Mixed traffic streets are common in most metropolitan cities, but it is not clear they are compatible with pedestrian traffic.

Source: Ministry of Land, Infrastructure and Transport (2013), "2012 Urban Statistics", Sejong, Korea, www.city.go.kr (accessed 23 July 2013).

Figure 1.53. **Width and length of roads in TL4 regions, 2012**



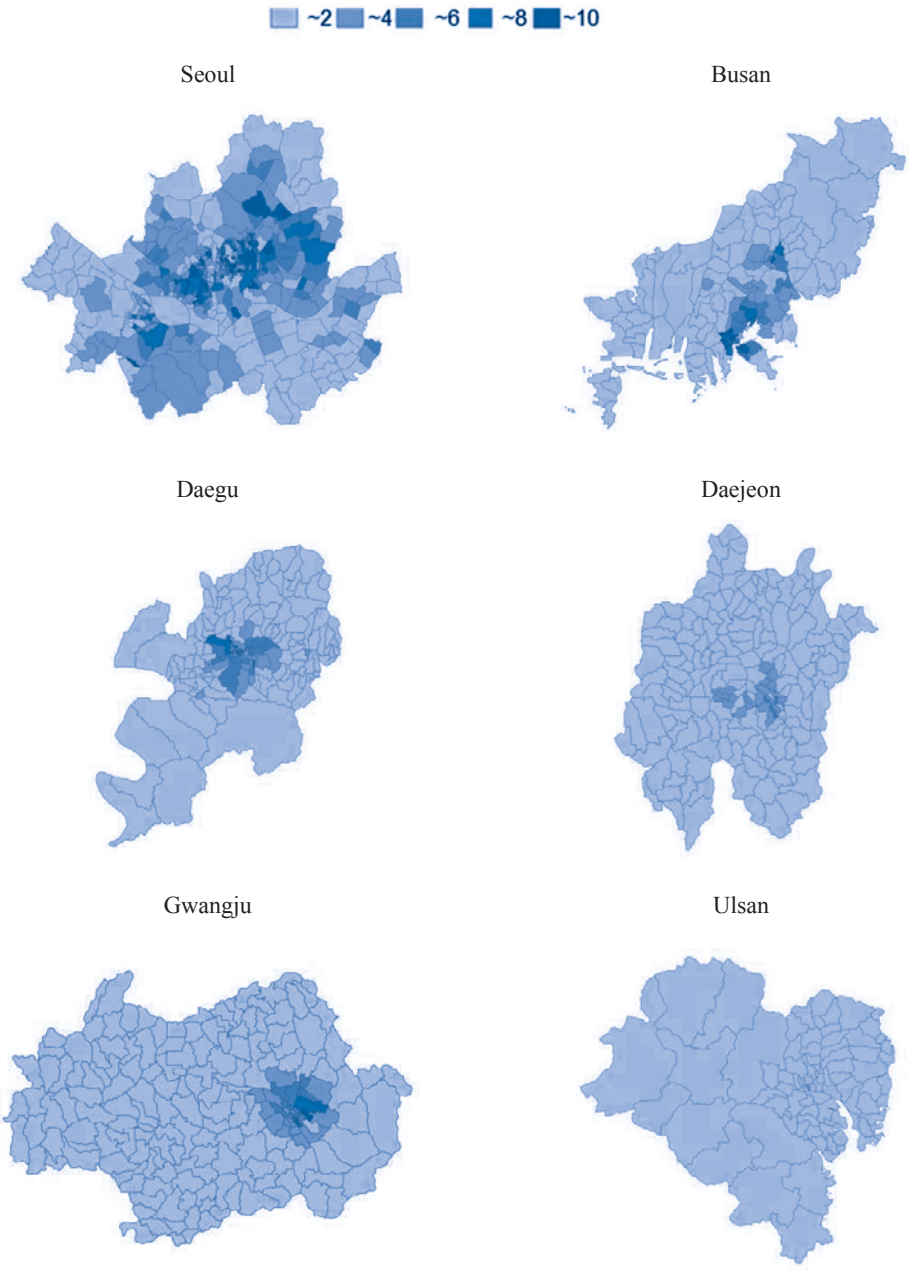
Source: Own elaboration based on Ministry of Land, Infrastructure and Transport (2013), "2012 Urban Statistics", Sejong, Korea, www.city.go.kr (accessed 23 July 2013).

Different road layouts at regional level influence walkable urban forms. To obtain a picture at regional level, the total size of roads in an area is dissolved to the length and width of a road per person. The length of roads per person is calculated by dividing the total length of roads in a specific area by its population (all types of roads are included). Similarly, the width of roads per person is calculated by dividing the road area per person by the length of road per person. This offers a simple overview of how roads are formed in cities. Based on this approach, Seoul and metropolitan cities have wider streets per person (0.91 metres long and 9.43 metres wide per person), while others have longer and narrower streets. Specifically, some TL4 regions in Seoul (Jung-gu at 17.35 m,

Seocho-gu at 24 m, Gangnam-gu at 18.16 m, Gangdong-gu at 19.30 m, which is about a four-lane road) have very wide roads (the dots at the upper side of Figure 1.53), while some cities in provinces have longer and narrower roads per person (diamonds shown on the bottom-right side of Figure 1.53). Many studies suggest that wide, vehicle-oriented roads reduce walkability and compromise the safety of pedestrians such as children or the elderly (Duncan et al., 2010). Mixed land-use policies might not be viable unless pedestrian-oriented roads are provided to encourage walking to nearby urban facilities.

Analysis of how roads are interconnected is helpful in evaluating street networks. While there are well-developed indicators to measure street forms relating to walkability, intersection density is one simple but feasible approach. Considered valuable in measuring accessibility and walkability (Ewing and Cervero, 2010; Duncan et al., 2010), it closely correlates with promoting more cycling, walking or use of public transport. Intersection density is defined as the number of intersections within areas of 100 m². In Seoul and six metropolitan areas, the streets tend to be well-connected, especially in urban cores. However, the southern and northern areas in Seoul differ widely (Figure 1.54). The southern area, where more cars are registered and which has wider roads, has fewer intersections, meaning bigger block sizes. The northern area, including the old urban centre, has more intersections. Busan has a similar range of intersection density, from 16.5 to 0.02 compared with Seoul (19.7 to 0.02). These two metropolitan areas are of various block sizes. In Daejeon, only the area around the railway station has relatively high intersection densities, while even the highest populated area around the city hall (as shown in the section on building form) shows a lower level of intersection densities. On the other hand, Ulsan appears to have a monotonous street form in terms of intersection density, ranging from 2.3 to 0.01.

Figure 1.54. **Intersection densities in metropolitan cities**



Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on *NGIS database* (National Geographic Information System).

While these street forms offer an overall view of conditions relating to walkability and detailed urban forms, more attention to street design, such as green areas along streets and well-connected pedestrian streets, is needed to improve walkability. One of the easiest ways for local policy makers to influence their existing urban form is through

changing the allocation of street conditions and spaces in areas that might support more urban activities (Donovan and Munro, 2013). Moreover, as the OECD argues (2012a), streets are an important element of the public space and streetscape. Better use of streets can enhance quality of life, even in high-density neighbourhoods. Diversified streets and street functions, such as prioritised pedestrian areas, could induce adjacent land uses and the development of a sense of place.

Socio-economic networks

Job density

Based on understanding land-use patterns and transport networks, social networks can reveal how cities really support people. A key to understanding social networks is job density. In this report, job density is defined as the total number of jobs in a specific area divided by the resident population of working age.[27] For instance, job density of lower than 100% in an area means that a number of people are commuting to another area, whereas people from other areas are commuting to areas where job density is higher than 100%. In fact, as many studies note, job density is closely related to commuting trip distances or mixed land uses (OECD, 2012a; Hastings, 2003). For example, higher commuting distances or lower mixed land uses (i.e. highly dominant residential areas) might generate lower job density in an area, and vice versa. In other words, higher self-reliance and well-mixed land uses can improve job density.

Firstly, the obvious gap between TL3 regions can be observed in the same way as economic disparities. Seoul records the highest level of job density (85.96%), as might be expected given the dominance of Seoul in job opportunities; 21% of total jobs in Korea, and 42% of total jobs in the Seoul Metropolitan Area. However, figures for the metropolitan cities vary widely: Ulsan (77.41%), Busan (74.69%), Gwangju (73.19%), Daejeon (67.77%), Daegu (64.73%) and Incheon (58.95%). Surprisingly, regions with the lowest job density in Korea are mostly located in the SMA. For example, among TL3 regions, Incheon and Gyeonggi-do in the SMA show lower job density (58.96% and 63.95% respectively). At TL4 level, Gwangmyeong, Euiwang, Osan and Bucheon record 55.3%, 59.1%, 65.19% and 76.28% respectively, which implies that a large portion of the working-age population are commuting to another area, mainly to Seoul (85.95%, the highest among TL3 regions). These cities are dominated by residential areas in the new town developments. Gwangyang, however, a small city of 137 100 inhabitants in 2010, and Naju (77 825 inhabitants in 2010) are at the highest level of job density.[28] These two cities have been encouraged to develop industrial complexes in the cities to attract employees. Particularly in the case of Gwangyang, this is because one of the biggest steel producers/companies in Korea is located there, which contributes to creating job opportunities in the area. This reveals the potential for extreme cases of some cities in a metropolitan area with low job opportunities and other cities within a province with high job opportunities.

Table 1.4. **Job density of TL4 regions (in nine provinces)**

In %

Lowest region			Highest region		
TL3	TL4	Job density	TL3	TL4	Job density
Gyeonggi-do	Dongducheon	78.6	Jeollanam-do	Gwangyang	116.4
	Bucheon	76.3		Naju	125.2
	Yongin	75.7	Jeollabuk-do	Gimje	117.2
	Goyang	73.1	Chungcheongnam-do	Asan	113.9
	Gunpo	68.6		Nonsan	111.5
	Euijeongbu	68.0		Gumi	111.7
	Namyangju	65.6	Gyeongsangbuk-do	Yeongcheon	117.2
	Osan	65.2	Gyeonggi-do	Gwacheon	117.5
	Euiwang	59.1		Hwaseong	2 128.2
	Gwangmyeong	55.4		Pocheon	142.5

Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistics Information, www.kosis.kr (accessed January 2013).

This result underscores the importance of land-use patterns, transport networks and social networks. While lower job density can be caused by diverse factors, if an area with lower job density has rigid land-use zoning that only supports residential areas, the land-use pattern can be a bottleneck to improving job opportunities in the area. Similarly, if an area with lower job density has relatively low accessibility to public transport, it can be isolated and find it hard to compete. Examining these diverse components of urban forms together offers a direction for maximising the growth potential in regions, as noted in earlier in this chapter.

Local service accessibility

Accessibility to local services is frequently mentioned as a crucial factor in enhancing quality of life (OECD, 2012a). In this section, accessibility to local services is examined by using the Matching Index (MI), which compares the volume of local services available in a neighbourhood and its population (Box 1.10). Good accessibility to local services implies that residents can benefit from shorter travel distances, and thus higher quality of life, which are the key objectives of compact city policies. Moreover, as a mismatch can occur in different situations (for example, a high level of mismatch can be observed both in strictly zoned residential areas with few local services and in central business districts with low population), a careful approach based on the local context is needed.

As might be expected, local services tend to show a large mismatch in the SMA, and especially in some of urban centres and hinterlands at neighbourhood level (Figure 1.55). For instance, Paris (MI of 0.12), Melbourne (MI of 0.16) and Vancouver (MI of 0.13) have a better match than Seoul-Incheon (MI of 0.23). Similarly, among Korean cities, Seoul (MI of 0.30) also shows higher mismatch than other metropolitan cities, such as Busan (MI of 0.15), Daegu (0.11), Incheon (0.09) and Daejeon (0.08).[29] A detailed observation at neighbourhood level in Seoul clarifies the diverse form of local services within a metropolitan area. For example, the southeast area (e.g. Gangnam-gu, MI of 0.069) and the old central business district (e.g. Jung-gu, MI of 0.04) in Seoul-Incheon has a larger share of the local services relative to that of the population, while the hinterlands and western area, including Bucheon, Suwon and Goyang, which are highly dense residential areas, have fewer local services relative to the population (Figure 1.56).

Box 1.10. **Methodology used to indicate a match between local services and homes**

The Matching Index (MI) was designed to examine the match between local service sector employees and population in a metropolitan area. The formula of MI is as follows:

$MI = \frac{1}{2} \Sigma \{ |(Ei / E) - (Pi / P)| \}$

Ei represents the number of employees in the local service sectors in TL5 region *i* in a given metropolitan area; *Pi* is the population in the TL5 region *i*; *E* is the total number of employees in the local service sectors in the given metropolitan area; and *P* is the total population in the metropolitan area. Simply, MI is calculated by aggregating the absolute value of the match in each TL5 region. Therefore, if the value of MI is closer to 0, it represents a better match, and in the opposite, if it is equal to 1, it means a complete mismatch.

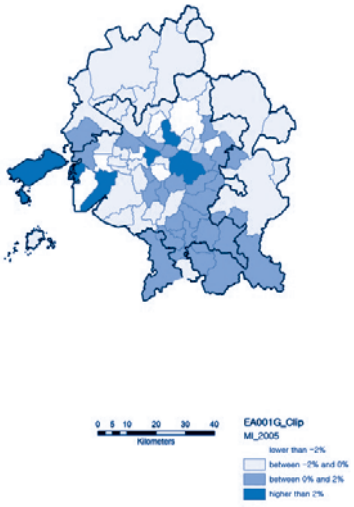
To define the local service sectors, the International Standard Industrial Classification (ISIC) was used here. Five sectors were selected: 46 (wholesale trade, except motor vehicles and motorcycles), 47 (retail trade, except motor vehicles and motorcycles), 56 (food and beverage service activities), 85 (education), 96 (other personal service activities). While the analysis is based on this classification, the relevant industrial classification codes of the country were selected to identify the number of employees in the local service sectors, since industrial classifications vary with countries and sometimes do not correspond to the ISIC categories. The employee data must also be interpreted carefully, as it can be biased if the analysis includes some employees who do not serve local residents.

Sources: OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en; Ewing, R., R. Pendall and D. Chen (2002), "Measuring sprawl and its impact", Vol. I, Smart Growth America, www.smartgrowthamerica.org/documents/MeasuringSprawlTechnical.pdf.

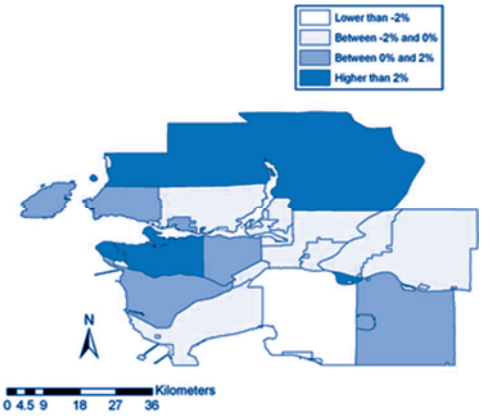
Figure 1.55. **Matching local services and homes in the Seoul-Incheon and Vancouver metropolitan areas**

(Ei / E – Pi / P) by municipality/district

(1) Seoul-Incheon



(2) Vancouver



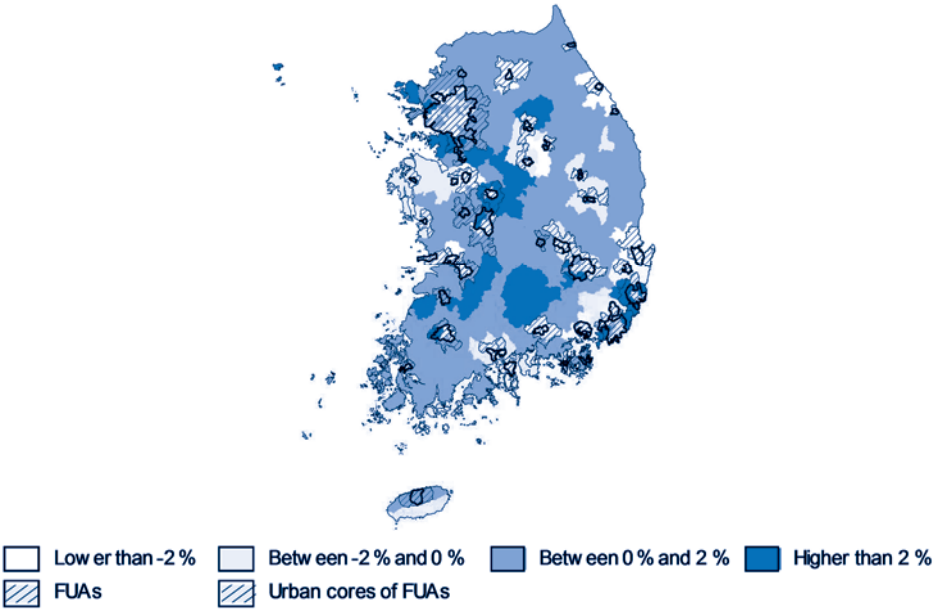
Notes: 1. Matching Index (MI) is used to analyse the local service sector (OECD, 2012a). The MI is defined as follows: $MI = \frac{1}{2} \Sigma \{ |(Ei / E) - (Pi / P)| \}$, Further information can be found in OECD (2012a). 2. The MI of local services for other metropolitan areas will be developed. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Service, www.kosis.kr.

Specifically, as the Matching Index of local services is based on the number of employees in service sectors, it is expected to have a strong relationship to job density. Bucheon and Goyang are the representative examples, as they have the lowest level of job density as well as low accessibility to local services.

Local services for the elderly have greatly increased over decades, but it is not clear whether they have been allocated appropriately. The number of facilities for the elderly has increased dramatically, reflecting the ageing trend, from 250 facilities in 2000 to 4 469 facilities in 2011 (Korean Statistical Information Service, 2013). However, Figure 1.56 shows that service facilities for the elderly tend to be located outside metropolitan areas. In line with the mobility issues discussed in the first section of this chapter, the distance to facilities may prove inconvenient for the elderly.

Figure 1.56. **Distribution of elderly facilities in Korea**



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Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistics Information System, www.kosis.kr.

Housing affordability

Housing affordability is another fundamental indicator of quality of life in cities. While various instruments have been developed to measure it (Box 1.11), the Housing Affordability Index (HAI) used by Korea Housing Finance Cooperation will be introduced here. However, given that the interaction of housing policies, land use and transport is difficult to assess, further ways to evaluate it could furnish more concrete evidence at a more granular level for setting urban policy.

Housing affordability varies noticeably among the different regions. The SMA's housing affordability is significantly higher than in the rest of the country (Figure 1.57), and Seoul's HAI is more than double that of other metropolitan areas. For the period 2004-12, its average rate was 141.29, whilst those of Daejeon, Gwangju and non-metropolitan cities were 60.53, 39.41 and 44.51 respectively.

Box 1.11. **Measuring housing affordability**

One of the indexes associated with affordability is the Housing Affordability Index (HAI). The HAI represents the ability to repay a mortgage loan based on household income and housing price, using the formula: median family income/necessary qualifying income x 100 (baseline 100). In other words, the HAI measures capacity to carry mortgage payments with monthly income by comparison with a median household income that can afford to buy a median priced house through a mortgage loan under standard conditions.

No institution in Korea officially publishes HAI statistics at present. The Bank of Korea (BOK) and the Korea Housing Finance Corporation mainly use the HAI, but there is a discrepancy between the affordability indexes presented by each institution, owing to differences in data collection and the formula used. The HAI measured by the BOK is included in a report entitled "The situation and development direction of the housing finance" published by the Bank of Korea's Research Department on 16 July 2007. It calculates the HAI based on the formula suggested in a study entitled "Housing Affordability Index in Korea (August, 2006)" from the Housing and Urban Research Institute under the Korea Housing Corporation.

According to the HAIs calculated by the BOK, the index for the Seoul Metropolitan Area fell from 114.4 in late 2005 to 101.2 in late 2006, and again to 85.9 in late March 2007. This was the first time in seven years since 2000 (88.8) that the HAI for Seoul declined below 100. The nationwide figure, which had reached 175.8, also fell to 160.7 in late 2006 and again to 139.8 in late March 2007.

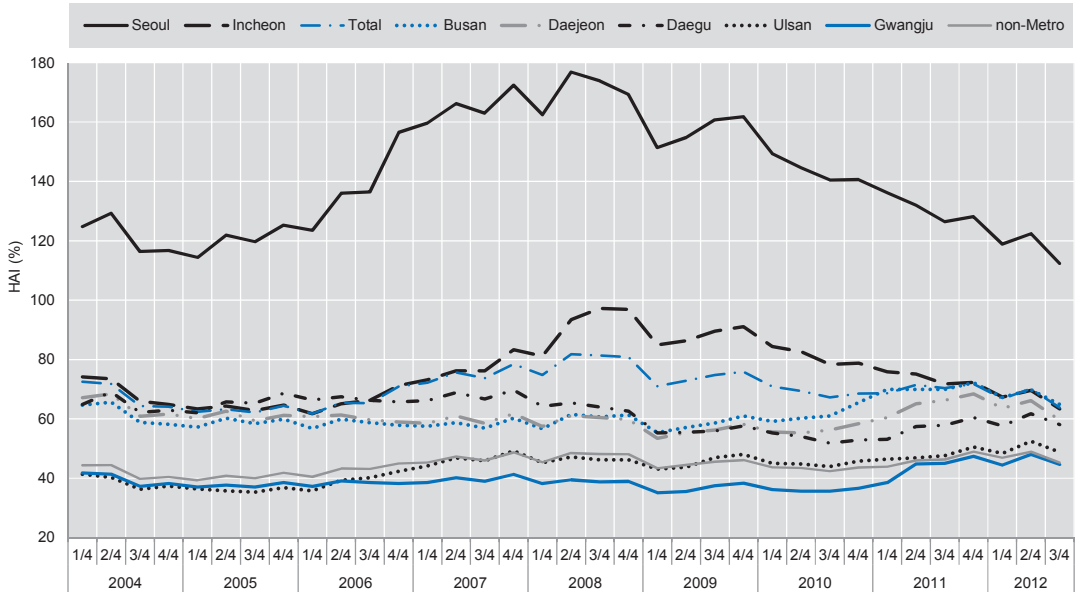
By contrast, the HAIs computed by the Korea Housing Finance Corporation reached a record high in 2008 and then started to decline. The indexes were below 100 in every city except the Seoul and Gyeonggi area. An HAI of more than 100 means that a median-income household can afford to buy a median priced house using a mortgage.

Source: Jeong, Y. and J. Lee (2013), "A study on the current status and prospects of compact city policy in Korea", Korea Research Institute for Human Settlements, Anyang, Korea.

Social mix

In the past decade, the issues of social mix and social cohesion have been widely discussed. The concept of social mix chiefly concerns who lives where (Bacqué et al., 2011). The relationship between physical form and social mix has occupied an important place on urban policy agendas (Kempen, 2008), including Korea's. Kim and Kim (2013) demonstrate that a neighbourhood's social mix helps to enhance individual social capital. Measuring the social mix, however, presents a challenge. It is often discussed in the context of mixed land use, from the perspective of mixing people of diverse socio-economic status in a given space (Box 1.12). Although the racial and income mix are often used to examine social mix, education mix (EM) and age mix (AM) are more useful distinctions for social mix conditions in Korea, based on data availability and social context. These are calculated by adapting the standardised Entropy Index[30] of three different groups: primary, secondary and tertiary educational level; under 15, between 15-65 years old and over 65 years old, respectively. An analysis has been conducted at TL4 level for EM and at TL5 level for AM based on the available data, while social cohesion is almost always used as a concept of relevance at the level of the urban neighbourhood (Kempen, 2008). This must be carefully interpreted in the context of urban policy.

Figure 1.57. **Housing Affordability Index of TL3 regions**



Source: Jeong, Y. and J. Lee (2013), "A study on the current status and prospects of compact city policy in Korea", Korea Research Institute for Human Settlements, Anyang, Korea.

Box 1.12. **Measuring social mix**

The term social mix is often used in conjunction with other terms used in social policy, such as social exclusion, social inclusion, social polarisation and social diversity, and it may be helpful to distinguish them.

The concepts all link to place. A country and/or nation state, sub-national jurisdictions (in Australia, the states and territories), regions, cities, towns and neighbourhoods can be the spatial units. Recognition of socio-economic inequalities across places has led to the notion of locational disadvantage, which underlines a geographic inequality. In social policy, this is not a new idea. The Western Sydney Area Assistance Scheme, for example, was designed to compensate for social disadvantages in Sydney in 1979.

A new focus on locational disadvantage in the late 1990s and early 2000s concerned the economic and social changes related to globalisation and "neo-liberalism". This concerns spatial inequality of employment; some places have opportunities in the new global economic environment, whereas other places do not. In response to this issue, governments have developed regional-based programmes, in particular targeting rural areas that have not benefitted from deregulation and "problem suburbs" in cities.

A lively debate surrounds the question and practices involved in diversity with social inclusion, although the discourses of diversity and Blairite social inclusion do not necessarily share the same economic perspective. The government of New South Wales' communitybuilders website, for example, refers to "inclusive communities" building on empowerment, reconciliation, cultural diversity, access and equity, equal opportunity and involving minority groups. Both concepts include a social-democratic understanding of "social citizenship" that highlights economic and political participation. This has been used to improve the circumstances of particular groups, such as people with disabilities, since the early 1990s.

Box 1.12. **Measuring social mix** (*cont.*)

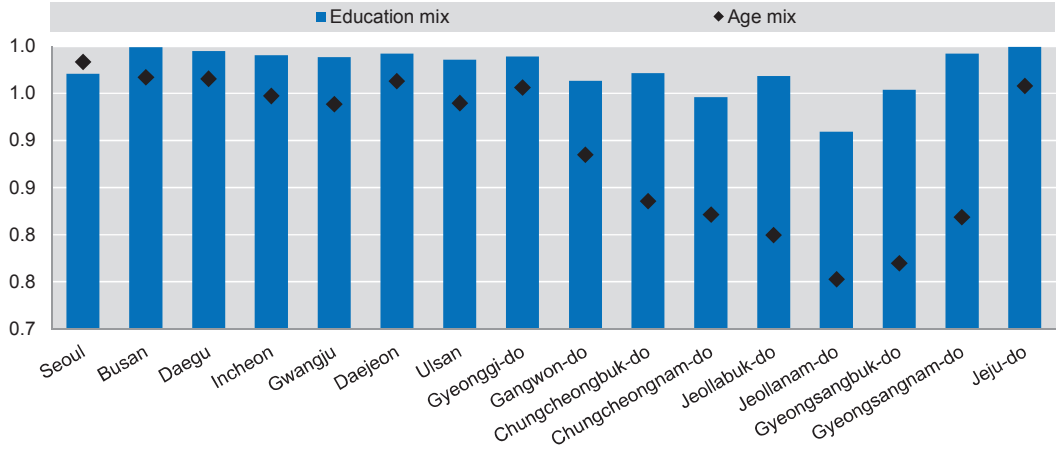
The term social mix, or socio-economic mix, can refer to a blend of people of different social classes or socio-economic status; social categories such as ethnicity and disability; stages in life cycle, e.g. younger, older; or household or family types in a given space (country, region, city, neighbourhood and subsidised housing).

The term is most commonly used to refer to people of diverse social classes or socio-economic status. In the United States, for example, Schill and Wachter (1995); Nyden, Maly and Lukehart. (1997), and Pendall (2000), suggest that the concentration of African-Americans among the poor implies that any discussion of socio-economic mix must be integrally related to discussion of racial integration.

Source: Johnston, C. (2002), "Housing policy and social mix: An exploratory paper", Shelter New South Wales.

Interestingly, distribution of different educational and age groups across regions are different across TL3 regions (Figure 1.58). For example, Jeollanam-do records the lowest AM (0.75) among metropolitan areas, owing to the dominant share of the elderly, and also has the lowest EM level (0.90). Gaps in education mix tend to be less than in age mix. This may be due to Korea's unprecedented progress in tertiary education attainment among OECD countries (Figure 1.59). This should be carefully evaluated, however, because lower EM does not necessarily entail a low educational level.

Figure 1.58. **Education mix and age mix in TL3 regions**

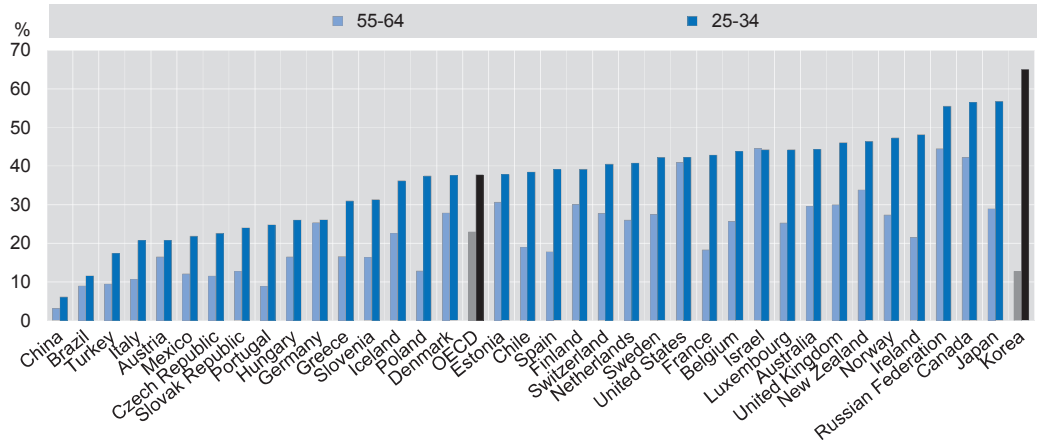


Note: The share of population with primary, secondary and tertiary level of education at national level (12.25%; 46.40%; 41.35%) is assumed as the equilibrium (33%; 33%; 33%) of education mix. For example, an area of a composition similar to the national one has a value closer to 1, whereas an area with either a greater share of less-educated (primary education) residents or more educated (tertiary education) than the national level has a value closer to 0. In the case of age mix, the shares of population aged less than 15, 15-65 and over 65 at national level are 16.23%, 72.47% and 11.30% respectively, which is used as the equilibrium level.

Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Service, www.kosis.kr.

Figure 1.59. **Population attaining tertiary education**

Percentage, 2010 or latest available year



Source: OECD (2013b), *OECD Factbook 2013: Economic, Environmental and Social Statistics*, OECD Publishing, Paris, http://dx.doi.org/10.1787/factbook-2013-en.

Notes

1. A detailed definition of urban form is given later in this chapter.
2. Please note that Seoul-Incheon is not an administrative unit. The combined territory was identified by applying the new OECD methodology used to define functional urban areas.
3. OECD Regional Typology classifies Territorial Levels based on criteria of population density and the size of urban centre located within the region. Please visit http://www.oecd.org/gov/regional-policy/OECD_regional_typology_Nov2012.pdf for more information.
4. This classification follows the terminology proposed by the OECD (2012c). In particular, the 75% threshold has been selected in line with the European Commission's methodology.
5. For the purpose of analysis, cities are grouped according to their GDP per capita and GDP growth rates between 2005 and 2009. This approach makes it possible to identify commonalities across cities at similar stages of development. This methodology is based on the OECD report *Promoting Growth of All Regions* (OECD, 2012d).
6. The urban areas here are based not on the administrative categories or the functional urban areas defined by the OECD, but one of four use areas (urban area, administrative area, agricultural area, conservative national-environment area), designated in the National Land Planning and Utilisation Act.

7. To determine the share of people who walk regularly, the rate of walking is defined as the share of people who walk for more than 30 minutes per day more than 5 days a week.

8. The breakdown of energy consumption by region shows the importance of the contribution of the industrial sector in some cities, especially medium-sized cities. According to the Ministry of Knowledge Economy (2009), with the exception of the metropolitan area of Ulsan, provinces that have medium-sized cities, including the provinces of Jeollanam-do, Gyeonggi-do, Gyeongsangbuk-do and Chungcheongnam-do, recorded the highest levels of energy consumption. These medium-sized cities are the largest cities in these regions and are the sites for energy-intensive industries such as electricity generation facilities, petroleum refineries, oil and gas industries, steel mills and chemical industries. For instance, per capita energy consumption in metropolitan cities and provinces (in TOE) is as follows: Seoul (1.54), Busan (1.95), Daeju (1.71), Incheon (3.63), Gwangju (1.49), Daejeon (1.69), Ulsan (19.26), Gyeonggi-do (2.11), Gangwon-do (4.69), Chungcheongbuk-do (4), Chungcheongnam-do (10.07), Jeollabuk-do (2.66), Jeollanam-do (19.09), Gyeongsangbuk-do (6.76), Gyeongsannma-do (2.4), and Jeju (1.61).

9. These are functional urban areas as defined by the OECD methodology, which do not correspond exactly with administrative units.

10. If the forest area is excluded from the urban area, the rate of impervious surfaces is even higher than 85%.

11. For example, the EU vision is based on maintaining the quality of urban life, urban planning and sustainable development, where mixed uses, high densities and good environmental conditions are seen as being central to improving both the economic performance and the vitality of cities (OECD/ECMT, 2007).

12. "Free marketeers" refers to opponents of controls on urban expansion (such as greenbelts in several OECD countries). They tend to assume that these policy interventions raise land prices and stall economic growth. "Smart growthers" argue that uncontrolled urban expansion has negative external effects, such as traffic congestion, a lack of green space, etc. (OECD/ECMT, 2007).

13. Urban land uses here are categorised as "use areas" in Korea. These are divided into four categories: urban area, administrative areas, agricultural areas and environmental conservation areas.

14. The Seoul Metropolitan Area (SMA), Korea's capital region, includes the city of Seoul and 32 surrounding municipalities. It is often treated as one region for a number of urban policies by the national government.

15. In fact, it could be argued that Busan's decrease in population density resulted from a decline in traditional industries such as shoes and rubber. The physical expansion of Busan might also be part of this trend.

16. Here the unit of analysis is the administrative unit, due to data availability. The administrative border of each metropolitan city, however, more or less covers the urban core of the metropolitan area defined by the OECD. Notably, the Seoul-Incheon Metropolitan Area covers the administrative borders of Seoul, Incheon and some parts of Gyeonggi-do.

17. This result is calculated using GIS, based on LandScan *Global Population Database* 2009.

18. More illustrations about the density structure of these metropolitan areas can be found in OECD (2012a).

19. This should not be interpreted as an ideal level of mixed land use. More specifically, lack of vertical mixed land use is often seen to impede overall mixed land use in Korea (see Chapter 2).

20. The international minimum standard set by WHO of 9 m² of open space per city dweller (Food and Agriculture Organization, 1992).

21. Parking lots consist of off-street parking lots, on-street parking lots and indoor parking lots.

23. The Gangnam district is a major commercial district and one of the densest areas in Korea.

24. Minimum standards for residential accommodation, as minimum standards for a life worthy of human dignity, were issued in October 2000 as Public Notice No. 2000-260 of the Ministry of Construction and Transport and were ratified when the Housing Act was amended in July 2000. A revision of minimum standards for residential accommodation was publicly announced in June 2004. The minimum standards for residential accommodation consist of a minimum residential area for each household; number of rooms by usage; standards for essential installation; and standards for housing structure, performance and environment.

25. This trend is not limited to Korean cities. In American cities and the Netherlands, the floor space of the average home has doubled in size in the last 20 years (OECD, 2012b).

26. While the annual increase in housing was 2.78% from 1995 to 2010, the increase for houses of over 100 m² is 5.57% (Korea Statistics Office, 2013).

27. Technically, the number of jobs in a specific area consists of jobs filled by residents and commuters from outside the area. The resident population of working age includes residents who work in the area, those who commute out of the area and those of working age who are economically inactive or unemployed.

28. It should be noted that this comparison covers TL4 regions in only nine *do* (provinces), due to data availability.

29. These numbers will be modified according to FUA units in the next step.

30. For the detailed formula, please refer to Box 1.10.

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Chapter 2

Compact city policy in Korea

This chapter diagnoses the current Korean policies and makes recommendations for further improvement. The first part reviews Korean urban policies in view of compact city policies. Compact city policies have been imbedded implicitly to a certain degree in several urban development policies or projects such as urban regeneration, new town development, the establishment of multi-modal transfer centres, greenbelt zoning and happy/bogeunjari housings. The second part produces policy recommendations based on the policy review from the first part of the chapter. The recommendations are categorised into five themes: i) establishing a national policy framework based on the concept of the compact city; ii) regenerating urban centres to avoid further urban expansion; iii) enhancing the attractiveness of cities through mixed land use; iv) integrating land-use policy with transport policy through transit-oriented development strategies; and v) improving multi-level governance to achieve the goals of compact cities.

Chapter 1 analysed Korean cities from the view of urban forms, and in particular, their "compactness". Overall, Korean cities have been developed in a physically compact way, without adequate consideration of urban amenities, including walkability, public transport, socio-economic networks and environmental sustainability. The process of rapid urbanisation has tended to neglect the provision of green spaces in cities, while prioritising economic growth. Furthermore, a study of urban forms reveals different priorities across and within cities. It also highlights the importance of a place-based policy, which can be established by examining each city's growth and bottlenecks at different levels. For example, small and medium-sized cities are suffering from a lack of adequate transport networks, while the Seoul Metropolitan Area needs better urban management policies to maintain its economic performance, by encouraging a balanced approach to the compact city and urban sustainability.

Compact city policies are comprehensive sets of policies intended to enhance urban sustainability by creating a better urban form. Korea's urban policy makers should consider such policies to enhance the country's urban competitiveness. The concept can offer Korea an opportunity for economic, environmental and social benefits, given the right policy initiatives. This chapter will assess compact city policies in Korean cities and how they could help contribute to urban sustainability.

Overview of Korean compact city policies

Adapting compact city policies to Korea's cities has been recommended in several government documents as a key policy action for achieving sustainability in urban areas (Box 2.1). In 2013, the new administration announced a new paradigm for land development (Box 2.2) that has much in common with the concept of the compact city. Although the creation of the compact city has not often been invoked as an explicit goal of long-term urban policy, some relevant projects can be found, including transport-oriented development (TOD), high-density development and provision of affordable housing near railway stations.

Several new town projects in suburban areas suggest the concept of the compact city. Dongtan 2 New Town[1] is often considered an example of Korean compact city development, with Sejong City and Songdo New City (Table 2.1). The Master Plan for the Dongtan 2 New Town development notes that the central business district will be developed with a high floor area ratio (FAR), unlike normal low-density suburban areas. The Master Plan aims to encourage mixed land use and provide as much green space as possible, while proposing seven specific zones: a community district, metropolitan business district, culture design valley district, techno-valley district, waterfront centre district, new residential culture town district and a medical welfare facility district. In particular, the metropolitan business district, which covers 1.5 km² and accommodates 7 000 households, best illustrates mixed land use. The development concepts for the metropolitan business district includes: the Business Core City and TOD Compact City. This makes this district an economic hub in the southern Seoul Metropolitan Area (SMA), by establishing infrastructure to attract high-tech industry and business. Moreover, the government plans to establish a high-density, multi-use complex around the Korea Train eXpress (KTX) station, a regional transport node, and build multi-family housing and commercial uses, based on accessibility to the new transport node. Some doubt remains as to whether it can attract the expected number of business enterprises, and there is concern that this new development may increase segregation between Hwaesong's eastern and western areas.

Box 2.1. **Korean government policy and the concept of the compact city**

Korea's goal in invoking the compact city is to enhance urban regeneration. In a context where new towns have been built very rapidly, the aim is to create an urban environment with easy access to transport, by promoting the mixed use of land. A secondary goal is to promote a sustainable urban environment, by restoring urban areas and conservation of the natural ecosystem, developing energy-saving urban facilities and housing, providing low carbon/ energy-saving housing construction, and using renewable energies. In growing cities, high-density development is encouraged, depending on the location, with the intent to prevent inefficiencies in densely populated areas. Under-utilised brownfields and other sites in existing districts, for example, are cited as a first priority of development. In underused public transport nodal points (i.e. railway stations) in urban centres, where population is either stagnant or declining, land use should either be mixed or refocused on multiple public facilities. In metropolitan areas, population and industry must "dispersively and intensively develop" to achieve a good balance of jobs and housing between the urban centre and its surrounding cities (Ministry of Land, Transport and Maritime Affairs, 2011).

"Compact development" implies sustainable urban development to improve land use and enhance self-sufficiency. A sustainable urban form involves creating a pedestrian-friendly environment by promoting mixed-use development and mass transit. This requires appropriate density development within existing districts, and walkable distances. In the urban core and surrounding districts, a balance must be struck between efficient land use through mixed-use development of housing, public and commercial facilities, and compact development that respects factors such as building winds, a right to sunlight and residents' health. In peripheral areas, better access to urban cores and low-density development can be achieved through public-transit system and pedestrian-friendly urban design (Ministry of Land, Transport and Maritime Affairs, 2007).

Sources: Ministry of Land, Transport and Maritime Affairs (2011), "Second revision of the Fourth National Comprehensive Plan" (in Korean), Ministry of Land, Transport and Maritime Affairs, Gyeonggi-do, Korea; Ministry of Land, Transport and Maritime Affairs (2007), "Sustainable new town planning standard", Ministry of Land, Transport and Maritime Affairs, Gyeonggi-do, Korea.

Box 2.2. **New land development strategies in Korea**

Much emphasis has been placed on encouraging development in harmony with the environment, and reaching sustainability by integrating land and urban plans and an environmental programme. The aim is to re-establish the direction of land policy through urban regeneration rather than by expanding suburbs and to support organised land planning using the technique of spatial analysis. To this end, several guidelines have been established.

- To prevent overdevelopment and urban sprawl, the government will establish a concrete project evaluation and management system, and reinforce the link between land use and environmental planning. Considerable effort will be spent on preventing urban sprawl as far as possible, while introducing growth management instruments and strengthening standards for development permits in order to better manage development.
- Design of new development should respect green space, and urban regeneration must make use of existing social and physical assets. In areas targeted for urban regeneration, the central and local governments will designate an urban regeneration area for intensive government-led investment.

Source: 18th Presidential Transition Committee of Korea (2013), "Key policy initiatives of the new administration", 18th Presidential Transit Committee of Korea, Seoul.

Table 2.1. **Projects for achieving compact development goals in Korea**

		Dongtan 2 New Town	Songdo New City	Sejong City
Development concept		Compact city: high-density civic business district with maximised floor area ratio, but low-density eco-suburban areas	Compact Smart City: an autonomous city with high density, high efficiency and self-sufficiency	Transport-oriented compact city: self-sufficient, multi-functional administrative new city that is environmentally friendly
Construction schedule		2008-15	1989-20	2005-30
Main feature	Location	Hwaseong	Incheon	Sejong
	Area	24 015 000 m²	30 720 000 m²	72 900 000 m²
	Target population	278 000 residents 111 000 houses	252 500 residents 63 125 houses	500 000 residents 200 000 houses
Key characteristics		– Aims to become a self-sufficient city – The biggest of the second-generation new towns in Korea	– New commercial hub in northeast Asia – International multi-complex: residential complexes, a university and the Songdo International Business District (IBD) – Supportive infrastructure provides high-quality hotels, schools, technology infrastructure and convention centres	– Four planning levels: metropolitan urban plan, construction plan, development plan, district unit plan – Relocating organisations: 36 organisations in 600 000 m² – Polycentric and ring spatial form

Source: Own elaboration based on Jeong, Y. and J. Lee (2013)[2], "A study on the current status and prospects of compact city policy in Korea", Korea Research Institute for Human Settlements, Anyang, Korea.

Other urban development projects that apply the concept of the compact city are Multi-Modal Transfer Centre (MMTC) projects aiming to promote TOD. According to the Five-Year Multi-Modal Transfer Centre Development Master Plan (2011-2015), three types of MMTC are suggested; *i)* national-based MMTC built on high-speed railway stations and large train stations; *ii)* regional-based MMTC built on railroad and subway stations to deal with regional traffic; and *iii*) local-sized MMTC built on subway stations to meet inner-city traffic demands. The common feature of each type is to utilise transit nodes as regional anchors to reduce the consumption of energy for travel and to activate local economies. However, comprehensive policy tools must still be developed, for instance elaborating traffic demand management strategies to reduce traffic congestion, environmental degradation and energy consumption, and preventing physical development.

Several land-use regulations have been introduced to prevent urban sprawl. Seoul established greenbelts in 1971, and was followed by 13 other cities aiming to stop rapid urban expansion and preserve green space. However, greenbelt policies encouraged leapfrog development, which resulted in deregulation of some greenbelt areas in seven metropolitan cities. In seven medium to small cities with little or no attempt to respect the greenbelt zone, the entire zone was demolished (Table 2.2). After this deregulation, interest developed in elaborating policy tools to prevent uncontrolled development in deregulated areas.[3] Land-use zoning has been reformed to prevent urban sprawl, introducing several impact fees.[4] A recent reform of zoning policies integrated quasi-agricultural and quasi-urban areas around suburban areas into "management areas" in 2003. The aim was to prevent urban sprawl and deregulate areas under development pressure. This reform has been less effective than expected, because many local authorities have interpreted management areas as "developable" and authorised

development projects there.[5] As a result, the government has developed a new growth management strategy, including a new type of land-use zoning policy.

Table 2.2. **Greenbelt areas by region, 1979-2020 (km^2)**

	1979	2009	2020
Nationwide	5 397	3 925	3 629
Seven metropolitan areas	4 294	3 925	3 629
Seoul Metropolitan Area	1 566	1 453	1 318
Seoul	167	154	152
Incheon	96	91	87
Gyeonggi-do	1 302	1 208	1 152
Seven small and medium-sized cities	1 103	0	0

Source: OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Recent urban policy has focused on urban revitalisation and transforming outdated and underdeveloped city hubs into vibrant urban areas. This has been made possible by legislation such as the Act for the Maintenance and Improvement of Urban Areas and Dwelling Conditions for Residents, the Special Act for the Promotion of Urban Renewal, and most recently, the Framework Act on Urban Regeneration. Meanwhile, the Liveable City programme enables cities to create car-free streets with small urban streams or cultural districts. Urban policy makers should note, however, that many former urban regeneration projects have been criticised for placing too much focus on housing construction for profit, with little concern for investment in the surrounding urban area (OECD, 2012b). Such projects require an integrated strategy that includes reviving economic functions and improving the living environment.

Housing policies also reflect the concept of the compact city. In particular, the current administration is promoting the "Happy Housing" project, to supply rental housing on railroad sites. This project seeks high-density and mixed-use developments on existing built-up areas, by building inexpensive rental housing with good accessibility. This project aims to develop affordable public rental housing on government-owned, inexpensive land (such as rail station areas and unused or unsold public facility sites) in previously developed areas. In addition to public housing, this project also seeks to develop high-density and mixed-use development, including office, commercial and public uses (community centres, police substations, health centres, parks and open spaces). As a pilot project, the government recently selected seven districts (four retarding reservoir sites and three railroad sites) and announced development plans to accommodate 10 000 public households.[6] It is too early to evaluate this project, but it may not be easy to avoid conflicts with existing residents concerned about lack of schools and too much density.

As noted earlier, the concept of the compact city is embedded in several urban development projects implicitly, rather than with explicit policy objectives. It is difficult to assess whether such policy interventions have been successful, as most are in their early stages. Some challenges in realising compact city strategies in Korea can be identified by studying existing compact city policies and projects in the light of compact city strategies proposed by the OECD (2012a) (Table 2.3). The following sections will provide a series of policy recommendations to enhance compact city policies in Korea and address any challenges.

Table 2.3. **Overview of compact city policy in Korea**

	Sub-strategies	Compact city policies/projects
Set explicit compact city goal	Establish a national urban policy framework that includes compact city policies	The second revision of the Fourth National Comprehensive Plan aims to develop a comprehensive "Korean Compact City". This plan reflects the characteristics of two types of cities. In developed or developing cities, it will establish a high-density development strategy and develop under-utilised land within cities, while avoiding overcrowding. In stagnant or declining cities, it will promote multi-land use around public transport nodes and attract public facilities to the city.
	Encourage metropolitan-wide strategic planning	Metropolitan area plans are established to deal with adjacent local authorities with a common interest in spatial development and inter-regional infrastructure. Like other urban plans, however, these are developed separately from economic development and sectoral plans, leading to further fragmentation of objectives and implementation strategies.
Encourage dense and proximate development	Increase effectiveness of regulatory tools	Greenbelts have been designated to protect rapid urban expansion, in particular around Seoul, but the government plans to release greenbelt land. Regulation and deregulation issues in Korean urban policy appear to have somewhat contradictory aims: to restrict urban sprawl and to manage urban growth with systematic and detailed plans.
	Target compact urban development in greenfield areas	No explicit strategies are evident, but Bogeumjari Housing (launched in 2010) is one good example of a compact development project in a greenfield area. Under the MLTM's Bogeumjari Housing Construction Plan (2008), 1.5 million new dwellings will be provided to homeless people by 2018, in cities or the surrounding greenbelt area, rather than in new cities. To achieve compact development, the MLTM will connect facilities and land and develop a high-density city around subway and bus stations.
	Set minimum-density requirements for new development	New development often aims to enhance mixed land use and high density, but no explicit requirement for minimum density requirement was noted. Instead, the Korean government regulates maximum-density requirements for development according to its land-use regulation.
	Establish mechanisms to reconcile conflicts of interests	Each level of an urban development plan aims to increase participation from a variety of actors, including the public sector, private business and citizens. A kind of impact fee has been imposed on developers to provide infrastructure, but a mismatch between housing and infrastructure exists.
	Strengthen urban-rural linkage	Several policy measures have been conducted in an effort to improve urban-rural linkages. In 1994, the Korean government introduced a new administrative unit, the "urban-rural integration city", which consolidates small or medium-sized cities with surrounding rural areas to generate economies of scale and minimise urban-rural disparities. "Soft" initiatives such as rural tourism and developing renewable energies are evident. It is not clear, however, how policy measures conducted by different authorities will be co-ordinated.

Table 2.3. **Overview of compact city policy in Korea** (*cont.*)

	Sub-strategies	Compact city policies/projects
Retrofit existing built-up areas	Promote brownfield development	Most brownfield developments have been conducted with urban regeneration projects, but too much focus on physical development.
	Harmonise industrial policies with compact city policies	This is likely to be achieved by regenerating old industrial sites and instituting mixed land use. Several projects embody this concept, including the Seoul Digital Industrial Complex, which has been transformed from an old industrial site to one of the largest IT complexes in Korea, with high-rise apartment factories and housing in the neighbourhood.
	Regenerate existing residential areas	Korea has been pursuing urban regeneration projects in lagging cities and districts. Several concerns have been noted, including a focus on the construction of residential areas and weak participation of the public sector. In response, to follow the policy recommendations of the OECD (2012b), urban regeneration policies are being streamlined to improve the planning process, for instance, by integrating all critical factors related to urban regeneration into a single comprehensive plan. The new Urban Renaissance Law to support this will be enacted soon.
	Promote transit-oriented development in built-up areas	The Multi-Modal Transfer Centre (MMTC) is a typical project for promoting transit-oriented development in Korea. Ten will be constructed in or around railway stations, aiming at mixed land use and high-density areas. Several issues remain, such as business models and financing. A strategic plan to consolidate existing development projects and attract private investment is required.
	Encourage intensification of existing urban assets	No specific policy tools could be found, but this is likely to be achieved by ongoing urban regeneration projects.
Enhance diversity and quality of life	Promote mixed land use	The Korean government has introduced a wide range of policies to enhance mixed land use through deregulating land-use regulation or creating new regulation. However, most high-rise residential apartments with stores or offices on the ground floor, a typical kind of mixed land use in Korea, were located in residential areas or semi-residential areas around suburbs. This hardly seems to satisfy the original objectives of mixed land use, such as reducing journey-to-work distance. In addition, rising prices generally influence the overall price of the surrounding real estate.
	Improve the match between residents and jobs	A situation similar to that of mixed land use policy is noted.
	Encourage focused investment in public space and foster a "sense of place"	Korea, with its unusually high rate of urbanisation and high-density development, has attempted to improve public space policy. However, it remains a question whether the outdoor spaces provided for new residential areas are too numerous and too large, and lack what is essential to encourage city life there. Concerns have grown that public space will continue to shrink while causing every kind of outdoor activity in city space negatively impacted by noise, pollution and insecurity. Policies to improve public space were pushed back on the priority list as housing supply was made a priority. Improving the management of public space allocation has been a challenge to Korean urban policy makers.
	Promote a walking and cycling environment	The Korea Green Growth Strategy committed to expanding pedestrian and bicycle infrastructure, through the development of pedestrian priority districts and the construction of 3 114 kilometres of bicycle lanes by 2018. It is not clear, however, how they will be well incorporated into the existing urban structure.

Table 2.3. **Overview of compact city policy in Korea** (*cont.*)

	Sub-strategies	Compact city policies/projects
Minimise adverse negative effects	Counteract traffic congestion	Improvements to the transport network have been highlighted as a way of reducing traffic congestion. They are believed to encourage ridership on public transport, as well as cycling and walking, which can in turn lead to reductions in greenhouse gas emissions. Improvements to the public transport system are planned to increase the share of public transport to 55% of total transport activity by 2013. The expansion of the high-speed train system and constructing bike lanes are examples of the flagship transport projects in Korea. Winning public support and persuading residents to change their preferred modes of travel nevertheless remains a challenge.
	Encourage the provision of affordable housing	Korea provides several types of rental housing. The National Rental Housing programme provides rental housing with deposit money for newlywed couples, teenage-supported families and the elderly. In addition, Purchased Tenant Rental Housing focuses on rental of existing housing to support occupants in insolvent rental housing, public rental housing and permanent rental housing. The Korea Land and Housing Corporation, a public organisation, manages this on behalf of the national government. However, soaring housing prices still threaten a stable supply of affordable housing.
	Promote high-quality urban design to lower "perceived" density	Recently, Korea has been more interested in diversifying and improving its urban landscape. Most Korean cities are losing their appeal, given that their urban landscapes are typically dominated by high-rise apartments. Enhancing the cultural identity of each city and incorporating this into urban planning is a dilemma for Korean planners. It is difficult to identify whether this effort is explicitly considering a new urban design or is intended to mitigate "perceived" density.
	Encourage the greening of built-up areas	Greening infrastructure is an essential pillar of the Korean Green Growth Strategy. Policy actions to green built-up areas are concentrated in the building and transport sectors, which are responsible for high levels of energy intensity and greenhouse gas emissions. Further introducing diverse policy tools, such as expanding price mechanisms, will help enhance policy effectiveness.

Source: OECD elaboration based on Jeong, Y. and J. Lee (2013), "A study on current status and prospects of compact city policy in Korea", Korea Research Institute for Human Settlements, Anyang, Korea.

Urban liveability and sustainability through well-designed compact city policy

As can be seen in OECD (2012a), properly applied compact city policies can contribute to urban sustainability, helping urban areas to become both more liveable and more competitive. Korean urban policy makers have noted the significant implications of urban form and incorporated the concept in several new town projects. However, to optimise the sustainability of urban areas, a series of policy recommendations can be made, including: *i)* establishing a national policy framework based on the concept of the compact city; *ii)* regenerating urban centres to avoid further urban expansion; *iii)* enhancing the attractiveness of cities through mixed land use; *iv)* integrating land-use policy with transport policy through TOD strategies; and *v)* improving multi-level governance to achieve the goals of compact cities. The five recommendations are based on an examination of current compact city policies and key urban policy guidelines.

Establish a national policy framework based on the concept of the compact city

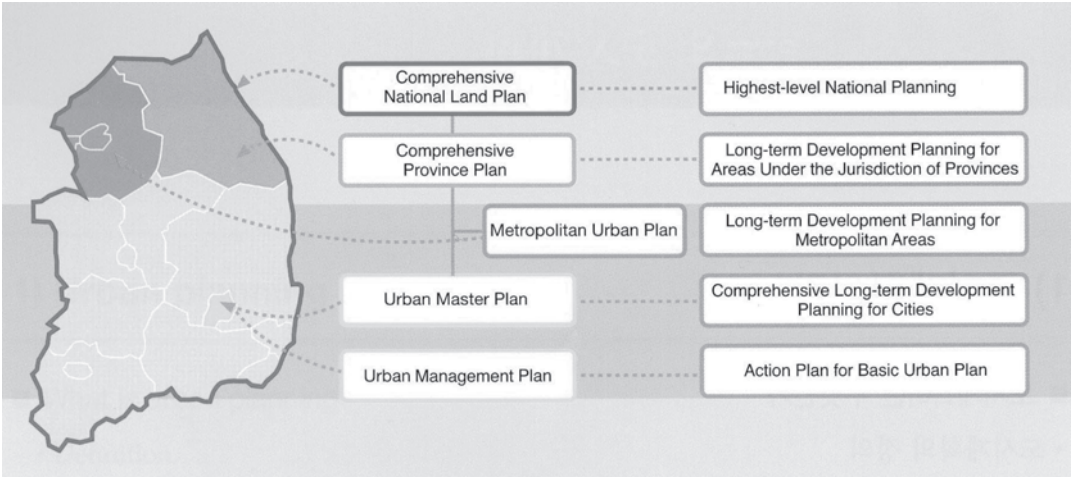
A clear understanding of the compact city is a first step. As noted in Chapter 1, previous urban policies tended to put too much emphasis on high-density development as the key element of a compact city. As a result, many high-density cities (and districts) in Korea are likely to be viewed as typical of a compact city although they do not necessarily incorporate values such as well-designed public space and environmental conservation. Although Korean cities are physically compact, they are not necessarily sustainable, nor, in many cases, do they offer the quality of place that attracts and retains the highly skilled population required by the knowledge and creative economies. A Korean compact city strategy must be move beyond physically dense or compressed development, for instance focusing on:

- formulating urban growth management strategies to prevent urban sprawl and scattered development patterns, while providing developable land in urban areas through urban redevelopment projects, and linking such developments to public transport
- regenerating older city centres to provide the kind of environment that will make the city centre a liveable place that attracts the people, knowledge and creative industries that often thrive in such areas in other cities around the world
- retrofitting existing high-rise buildings to become more sustainable and incorporating more green space into their surroundings to enhance the urban landscape
- developing a set of policies to combat the negative effects of compact development, by integrating policies such as land-use policy, transport policy and environmental policy to address potential negative impacts, such as congestion and pollution.

Compact city strategies must be designed to generate a significant synergy effect with cutting-edge urban development strategies such as the Ubiquitous City,[7] not as an alternative model. The concept of the compact city provides a milestone because such high technologies can be realised in a sustainable urban form where urban functions are well matched. Such technologies could be introduced to prevent potential negative impacts of compact city policy, including traffic congestion, heat islands and degradation of the cityscape. The compact city itself is not the final goal; rather, it must be a set of policy instruments complementary to ongoing urban policies in Korea including:

revitalising cities through urban regeneration, advancing the land-use system, establishing a pleasant and liveable city, and building an urban management system capable of disaster prevention.[8] This could be realised when the concept of the compact city is incorporated into the urban planning process: Comprehensive National Land Planning, Comprehensive Province Planning, Metropolitan Planning, Basic Urban Planning and Urban Management Planning (Figure 2.1).

Figure 2.1. **Korea's land and urban planning system**



Source: Ministry of Land, Infrastructure and Transport (2013b), *The Guidebook for Korean Urban Policy*, Ministry of Land, Infrastructure and Transport, Sejong, Korea.

Realising compact city strategies at the local city level often requires a national framework to guide such development (Box 2.3). This should provide a clear, strategic vision and help to decentralise the powers and levers cities need to drive development and growth. In addition to the existing urban planning guidelines, such as the Urban Planning Guideline for a Low-Carbon and Green City and the Sustainable New Town Planning Standard, an urban planning guideline defining the concept of the compact city and suggesting action to promote the compact city could help encourage compact city policies. Such a policy framework could include modification of land-use zoning regulations to better encourage compact city projects. For instance, the District Unit Planning for specific districts, such as urban development areas, urban redevelopment areas, housing-site creation project districts and urban natural park zones, could better encourage compact city development by introducing incentives. Such a policy framework should respect the importance of cityscape planning to maintain a balance between high density and open space, as explored in the section on building forms in Chapter 1. For instance, Aker Brygge in Oslo, Norway, has a good combination of high density, mix of functions and good city space. Groups of its high-rise buildings are not perceived as dense, because the high buildings along the street have fewer stories than those behind, and have active ground-floor facades that make street life vibrant (Gehl, 2010). Density targets set in urban planning in the City of Prince Albert, Canada, explicitly deal with density issues in the urban planning process (Box 2.4).

Box 2.3. National framework examples to guide compact city development

In May 2011, the Australian government released "Our Cities, Our Future – A National Urban Policy for a Productive, Sustainable and Livable Future". It outlines 14 objectives for Australia's major cities, including: improve labour and capital productivity; integrate land use and infrastructure; protect and sustain nature and built environments; support affordable living choices; and improve accessibility and reduce dependence on private vehicles.

France has been trying to renew its approach to urban planning to include the concept of compact cities. This policy direction was particularly stressed at the *Grenelle de l'environnement* launched in 2007.

In the Netherlands, the National Spatial Strategy and the Frame of Reference on Urbanization set the national framework for spatial planning. This document supports cities that are sustainable, more compact construction, less urban sprawl and restructuring of brownfield areas rather than creating new ones. In particular, the policy document identified six urban networks in the Netherlands: Randstad Holland, Brabantstad, Zuid-Limburg, Twente, Arnhem-Nijmegen and Groningen-Assen. It emphasises that a spatial strategy of more compact construction and less urban sprawl will be necessary to achieve sustainable development. It also identifies some compact city principles, including: urban development, subjecting infrastructure and economic activities to a location policy and a compact city policy, under which new residential and commercial development must be located, wherever possible, in or adjacent to existing built-up areas and infrastructure.

In the United Kingdom, the National Planning Policy Framework (NPPF) introduced by the Coalition government in March 2012 to provide a simpler, more coherent and comprehensible set of national land-use planning priorities and rules, reaffirms many of the principles of compact city development. These include:

- a presumption in favour of sustainable development
- a reaffirmation of the government's commitment to maintaining greenbelt protections to prevent urban sprawl
- maintaining a "town centres first" policy and sequential test, where developers look for a town centre location first, then at the edge of town and only out of town if no suitable central site is available
- local authority policies must encourage brownfield land to be brought back into use
- a new "duty to co-operate", to encourage cities and local authorities to work together on strategic planning policies like a compact city approach
- confirming the role of planning in tackling climate change and helping the transition to a low-carbon economy.

Sources: OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en; Planning Officers Society (2013), "National Planning Policy Framework: Summary and initial response", Planning Officers Society, Aylesbury, United Kingdom, www.planningofficers.org.uk/POS-Library/Others/National-Planning-Policy-Framework---summary-and-initial-response_334.htm (accessed 1 September 2013).

It should be noted that no one size fits all, and that compact city strategies should be tailored to specific urban contexts. For instance, large metropolitan cities such as Seoul, Busan and Daejeon, which have growing concerns about inner-city decay, should put more focus on developing strategies for brownfield development and inner-city revitalisation. A growing city like Hwaseong will need to develop urban growth management strategies, in particular locating new development along public transit. The International Energy Agency (IEA) (2013) provides a good indication of how to tailor land-use policies to different local contexts (Table 2.4).

Box 2.4. **Reflecting target density in the urban planning process: The case of the city of Prince Albert, Canada**

Plan Prince Albert, known as the City of Prince Albert Official Community Plan, aims to direct future land use and development of the city in the Canadian province of Saskatchewan. Key policies in the plan include: residential land use; park, recreation and natural areas; social environment; transport; relationships with other regional stakeholders; municipal utilities and services; a healthy economy; and plan implementation and monitoring. An explicit decision on which locations and densities are most appropriate for residential expansion is a key element of the plan, together with flexibility to future change, distribution of employment and building strong linkages through the transport system. Recently, the city of Prince Albert has been revising the existing plan to prepare for future growth.

Three options are under review: first, to lower overall densities in the city, while constructing new housing units in new neighbourhoods with less infill development; second, to maintain the assumptions of the current Policy Plan, with not all residential development taking place in new neighbourhoods; and third, to design a more compact city with higher overall densities, to enable the city to accommodate more population on the same amount of land. In comparing the advantages and disadvantages of each option, comprehensive criteria are considered: viability of public transit, cost of building or maintenance of infrastructure, impacts on new neighbourhoods, cost of housing, types of housing, cost of improvement of new utilities on old areas, traffic congestion, etc. The city government acknowledges that there is no one way to determine overall density and form of a city, and that it will rather be decided through a combination of land-use policy, consumer/market preferences and consultation with the local community.

Source: City of Prince Albert (2013), "Urban growth and urban form: Managing urban growth", City of Prince Albert, Saskatchewan, www.citypa.ca/Development/Planning/PlanPrinceAlbert/PlanPrinceAlbertTheProcess/tabid/339/Default.aspx (accessed 1 September 2013).

Regenerate urban centres to avoid further urban expansion

As discussed in Chapter 1, Korea, while achieving enormous economic growth under a centralised, state-led model of industrialisation, has developed a monocentric, unbalanced and possibly unsustainable model of urban development in the past 50 years. This has led to criticism that the policy-making system is too centralised and top-down to cope with the diverse urban challenges that the next decades will generate. The traditional model of urban development and policy making is under pressure for a variety of reasons. Partly it is because of more general changes in public attitudes to decision making, or because of dissatisfaction with the economic, social and environmental results and future costs of the current model: inner-city decay, social polarisation, high housing densities and sprawl, suburbanisation and environmental damage. In addition, the global economic crisis has meant that local authorities will not be able to pay for infrastructure and large-scale development, as they have in the past, and will need to regenerate existing built-up areas without undertaking new development.

One of the most serious challenges for Korean policy makers must be to manage regeneration of existing city centres, and more sustainable, self-sufficient, decentralised development. The Korean government has recognised the challenges and is now attempting to develop a different set of principles to guide behaviour in the future. This is evident in the Neighbourhood Regeneration Plan and a new institutional framework for promoting urban regeneration. However, past experience of plans and principles that were developed but not put into practice in Korea emphasise the need for vigilance in applying them (Box 2.5).

Table 2.4. **Examples of land-use and transport policies tailored to specific city types**

	Developing cities	Sprawling cities	Congested cities	Multi-modal cities
Increase density	Minimum density requirements, transit-oriented development, mixed-use zoning, clustering		Affordable housing programmes, zoning reform, builder incentives, smart growth reforms	
Improve transport network	Park and ride facilities		Bus/taxi-only lanes	
	Bus rapid transit network development (with feeder routes)			
	Formal transit development	Light/commuter rail	Trolley/metro/light rail	
	Prioritised bus lanes and signalisation		Complete streets design	
	Dedicated pedestrian and cycling lanes	High-occupancy vehicle lanes	Cycling lanes	
	Seamless transport (interconnectivity): easy, accessible, demarcated connections between travel modes			
	Road freight to rail facilities			
Reduce driving	Teleworking programmes		Transit incentives	
	Parking maximums/restrictions, fees and levies			
	Road pricing/tolls		Congestion pricing and vehicle quotas	
	Vehicle registration tax/pay as you go fees/fuel prices and taxes			
	Improved public transport services and increased frequency/reliability			
	Eco-driving programmes			
	Carpool/rideshare programmes		Integrated ticketing for transit	
	Freight delivery restrictions			
Improve safety	Separated cycling lanes, sidewalk improvements, zebra crossings, median barriers/islands (mid-road protection for crossing pedestrians)			
	Safe routes to transit/school programmes			
	Traffic-calming measures: lane narrowing, road "diet", speed reductions, one-way to two-way streets, street closures, reduced speed zones, improved signalisation		Traffic-calming measures: speed bumps, curb extensions, "shared space" roads, cyclist/pedestrian priority roads, chokers (narrowing at cross roads), pedestrian zones (reduced speed), car-free zones	

Source: International Energy Agency (2013), *A Tale of Renewed Cities: A Policy Guide on How to Transform Cities by Improving Energy Efficiency in Urban Transport Systems*, IEA/OECD, Paris, available at: www.iea.org/publications/freepublications/publication/Renewed_Cities_WEB.pdf (accessed 23 September 2014).

A more comprehensive approach to urban regeneration

Urban regeneration policy should focus on comprehensive objectives such as economic competitiveness, social cohesion and environmental sustainability. In Korea, urban generation policies have frequently placed too much emphasis on housing construction for profit, with little concern for investment in the surrounding urban area and urban environmental improvements (OECD, 2012b). The experience of Korea and other countries have shown that this does not work. Urban regeneration policies should extend beyond physical redevelopment and adapt to changing urban challenges (Box 2.6). Barcelona's and Helsinki's experiences provide some helpful insights. In the 1990s, Barcelona's strategy was essentially that of urban regeneration. It focused upon infrastructure, the physical environment, the city centre, the waterfront and prestige projects like the Olympics and urban tourism. That strategy was enormously successful. However, in recent years, Barcelona has recognised the limits of this approach, which has left it with relatively low gross domestic product (GDP) and limited working relationships between the city and the universities. The city has now adopted a different strategy to increase the city's competitiveness, by encouraging innovation and attempting to involve universities in the future of the city. Helsinki has successfully pursued such a high value-added strategy with its focus on universities, innovation and networks. This has underpinned its dramatic economic renaissance (Parkinson et al., 2012).

Box 2.5. The Neighbourhood Regeneration Plan and a new framework to promote urban regeneration

The Neighbourhood Regeneration Plan, a new approach to urban regeneration in Korea, seeks diverse regeneration projects at a neighbourhood level, to avoid the large-scale physical redevelopment often pursued by previous regeneration policies. The plan aims to address socio-economic issues often noted in declining cities, including population decrease, unemployment, sluggish local businesses, poor education, poverty, security and social exclusion. However, the plan particularly encourages the participation of the local community at all stages, including the design, implementation and monitoring of regeneration projects. In addition, the plan aims to improve the quality of community life, minimising disparities across communities, refreshing local economies and enhancing sustainable growth in the environment.

Full participation and co-ordination of diverse stakeholders, such as local governments, residents, research institutions, non-governmental organisations (NGOs) and business sectors are acknowledged as a key factor in the success of urban regeneration, which help find creative means of regeneration and receive full support from them. Jeonju and Changwon were selected as test-bed cities in 2011 for the neighbourhood regeneration plan. The districts identified by the cities as decaying communities included 952 households and 1 313 retail stores in Jeonju; and 1 105 households and 829 retail shops in Changwon. As policy actions, the cities have prioritised the education of residents to build capacity for regeneration, and revitalization of retail businesses, as well as sustainable environmental improvements. Close co-operation with residents, institutions, local businesses and NGOs is sought to support the local governments. It is too early to evaluate the policies at this stage, but preliminary results from the projects have elicited positive reactions from residents and strong commitment from local government.

The Special Act on Promotion and Support for Urban Regeneration (Urban Regeneration Act) was enacted in 2013 to facilitate systematic public support, including project co-ordination and connection as well as local-initiated project planning. In building an urban regeneration framework with bottom-up urban regeneration activities, a key factor is to design the institutional structure and clarify the role of each player involved. Three entities play critical roles in developing and implementing urban regeneration projects: a central-level Urban Regeneration Committee in charge of review and co-ordination; a central- or metropolitan-level urban regeneration support agency; and finally, local government-level urban regeneration centres.

- Urban Regeneration Committee: The urban regeneration project should be carried out in a comprehensive manner, involving all the departments involved. This requires a strong urban regeneration body in charge of review and co-ordination of the whole process of urban regeneration project at the central as well as at the local level. The central Urban Regeneration (UR) Committee consists of heads of the Ministry of Land, Infrastructure and Transportation; the Ministry of Strategy and Finance; the Ministry of Security and Public Administration; the Ministry of Health and Welfare; and so on. The central UR Committee is an advisory body, but more importantly an approval body that leads consultations with the departments involved and adjusts urban regeneration budgets. This committee selects promising urban regeneration projects worthy of receiving government assistance, among the projects proposed by lower-level local governments, and assesses and verifies that the assistance helps boost the self-sufficiency of the affected area. Metropolitan-level regional UR committees do the same at the local level.

- Urban Regeneration Support Agency: The Urban Regeneration Support Agency is a government-affiliated urban regeneration body that co-ordinates the urban regeneration activities of central and local governments and supports the urban regeneration activities of local communities in a systematic and consistent manner. The UR support agency is charged with allocating and executing the urban regeneration-related government budget, administering and managing funds, implementing planning, dispatching experts, presiding over consultations among related parties, and so on. The agency is supposed to formulate local-level urban regeneration strategies and lead urban regeneration projects in a consistent manner. Meanwhile, separate metropolitan-level support agencies can be set up to carry out urban regeneration activities appropriate for the specific needs of each region.

Box 2.5. **The Neighbourhood Regeneration Plan and a new framework to promote urban regeneration** (*cont.*)

- Urban regeneration support centre: To enhance local urban regeneration capacity and nurture urban regeneration experts, each local government should set up an urban regeneration support centre as an actor in urban regeneration projects as well as the governing body and consultative group of urban regeneration activities, by stipulating its installation under the law. The urban regeneration support centre is made up of public servants responsible for urban regeneration, urban regeneration activists and experts of the region, and is in charge of carrying out urban regeneration projects and deciding on major issues regarding budget execution. The major tasks of the centre are to formulate urban regeneration plans, develop and implement local urban regeneration projects, and reinforce regional urban regeneration capacity by operating programmes to nurture local experts. It can also implement a range of projects, such as local specialties/natural resource promotional projects; traditional markets'/shopping districts' revitalisation projects; commissioning of local festivals, parks and parking lot management, community centre programmes and school meals; garbage/waste disposal and resource recycling projects; green energy projects that promote the use of solar heat and bicycles; and assistance projects for low-income/multicultural families.

Based on this Special Act, 13 bellwether regions for urban regeneration were chosen (2 regions were selected as the economy-base type and 11 regions as the vicinity-regeneration type). In the bellwether regions, the plans for activation of urban regeneration, a detailed executive plan, were to be established by September 2014 and the corresponding projects will be finished in a period of 4 years, by 2017. As for the bellwether regions, up to KRW 200 million for establishing the plans and KRW 6-25 billion for promoting the projects will be invested using public funds during the four years. In addition, the MOLIT plans to support the relevant administrative and technical items with the Korea Land & Housing corporation, Korea research institutes, and the Architecture and Urban Research Institute. In particular, the economy-base type will be supported in a way that lets the local governments and residents unearth anchor projects such as composite development projects, able to be funded by the private sector.

Note: 1. Instead of setting up a new body, existing urban regeneration-related public enterprises can be enlisted for urban regeneration activities if there are concerns about government or budget expansion.

Sources: Ministry of Land, Infrastructure and Transport (2013c), "New policy framework for urban regeneration", a background report submitted to the OECD; Korean Urban Regeneration Centre (KURC) (2013a), "Changwon test-bed projects", KURC, Seoul; Korean Urban Regeneration Centre (KURC) (2013b), "Jeonju test-bed projects", KURC, Seoul; Korean Urban Regeneration Centre (KURC) (2013c), "Neighbourhood Regeneration Plan and roles of the government", KURC, Seoul.

Urban regeneration policy in Korea should pay attention to need and opportunity at the same time. Three broad kinds of approaches to urban regeneration can be noted. The first targets needs, such as community-based personal services or transfer payments to poor communities. A second seeks to expand opportunities through city-centre marketing initiatives or business growth schemes. A third tries to link opportunities and needs, by improving the accessibility of unemployed people to jobs or tackling institutional barriers to economic and social inclusion. The balance between these will differ across cities, depending on local circumstances and levels of prosperity. However, it is important to avoid "needs" and "opportunities" policies being pursued independently of each other. In Korea, as in other countries, separate organisations tend typically to be responsible for these two areas, creating the risk of inconsistency or even contradictions between them. If no one is charged with making the connections, the prospect of creating "twin-track" cities, where poverty exists alongside prosperity, is reinforced. The economic strategy amounts to a rather narrow agenda, for example high-tech industries or knowledge-based services in terms of the direct beneficiaries. New jobs, housing and consumer services have focused on high-level occupations and advantaged locations, often for commercial reasons and due to a lack of public investment. In this case, the risk is that the benefits

will not filter through to disadvantaged communities, especially if people moving to the city from elsewhere take up new opportunities, rather than local residents moving up the job or housing ladder.

Box 2.6. **Evolution of the definition of urban regeneration**

Defining regeneration is not straightforward (Parkinson, 1996). The term has meant different things to different people at different times. It is sometimes defined as the policy inputs, the resources invested in the regeneration process: money, time and people. It is also defined as the outputs of the investment – houses built, training schemes provided, jobs created, roads built and land reclaimed. At other times, it is defined more specifically as the impact of that investment: the economic, social and environmental changes or improvements that such investment has produced in the urban arena. Sometimes it is seen as the process of involving and maximising the contribution of different partners, such as the community or private sectors, in regeneration.

Regeneration involves many different players in many policy areas and occurs at different scales and spatial levels. It may be *ad hoc* or carefully planned, market driven or publicly financed. It may be led by public, private or community sectors or by some combination of them acting in partnership. Regeneration describes prestigious international, flagship development projects as well as small community-based self-help schemes. It includes diverse economic, physical or social schemes from small business development or education and training programmes, to major physical infrastructure projects or environmental improvements, to crime reduction, the improvement of housing and the provision of community services. Regeneration can take place at different spatial levels: national, regional, city wide or neighbourhood. It may target different groups: the young, ethnic minorities, the long-term unemployed, the handicapped, housing tenure groups (Parkinson, 1996).

Regeneration developed as a response to economic change in the United Kingdom and Europe. Roberts and Sykes' (2000) definition of regeneration attempts to capture the complexity of the process and the involvement of different actors and different interventions, describing it as: "Comprehensive and integrated vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change" (Roberts and Sykes, 2000: 22). Past interpretations of regeneration referred to it as simply being the delivery of physical regeneration, as opposed to achieving a wider range of outcomes. Over time, however, the concept of regeneration has needed to adapt constantly to the changing economy, changing policy contexts, changing roles of central and local government and to altered circumstances in local areas.

Reflecting wider changes in the economy, and the growing importance of skills, more recent definitions of regeneration tend to focus on both people and places. In 2009, the UK Department for Communities and Local Government described the aims of regeneration as:

- achieving long-term change in a local area
- improving economic performance
- making places more attractive to residents and businesses
- breaking cycles of poverty
- enabling everyone to take advantage of economic opportunities
- delivering sustainable development and greater equality (UK Department for Communities and Local Government, 2009).

Sources: Parkinson, M. (1996), *Strategic Responses to Area Regeneration*, Joseph Rowntree Foundation, York, United Kingdom; Roberts, P. and H. Sykes (eds.) (2000), *Urban Regeneration*, Sage, London; Department of Communities and Local Government/Host boroughs Unit (2009), *Strategic Regeneration Framework*, CLG, London CLG (2009).

Urban regeneration policies[9] should recognise that liveability as well as economic success influences people's choice of the places they want to live. Cities and neighbourhoods should become places of choice and connection rather than compulsion and exclusion. Successful cities are attractive to a rich economic and social mix of people and communities. The experience of different cities reinforces the significance of quality of place as a feature of economic competitiveness, although it is difficult to measure its impact. Munich has many "soft" locational advantages, for example its climate, which helps it attract talent and skilled labour. Lyon has successfully dramatised its city centre and built on its lighting strategy and the Festival of Light to attract not only tourism but business investors and employees (Parkinson et al., 2012). Creative efforts to shape public space can enhance urban liveability (Box 2.7). Accentuating place is important for reducing the negative impressions of densification often left by strategies for retrofitting urban centres. Rotterdam's Seven Green Strategies are thought to have greatly enhanced the quality of urban space by considering urban elements such as boulevards, quays, squares, parks and playgrounds (Box 2.8).

Box 2.7. **Examples of making streets lively and vibrant**

Summer Streets in New York

On three consecutive Saturdays in the summer, nearly seven miles of New York City's streets are opened up for everyone to play, walk, bike and breathe. Summer Streets, an annual celebration of the city's most valuable public space, its streets, provides space for healthy recreation and encourages New Yorkers to use more sustainable forms of transport. Part bike tour, part walking tour, part block party, it is a great time for exercise, people watching or just enjoying summer mornings. In 2012, more than 250 000 people took advantage of the event, which runs from 7 a.m. to 1 p.m. Summer Streets is modelled on other events around the world, including Ciclovía in Bogotá, Colombia, and Paris Plage. Its route extends from the Brooklyn Bridge to Central Park, along Park Avenue and connecting streets, with easy side travel options on low-traffic streets to the Hudson River Greenway, Harlem, Brooklyn and Governors Island, allowing participants to plan a route as long or short as they wish. All activities are free of charge and designed for people of all ages and ability levels to share the streets respectfully. Summer Streets is a project of the New York City Department of Transportation, joined by several other city agencies and the Mayor's Fund to Advance New York City.

Melbourne's "active edges" policy

These regulations inform the design of new buildings, to ensure a lively urban environment with a mix of functions and activities. The goal is to ensure that ground-floor facades appeal to pedestrians and contribute good lighting and levels of interest and activity. Shops and food service outlets must have a display window or entrance of at least 5 metres, or 80% of the ground-floor facade (whichever is larger); the rhythm, scale, architectural detail, windows and colours of new facades must be in keeping with existing street space and buildings must provide details of interest to pedestrians and use high-quality, durable materials (City of Melbourne, 2004).

Sources: City of New York (2013), "Summer Streets", City of New York, New York, www.nyc.gov/html/dot/summerstreets/html/home/home.shtml; City of Vancouver (2004), "Financing growth", City of Vancouver, http://vancouver.ca/commsvcs/planning/financinggrowth/pdf/fgchoices.pdf (accessed 6 January 2012); City of Melbourne (2004), "Places for people: Melbourne", City of Melbourne, Melbourne, www.melbourne.vic.gov.au/AboutCouncil/PlansandPublications/Documents/Places_People_2004.pdf (accessed 28 November 2011).

Box 2.8. **Rotterdam's Seven Green Strategies to improve the quality of the inner city**

Rotterdam has developed its Green Strategies for its inner city to improve the quality of the urban area and attract inhabitants and visitors. The strategies actively involve private parties and developers and the municipalities, generating the impression that "The inhabitants of Rotterdam make their city." The Seven Green Strategies are as follows:

- The Boulevard Strategy aims to develop a green network that connects squares, parks and green areas, by planting more greenery along the road and tram tracks. The strategy is represented by the slogan "The more beautiful the boulevards, the more beautiful the city".
- The Quays Strategy plans to transform the river banks and quays into an attractive, green recreational landscape, by removing car parks and designing new green spaces to provide walking and cycling routes.
- The Square Strategy aims to give each square various uses, surrounded by buildings with diverse programmes and attractive public places, enhancing the identity of the city.
- The Parks Strategy plans to develop parks within walking distance of every home, while maintaining or enhancing the quality of the park.
- The Playgrounds Strategy reinforces a child-friendly environment, with broad sidewalks, slow traffic routes and speed-bump zones, which help create squares where children can play and people can sit.
- The Green Roofs and Facades Strategy aims to provide environmental benefits such as absorbing CO_2 emissions, offering water buffers and enhancing the living environment.
- The Glamorous Green Strategy activates improvements of the quality of outdoor space to encourage people to stay longer and feel more connected with the city.

Source: Tillie, N. et al. (2012), "Rotterdam people make the inner city", Fifth International Architecture Biennale Rotterdam, Rotterdam, Netherlands.

National policies and the public sector are crucial to the success of urban regeneration policies

National and regional policies are critical for the performance of cities. The evidence is that many national governments are targeting, resourcing and empowering cities. The Korean government is developing an ambitious urban regeneration plan, but the national and local government should continue to show strong commitment toward regenerating cities through specific policy initiatives. Finland, France and the Netherlands have coherent national urban strategies. In Germany and Spain, regional government policies have been more important and national policy less. However, higher level governments have acknowledged the need to support cities. UK national and regional policy has increasingly recognised the contribution of provincial cities and the need to support and create the right institutional architecture for them. France has also taken steps to facilitate social mix and urban regeneration. The *Solidarité et Renouvellement Urbains* (Urban Solidarity and Renewal, SRU) legislation established in 2000 mandated that a minimum of 20% of social housing in total housing stock should be built in each commune by 2020, which is expected to enhance housing tenure mix (Colini et al., 2013). In Helsinki, national government policy was critical in the city's extraordinary renaissance, progressing from an economic basket case to one of Europe's most successful cities in the 15 years from the early 1990s until now. The state government of Bavaria was crucial in making the investment in infrastructure and human capital that has underpinned Munich's phoenix-like rise from the ashes since World War II. Governments in the Netherlands

have also invested heavily in major cities (Parkinson, M., 2007). The private sector is crucial to competitiveness, but the European evidence is that the public sector must provide the basic investment and assume the initial risk, which the private sector is sometimes reluctant to do.

Local leadership should be supported and encouraged in Korea. Cities' room for manoeuvre is affected by wider forces like globalisation, long-term economic changes and national policies and performance. However, part of what cities in OECD countries have achieved in the past decade has been the result of local leaders exploiting favourable national economic performance. A key characteristic of successful cities is their strategic capacity to exploit their assets. In other words, local leadership is important in helping to develop new economic futures for cities and their businesses and residents. Assertive, pro-active leadership in Manchester shaped the renaissance of the city and the emergence of a city-regional political agenda (Parkinson et al., 2012). Another example of making use of public assets is the renovation of the railway system in Toyama City, Japan. Existing railway lines were transformed into a light rail transport (LRT) line to increase service and improve business efficiency, and the number of users has almost doubled since the LRT started operation. With the LRT construction, the city of Toyama's Action Plan aims to reduce CO_2 emissions by focusing on improving public transport. In 2008, this innovative urban development plan was selected as one of the five eco-friendly model cities in Japan out of 82 candidate cities (OECD, 2012a). Again, stability of political and administrative leadership, long-term commitment to strategic agendas, a willingness to take calculated risks, the capacity to encourage public and private sector partners, the ability to reconcile shifting agendas – all promote success.

A long-term outlook and flexibility are needed

A vision for long-term urban regeneration and policy actions will be crucial in increasing the chance of successful urban regeneration in Korea. The economic success of individual Korean cities today is the result of long-term interaction between their particular combinations of expertise and wider external forces. This shows not only that history matters but how long it takes for a city to develop along a particular path also matters. Long-term perspectives and policies, rather than general and short-term policies, are needed to make changes in those paths of development. The secret of many reviving cities is the stable political leadership that allowed them to build up the skills, track record, confidence and networks necessary for regeneration in the long term. Government needs to give people and policies as much time to flourish as is realistically possible. Urban regeneration strategies need to be flexible to reflect changing objectives for regeneration and to respond to different policy environments (see Box 2.9).

Targeted long-term action can help prevent social problems endemic in specific areas. Montgomery County, Maryland, has implemented 30-year inclusive development, which required private housing developers to let 10% of the units at below-market rents. The local authority can use half of these to provide for low-income residents (Colini et al., 2013). This facilitated a mix of tenure and rents within a given street. Physical demolition, one of the radical solutions and sometimes the politically preferred option (to achieve rapid, visible effects), might not be appropriate under certain circumstances. As Colini et al. (2013) point out, "Demolition in itself is not a magic solution. If the underlying causes of hyper-segregation are not explored and handled by other tools, demolition will only postpone and spatially shift the problems to other areas of the city." Again, a key factor in successful urban regeneration is to discover why a declining district or a city developed problems and design long-term strategies to tackle them.

Box 2.9. The United Kingdom's evolution in urban regeneration

Regeneration initiatives responding to the 1980s recession: In response to the large-scale de-industrialisation of the 1980s recession, the emphasis of regeneration was on physical projects to fill the spatial void of brownfield sites, encourage investment into hard-hit areas and kick-start the economy. The 1980s marked a paradigm shift in the co-ordination of regeneration. Until 1979, local authorities were the lead authority, but during the 1980s, powers were gradually removed from local government. Central government agencies were placed directly in urban areas to deliver regeneration initiatives within tightly defined spatial areas, with an emphasis on delivery rather than strategy. The aim of these agencies was to lever in private sector investment, and the agencies were held accountable not to the local authority but to boards made up of appointed business representatives. Local government essentially became the supplier of land within the process. A significant number of local authorities did take action during the 1980s to adopt more people-based policies, using financial support to implement company policies around personnel and investment strategies in reaction to rising local unemployment. In the most significant cases, however, this approach was largely a political reaction against central government. Urban development corporations (UDCs) were the flagship regeneration policy of this period and are identified as "one of the most important urban regeneration programmes". They were introduced in several specific areas of the country as non-departmental public bodies under the Local Government, Planning and Land Act 1980, with the broad remit to secure the regeneration of their designated areas. The UDCs were to "represent the future, an amalgam of free enterprise, deregulated decision making and streamlined bureaucracy". Despite the successes of the UDCs, there were trade-offs associated with their separate status. They were criticised for failing to engage with local people, jobs were often "poached" rather than increasing overall employment, and as central government agencies, there was little representation from the local public sector. The Sheffield UDC is an example of this tension, with central government having strong control over the local regeneration process in a place where the local government was highly interventionist. Whilst local government also had some success with people-focused approaches, its work was constrained by a lack of finance and expertise in dealing with specific issues around regeneration and local economic development. Initiatives were also too local in focus, risking detrimental impacts on neighbouring areas.

Regeneration initiatives responding to the 1990s recession: In contrast to approaches deployed in the 1980s, initiatives in the 1990s aimed at creating more sustainable forms of regeneration. Competitiveness was a significant element as cities attempted to revive their image and attractiveness to leverage investment and economic development. There was also emphasis on a "new localism" agenda and greater partnership working. The 1990s marked a significant shift from the 1980s in the way in which regeneration initiatives were co-ordinated and managed: "The governments were being roundly criticised for the way local authorities had become marginalised in the regeneration process".[1] Projects during the 1990s involved local authorities, and partnerships between public, private and voluntary bodies became an essential characteristic of the regeneration process, in contrast to the more isolated ways of working in the 1980s. Policy levers such as Section 106 in the 1990 Town and Country Planning Act enabled local authorities to enter into agreements with the private sector about contributions in exchange for development. Overall, regeneration interventions were more holistic in approach, with a greater focus on strategy as well as delivery, and on community and social issues. In the 1990s, competitive bidding was introduced through the *City Challenge* (1992-98), requiring bids for funding to regenerate deprived inner-city areas. Of 31 City Challenge Partnerships, each was able to bid for GBP 37.5 million over five years. City Challenge was the forerunner to the Single Regeneration Budget (SRB) (1994-2006), which streamlined 20 budgets into one pot for which local areas could bid, distributing GBP 5.7 billion. Both policies introduced partnership working

Box 2.9. **The United Kingdom's evolution in urban regeneration** (*cont.*)

into regeneration (interested parties formed partnerships at the local level in annual bidding rounds), improved efficiency and engaged more with local communities. In response to the housing market collapse in the 1990s recession, Housing Associations purchased private sector homes and provided some assistance to limit repossessions. This was an area where local authorities did not have high levels of involvement, with access to limited resources and no borrowing powers. The New Deal for Communities was also a partnership-based strategy, set up in 1998 to regenerate some of the most deprived neighbourhoods in the United Kingdom. Residents were placed in charge of the regeneration of their areas, with 39 partnerships established in total, focusing on jobs, crime, educational achievement, health and housing. Despite the apparent successes of these projects, there are also criticisms. Hall (1998) has argued that City Challenge has "perpetuated existing inequalities … because of the haste of the bidding process, it relied upon existing experience and networks". This meant that areas already in a stronger position benefitted, whilst some of the most deprived locations lost out in the bidding process of the SRB, as deprivation was not a weighted criterion. Competitions can also encourage areas – sometimes neighbours – to invest considerable time and energy competing for funding, although only a small number benefit tangibly from the process.

Regeneration initiatives in the 2000s: Over time, partnership, sustainable development and the environment have gained increasing importance in the regeneration process. The governance structure of regeneration has become multi-layered. National government has retained ultimate responsibility for many decisions about local regeneration (e.g. final decisions on infrastructure funding). National bodies also remain important. The newly created Homes and Communities Agency, for example, has responsibility for housing development. Regional development authorities (RDAs) were created in 1998, subsuming the Single Regeneration Budget into the Single Programme in 2002. They were set up as business-led bodies with responsibility for regional economic strategies, delivering regeneration alongside a more comprehensive approach to overall economic development. They have more recently been charged with developing integrated regional strategies, bringing together economic and spatial strategies in partnership with local authorities. Local government has had increasing responsibilities, and incentives, for regeneration, including Local Authority Business Growth Incentives (LAGBI) and powers to raise supplementary business rates, and a reduction in ring-fencing of central government grants. Principal local authorities were granted a "well-being" power in 2000 to do anything considered likely to promote the economic, social and environmental well-being of their area, unless prohibited in other legislation. Under the Local Democracy, Economic Development and Construction (LDEDC) Act, they have a duty to conduct an economic assessment of their area. City regions – local authorities working together across travel-to-work areas (similar to the "metropolitan county" approach) – have become increasingly influential, with a growing number of multi-area agreements and the announcement of two City Region Pathfinders in Manchester and Leeds. The private sector has also become an increasingly important partner in regeneration, working with the public sector in multiple ways, including public-private partnerships such as Private Finance Initiatives and RDA boards. Regeneration strategies in the 2000s have been shaped by the changes to governance structures outlined above. There has been greater focus on "urban renaissance" to encourage the rebirth of city centres. Key initiatives focused solely on regeneration have included: Urban regeneration companies (URCs), set up to co-ordinate investment from the public and private sector and "the only policy tool that is dedicated almost exclusively to the delivery of physical regeneration". Economic development companies, building on the principle of URCs, were established in response to the devolution agenda of the 2007 Sub-National Review of Economic Development and Regeneration, with the aim of delivering more professional development activities.

Note: 1. In fact, this relates to high, dense physical development.

Source: Work Foundation (2011), "Past recessions: What are the lessons for regeneration in future?", Northern Way.

Enhance the attractiveness of cities through mixed land use

Set national goals

Evidence and theory-based national goals for mixed land use should be collected. Various mixed land-use developments have been independently conducted without clear objectives. Current mixed land-use policy directions are found in individual urban regeneration projects, but not in urban development strategy as a whole. Furthermore, too much focus has been spent on establishing large-scale vertical mixed-use developments (e.g. mega-structures) rather than designing various other types of mixed land use in terms of scale, location and physical forms in the city centre.[10] This has meant that local governments have established clusters of high-rise buildings in the name of mixed land use. To avoid this, the national government may need to identify the advantages and disadvantages of mixed land use, and decide what to emphasise among its various goals (benefits) (Table 2.5). Urban vitality and regeneration can be one of the key goals of mixed land use in the city centre, but reducing dependency on private vehicles might be a more important goal in suburban areas.

In addition, it would be helpful if the national government were to develop implementation guidelines for each type of mixed land use and sub-region of a city. Currently, the Second Revision of the Fourth National Comprehensive Plan cites compact development and mixed land use as one of the key national planning goals. In addition, the Urban Planning Guideline for the Low Carbon and Green City also stresses the importance of mixed land use. However, these government documents seldom contribute to achieving mixed land use, because they are not legally enforceable in practice and do not explain concrete objectives and implementation strategies. Similarly, the Sustainable New Town Planning Standard suggests concrete guidelines for land-use diversity, but it also has limitations, since it can be only applied to the new town planning. If the Korean government decides to develop guidelines, it could include a list of "use areas" that allow mixed land use or mixed-use development, a list of architectural uses allowed in the mixed-use buildings, the allowable proportion of each use in mixed-use building, and allowable mixing methods (Box 2.11 describes the current land-use zoning system in Korea). Furthermore, applicable types of mixed use by type of sub-region (including specific goals) of city could also be suggested in the guidelines, since the Smart Code[11] designates applicable types of community by type of regional sector and transect zone. In addition, district unit planning could be another instrument for instituting mixed land-use principles. The existing Guideline for Developing District Unit Planning could be improved to encourage mixed land use or mixed-use development,[12] for instance by illustrating incentives for mixed land use. Adelaide City Council's (2010) *Guide to Mixed Use Development* could provide useful insights for preparing the guidelines. The City Council states: "The key to successful mixed use development is adherence to a number of basic principles including: a sound understanding of market preferences and dynamics, appropriate location of uses, hours of operation for more lively activities, timing of service delivery and appropriate design and construction measures to achieve satisfactory development performance in terms of 'green' energy efficiency, noise attenuation, air quality and vibration".

Table 2.5. **Benefits of mixed land use and its contribution to urban sustainability**

Changes in built environment	Changes in people's activities and urban functions	Contribution to urban sustainability
– Increase in job-housing proximity (jobs/housing balance)	– Minimise travel-to-work distance: shorter intra-urban travel distances (particularly vehicle travel)	**Environmental benefits** – Reduce traffic impact (fewer CO_2 emissions, less pollution from automobiles and less energy consumption)
– More convenient access to community service and facilities (e.g. schools, commercial and recreational facilities, care for elderly people)	– More multi-function travel	– Greater energy efficiency
– More efficient public service delivery	– Less traffic congestion	**Social benefits**
– Creating a pedestrian-friendly environment	– Less automobile dependency – Reduce car ownership	– Higher mobility for people without access to a car
– Suburban place making (by making streets, public spaces and pedestrian-oriented retail become places where people meet)	– Increase in transit use	– Greater feeling of safety (perceived security)
– Optimum use of land resources and sharing of utilities and amenities	– Increase in active transport (walking and cycling)	– Assisting surveillance
– Historic renovation and adaptive reuse of structures (use of unwanted or obsolete property)	– Increase in the number and activity of people on the street (active street life)	– Greater social capital, social cohesion, social integration, social network and sense of community
	– 24-hour city (creates an urban environment active at all hours)	– Higher quality of life: improved human health, due to more cycling and walking
	– Revitalise downtowns and community life	**Economic benefits**
		– Lower transport costs
	– Attract more people	– Higher productivity, due to shorter travel time for workers
	– Enable community self-help	– More efficient use of space and buildings
		– Lower infrastructure and service costs (support viable urban facilities including public transit and make optimum use of infrastructure)
		– Lower cost of infrastructure maintenance
		– Support for small business
		– Raise property values
		– Increase in local tax revenue
		– Increase in economic activity and economic development

Notes: The increase in property values due to mixed land use is regarded as one of its advantages. However, in Korea, it is regarded as one of the dominant side effects of mixed land use, because the higher price of land and housing usually interferes with other developments in city centre and urban revitalisation. In addition, large-sized mixed-use development in inner-city areas may worsen traffic congestion in countries like Korea, with high-density urban centres. Along with noise, light pollution is also one of the possible side effects derived from the conflict between different uses.

Sources: Coupland, A. (1997), *Reclaiming the City: Mixed Use Development*, Spon Press, London; Llewelyn-Davies (2000), *Urban Design Compendium*, English Partnership/Housing Corporation, London; DTLR/CABE (2001), *Better Places to Live – By Design*, Thomas Telford Publishing, London; Grant, J. (2002), "Mixed use in theory and practice: Canadian experience with implementing a planning principle", *Journal of the American Planning Association*, Vol. 68, No. 1; Carmona, M. et al. (2003), *Public Places – Urban Spaces*, Architectural Press, Oxford; Urban Land Institute (ULI) (1987; 2003), *Mixed-use Development Handbook*, ULI, Washington, DC.

A review of the current status of mixed land use could be helpful to facilitate mixed land use and maximise its benefits, and find the right policy direction. Performance indicators by type of sub-region of city could be developed to compare levels of mixed land use in specific areas. The first step should be to decide on a suitable spatial unit (geographical boundary) for analysis. Because almost all measurements tend to be inaccurate when a large spatial unit is used, an administrative unit smaller than TL5 (*yeup*, *myeon* and *dong*[13]) should be chosen. The commonly accepted walkable boundary (e.g. a 500-metre buffer) might be more desirable. Next, the various types of measurements should be reviewed and a universal methodology developed for impact analysis (Box 2.10). The methodology should encompass various environmental, social and economic performance indicators to quantify the benefits and side effects of mixed land use, because the aim is to solve urban problems and achieve urban sustainability rather than simply improve the level of mixed land use.

Box 2.10. **Empirical studies on the impact of mixed land use**

As regards the environment, almost all the research supports the positive impact of mixed land use. Cervero (1996), using data from the 1985 American Housing Survey, shows that retail activities in neighbourhoods (i.e. mixed-use neighbourhoods) increase mass transit and active transport (walking and bicycling). He also suggests that use of nearby commercial land leads to lower vehicle ownership rates and short commuting distances. In addition, he finds that mixed land use is more critical than higher density for enhancing walking and bicycling. By analysing 239 projects in 6 large, diverse metropolitan regions, using hierarchical modelling, Ewing et al. (2011) also prove that mixed-use development with diverse activities on site, smaller projects in walkable areas with good transit access and centrally located projects respectively capture a large share of trips internally, increase walk and transit trips and generate shorter vehicle trips. They conclude that mixed-use development mitigates traffic impact by comparison with conventional suburban developments. Joh et al. (2008) show that residents in mixed-use centres walk more frequently than those in auto-oriented corridors, even though there are no discernible differences in individual driving trips between them. Duncan et al. (2010) also show that the Land-Use Mix (LUM) Index is positively associated with frequency and duration of walking for transport. Song (1998a), Kim et al. (2009) and Jin et al. (2012) suggest that the degree of mixed land use (measured using the Entropy Index) of origin or destination is negatively associated with commute distance. Song (1998b), Kim and Ahn (2010) and Sung and Choo (2010) also show that mixed land use increases the use of public transit and active transport. Moreover, Song and Nam (2009) show that the degree of mixed land use reduces fuel consumption per capita.

Secondly, as for the social aspect, Aurand (2010) shows that mixed land use contributes to an increase in the share of affordable housing. Fillion et al. (2000) also argue that mixed-use centres in suburban areas increase the dynamics of inner-city areas in the Greater Toronto Area. More specifically, Graham and Glaister (2003) suggest that a higher level of mixed land use helps to decrease pedestrian casualties and fatalities by analysing 8 414 wards in England. Yamada et al. (2012) also analyse the relationship between the level of mixed land use and Body Mass Index for 4 960 Salt Lake County adults, and conclude that the impact of mixed land use can be different according to its measuring method and geographic scales. Kim et al. (2010) interviewed 147 residents living in a residential-commercial complex building in Seoul. The study showed that the residents are satisfied with the building's safety, security, privacy and access to facilities, but report that noise and odour attributable to the commercial uses are the chief problem of the mixed-use building.

Box 2.10. **Empirical studies on the impact of mixed land use** (*cont.*)

Lastly, as for the economic aspect, studies show contradictory results. Cao and Cory (1982) reveal that mixed land use increases property values in surrounding areas, while Sohn and Moudon (2008) prove that a higher proportion of land devoted to retail uses in a cluster decreases office property values. Using hedonic price analysis, Song and Knaap (2004) analyse the impact on the prices of single-family houses when mixed land uses are included in neighbourhoods. The results can differ, depending on the type of uses. Prices of single-family houses increase with proximity to or with increasing amounts of commercial land use in a neighbourhood, while they tend to fall with proximity to multi-family residential uses. Koster and Rouwendal (2012) reveal that households are willing to pay about 2.5% more for a house in a mixed neighbourhood, but the willingness to pay for mixed land use differs by housing type. They show that only apartment residents are willing to pay for mixed land use, while residents of other housing types are not. Likewise, research findings can vary based on their empirical setting. It is thus difficult to guarantee that mixed land use can increase tax revenue through commercial vitalisation and a rise in property values.

Sources: Cervero, R. (1996); Ewing, R. et al. (2011); Joh, K. et al. (2008); Duncan, M. et al. (2010); Song, M. (1998a); Kim, S., H. Kim and K. Ahn (2009); Jin, E., J. Koo and W. Lee (2012); Song, M. (1998b); Kim, S. and K. Ahn (2010); Sung, H. and S. Choo (2010); Song, K. and J. Nam (2009); Aurand, A. (2010); Fillion, P., K. McSpurren and N. Huether (2000); Graham, D.J. and S. Glaister (2003); Yamada, I. et al. (2012); Kim, T., S. Kang and W. Seo (2010); Cao, T.V. and D.C. Cory (1982); Sohn, D.W. and A.V. Moudon (2008); Song, Y. and G.J. Knaap (2004); Koster, H.R.A. and J. Rouwendal (2012).

Increase flexibility in the zoning system

Mixed land use could be more easily achieved by making the land-use zoning system more flexible (Box 2.11). The zoning system is highly relevant to mixed-use policies because it regulates mixed land use through land-use regulations and incentives. Korea's zoning system has been deregulated,[14] implicitly encouraging and permitting partial mixed land use. For instance, the current zoning system allows commercial use building in the residential areas and vice versa.[15] Horizontal mixed use has emerged by default, as in European countries (Hirt, 2012), although the Korean government has not explicitly promoted mixed land-use policies until recently. The current zoning regulation and planning system does not go far enough to encourage vertical mixed use. The national zoning system allows only one type, a residential-commercial complex building allowed only in the commercial areas. Meanwhile, developers are allowed to build luxury housing complexes and are not encouraged to promote mixed-use building. Another type of vertical mix, the mega-structure, lacks diversity and has not yet played a critical role in achieving urban vitality and regeneration. Current land-use zoning could be improved to allow more diverse mixed-use types, through diverse government documents or national legislation including the Enforcement Decree of the National Land Planning and Utilisation Act, which designates allowable architectural uses and maximum density of each use area, and the Enforcement Decree of the Building Act, which defines building types of each allowable architectural use designated by the previous Enforcement Decree.

Korea's national government might consider introducing structural changes in the national zoning structure to respond to the demand for mixed land use. Since the zoning framework is already relatively flexible, more approaches based on urban form, such as form-based code and place-type designation, could help optimise its potential (Boxes 2.12 and 2.13). For instance, a transect-based zoning could be considered a new subdivision instrument, replacing the current designation of use areas. Under transect-based zoning,

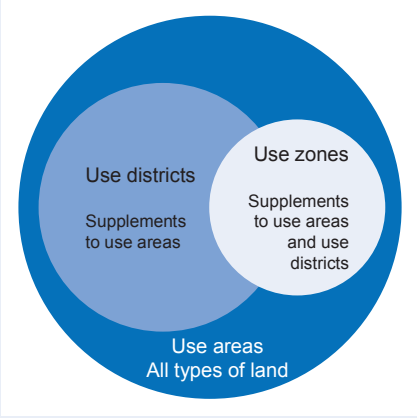
the development code subdivides a city into sections or zones to apply various regulations. Under the conventional zoning code, the primary differences between zones are the different land uses they allow. However, transect-based zoning establishes zones based on differences in building intensity and form, as well as the features of the public realm, while applying somewhat less restrictive regulations to differences in permitted land uses (Parolek et al., 2008). The most commonly used organising principle is the rural-to-urban transect.

The rural-to-urban transect is a means for considering and organising the human habitats' continuum of intensity that ranges from the most rural to the most urban. It provides a standardised method for differentiating between the intentions for urban form in various areas, using gradual transitions rather than harsh distinctions. The transect model, first adopted by Duany, Plater-Zyberk and Co., provides six zones: [n]atural (T1), [r]ural (T2), [s]ub-urban (T3), [g]eneral [u]rban (T4), [u]rban [c]entre (T5) and [u]rban [c]ore (T6), together with a [s]pecial [d]istrict (SD) designation for areas with particularly specialised purposes. (Parolek et al., 2008)

Such a change in land-use policies would of course demand great time and effort from the public sector, and should be pursued with caution.

Box 2.11. **Overview of the land-use zoning system in Korea**

The zoning system in Korea has been described as strict, complex and hierarchical, specifying the density, use or location of construction. The three pillars of the zoning system are use areas, use districts and use zones, whose complexity has often attracted criticism. The figure below illustrates the relationship between them, which may overlap.



Areas are designated by their primary uses, whereas districts are specifically limited by the type of establishments located within their perimeters. The use areas are divided into four categories: urban areas, administrative areas, agricultural areas and environmental conservation areas. Urban areas are subdivided into residential areas, commercial areas, industrial areas and greenbelts. Administrative areas are subdivided into three categories for managing the designated areas, for planning, production or conservation. Depending on the use areas, architectural structures may vary by type and size, including floor area ratio, land area and limitation in land division and building height. The use areas are determined and modified by urban management plans. The use districts are designated under a total of 12 categories (scenic districts, aesthetic districts, high-altitude districts, fire prevention districts, disaster prevention districts, conservation districts, facilities protection districts, community districts, development promotion districts and exclusive land-use districts), each of which is divided into subgroups and managed appropriately. Regulatory controls and activities are determined by local government ordinances. The use zones are designated to intensify or lift restrictions on areas or districts, depending on the use or forms of land and architectural structures. These zones are divided into four groups, including green belt zones, controlled urbanisation zones, protected fishery resources zones and urban natural park zones.

Source: Ministry of Land, Infrastructure and Transport (2013b), *The Guidebook for Korean Urban Policy*, Ministry of Land, Infrastructure and Transport, Sejong, Korea.

Introducing diverse incentives

Diverse incentives could be introduced by the Korean government to facilitate mixed land-use development. The Urban Land Institute (ULI) (2003) divides the institutional tools for encouraging mixed land use into two groups: "regulatory process and tools" and "development incentives and tools". Development incentives and tools include land assembly, land write-downs and tax incentives; providing infrastructure improvements; public components, ownership and financing and public development entities (ULI, 2003). Among them, a density bonus is most frequently applied, and is generally realised through incentive zoning. However, in Korea, density bonuses (incentives) are usually provided to create public open space (parks, plazas and walkways), joint developments and affordable housing rather than creating mixed land use.

Box 2.12. **Form-based code**

Form-based codes, a solution championed by the New Urbanists, emerged in the 1980s as a way to revitalise and promote walkable, mixed-use, sustainable communities and to counter urban sprawl (Parolek et al. 2008; Talen, 2013). This concept was referred to as "Traditional Neighbourhood Development (TND) ordinance" or "form codes", but it has commonly been known as form-based codes, since Carol Wyant, a Chicago consultant, coined the term in 2001 (Parolek et al., 2008). Form-based codes is one of the new approaches to assign suitable physical forms necessary when the regional context and conditions are considered. Form-based codes have many differences compared to conventional zoning regulations, as shown in the following table.

Conventional zoning codes and form-based codes

Conventional planning and zoning codes	Form-based codes
Auto-oriented, segregated land-use planning principles	Mixed use, walkable, compact development-oriented principles
Organised around single-use zones	Based on spatial organising principles that identify and reinforce an urban hierarchy, such as the rural-to-urban transect
Use is primary	Physical form and character are primary, with secondary attention to use
Reactive to individual development proposals	Pro-active community visioning
Proscriptive regulations, regulating what is not permitted, as well as unpredictable numeric parameters, like density and floor area ratio	Proscriptive regulations, describing what is required, such as build-to lines and combined minimum and maximum building heights
Regulates to create buildings	Regulates to create places

Source: Parolek, D.G., K. Parolek and P.C. Crawford (2008), *Form-Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers*, John Wiley & Sons, Hoboken, New Jersey.

Most of all, form-based codes use physical form, rather than separation of land uses, as their organising principle (Form-Based Codes Institute, n.d.; Talen, 2013). In other words, form-based codes regulate not the type of land use, but the form that land use may take; therefore, it "avoids labelling areas as 'residential,' 'commercial' and so on, using instead the broader categories 'urban core', 'urban centre', 'general urban', 'suburban edge' and so on. It focuses on regulating the shape and style of buildings and their relationship to the street" (Duany and Talen, 2002; Parolek et al., 2008; Hirt, 2012). This nature of the form-based codes offers more flexibility in land uses than do the traditional Euclidean codes, encouraging mixed land use and creating characterful places. Form-based codes include types and styles of building, public space design and the linkages between urban spaces. Of course, they are also partially included in the conventional zoning and other innovative zoning regulations. However, the most significant feature of form-based codes is their goal-oriented characteristic. Form-based codes are established based on the specific policy goals and images of cities as well as the general urban context. In other words, it is an approach to assign development forms suited to achieve specific goals of urban planning, such as compact and mixed-use environments, walkable neighbourhoods and sustainability. In addition, form-based codes foster "predictable results in the built environment and a high-quality public realm" (Form-Based Codes Institute, n.d.; Talen, 2013); and can be a good methodology to achieve compact city and mixed land-use goals. As mentioned above, form-based codes is a unified development codes template for urban planning, and urban and architectural design. This consistent approach avoids the possibility that some intended policy goals, such as mixed land use, may be blocked by conflicting layers of regulatory systems.

Sources: Parolek, D.G., K. Parolek and P.C. Crawford (2008), *Form-Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers*, John Wiley & Sons, Hoboken, New Jersey; Talen, E. (2013), "Zoning for and against sprawl: The case for form-based codes", *Journal of Urban Design*, Vol. 18, No. 2, pp. 175-200; Form-Based Codes Institute (n.d.), "What are form-based codes?", www.formbasedcodes.org; Duany, A. and E. Talen (2002), "Transect planning", *Journal of the American Planning Association*, Vol. 68, No. 3, pp. 245-266; Hirt, S. (2012), "Mixed use by default: How the Europeans (don't) zone", *Journal of Planning Literature*, Vol. 27, No. 4, pp. 375-393.

Box 2.13. **"Place Type" designations: The case of the City of South Gate, California**

A "Place Types" designation is a newly developed methodology of land-use regulation, initiated in several US cities in the late 2000s. The General Plan 2035 of the City of South Gate, California, near Los Angeles, first adopted this methodology (City of South Gate, 2009). The city government aims to preserve and enhance the strengths of the city, including strong neighbourhoods and the unique character of the town centre, through its General Plan. It also aims to respond to citizens' desires to improve the city's visual quality, address residential overcrowding and provide expanded economic opportunities. Mixed land use is also a goal, given the predominance of industrial jobs and the lack of job diversity, with few office and research and development positions, and also a lack of variety of restaurants and retail stores, especially at the higher end.

The plan sets up 13 community design strategies, at least 5 of which are related to mixed-use polices. Firstly, they introduce new developments to be focused on transit corridors. Second, they plan to create neighbourhood nodes, local community meeting and gathering places with a mix of uses, to serve residents' daily needs throughout the city. Thirdly, a transit village is planned near the city's two major intersections, and new transit uses are to be explored for the area, as well as a mixed-use district with high-density housing, retail and office use. Fourth, a civic centre district and mixed-use opportunities, including retail and residential, will also be explored, as will a mixed-use educational centre and mixed-use amenities.

The city government also plans to create mixed-use corridors linking major activity centres in the city. The South Gate General Plan 2035 uses "Place Types" designations that include form and character requirements, unlike other general plans, which designate an allowable future land use for each parcel. The General Plan and the "Place Types" approach have several distinctive characteristics. They divide the city of South Gate into unique and identifiable neighbourhoods, districts and corridors, before designating land uses (place types, in this case). This is comparable to Korea's concept of the special zoning district, but designates every parcel in the city as a neighbourhood, district or corridor. As the General Plan report notes: "This approach goes beyond simple allowable land uses and identifies the character and form of a community. Neighbourhoods, [d]istricts and [c]orridors define the geography of the community and provide the [c]ity with a sense of identity and uniqueness" (City of South Gate, 2009). Secondly, conventional land-use designations (which identify only use and density/intensity) are replaced with "Place Type" designations. Allowable place types rather than allowable land uses are named in the policy guidance for each district and corridor. The plan suggests 15 allowable place types: neighbourhood low, neighbourhood medium, neighbourhood medium-high, neighbourhood high, neighbourhood centre, boulevard medium-high, boulevard high, urban village, single-use retail, main street, office/R&D, light industrial/flex, manufacturing/distribution, civic/institutional and open space. Like land-use regulations of conventional zoning, each place type identifies the specific allowable land use and the density or intensity of use. In addition, "Place type designations also include policy guidance that addresses the form and character of future development", as explained above. Each place type designation includes design guidance: "building location and frontage, pedestrian access and design, public transport access and design, and private vehicle access, parking and services. In this way, [p]lace [t]ypes add a third dimension to the traditionally two-dimensional land-use plan" (City of South Gate, 2009). The plan also contains a brief description and images of the desired character of each place type for reference. The last, but most important, characteristic of this approach for enhancing mixed land use is that "more than one [p]lace [t]ype may be applied to each [d]istrict and [c]orridor (or sub-part thereof)". This allows for a greater mix of uses and for flexibility in meeting future economic and environmental conditions or changes in the community's vision for the area. Additionally, to better express the desired vision for each district or corridor, a hierarchy of permitted place types was identified, ranging from "highly desired" to "discouraged".

Source: City of South Gate (2009), "The City of South Gate General Plan 2035", City of South Gate, California.

Incentive zoning could be designed to meet specific urban goals, such as mixed land use, mixed income (affordable housing) and inclusion of public amenities on site. For example, the city of New York has five special mixed use districts (Special Coney Island Mixed Use District, Brooklyn; Special Franklin Street Mixed Use District, Brooklyn; Special Hunters Point Mixed Use District, Queens; Special Lower Manhattan Mixed Use District, Manhattan; and Special Northside Mixed Use District, Brooklyn), and each district provides zoning incentives (such as a FAR bonus) for developers who provide the specific urban qualities the commission seeks to promote in that area. These special zoning areas and incentive tools have contributed to diversity of land use and to the vitality of the city.

Financial incentives could be also considered. The Oregon Transportation and Growth Management Program (2013) provides a good example. Many cities in Oregon designate "urban renewal districts" to finance mixed-use developments in town centres and commercial areas. Financial incentives in use are: tax increment financing, which provides funds for land acquisition and project development in targeted areas; tax abatements for the housing portion of a mixed-use project; reduction of permit fees in targeted areas; and reductions or waivers in system development fees in targeted areas (Oregon Transportation and Growth Management Program, 2013). The grant programme is another example of financial incentives. The city of Monroe, Louisiana, implements a "Mixed-use Development Incentives (MuDI) Grant Program". This is an incentive to taxpaying entities planning to convert a building within the central business district (CBD) or municipal service district (MSD) of downtown Monroe into a mixed-use development. This programme provides an incentive of a minimum of USD 5 but up to USD 10 per square foot based on USD 100 of value per square foot for seven years, at the City Council's discretion. For example, a property owner who wants to convert a 25 000 square-foot building (value: USD 2.5 million) into a mixed-use building, can receive a grant of at least USD 125 000 for seven years (USD 17 857 per year). The mixed-use projects must be multi-building projects consisting of a minimum of 25 000 square feet, to maximise their economic impact and quality development. In addition, property owners must meet the following conditions (City of Monroe, 2013):

- the grant portion of the project must be spent on the exterior and interior renovation of existing buildings only
- the proposed project must meet all applicable zoning requirements
- all required permits (i.e. zoning) must have been obtained prior to payment
- the proposed project must follow the guidelines for renovation and rehabilitation of historic structures or structures within historic districts.

Beyond zoning bonuses, deregulation of zoning restrictions could be a powerful strategy of regulatory incentives. The Portland city government rezones by reviewing existing zoning regulation when property owners or developers wish to propose mixed-use development projects. The reviewing process focuses solely on the impact of new mixed-use development rather than whether the use is appropriate. Other regulatory incentives include (Oregon Transportation and Growth Management Program, 2013):

- providing density and building height or floor area bonuses when a specified mix of uses is proposed and a high level of pedestrian orientation is provided
- allowing mixed-use master plans to set the development framework, followed by administrative review of specified phases of the master plan

- allowing "adjustments" to code standards (instead of variances) in the context of a discretionary review
- allowing automatic adjustment of up to a specified percentage of certain (limited) standards for mixed-use projects (e.g. building height, lot coverage, etc.).

Integrate land-use policy with transport policy through transit-oriented development strategies

Develop well-defined policy packages

Korea could elaborate an appropriate type of TOD model reflecting the context of Korean cities as well as comprehensive policy packages. According to the Korea Master Plan for Multimodal Centres (2011-2015), rail station areas are expected to be developed as mixed land use and high-density areas.[16] In addition, several new town development projects, including the Unjung New Town, introduce the concept of TOD (Box 2.14). Existing plans to apply the TOD concept look promising but need to be more comprehensive and involve diverse stakeholders in the decision-making process. This is important to avoid allocating limited financial resources only to physical development, which is typical of current TOD projects in Korea. It should also play a more critical role in providing the policy framework to integrate urban planning and transport investment.

Box 2.14. **Unjung New Town Project in Korea**

The Unjung New Town project plans to accommodate a population of 132 000 in the north-western suburbs of the Seoul Metropolitan Area. This project focuses new development around the rail station and introduces bus rapid transit (BRT) investment. The plan allows for two major regional transit systems with 134 000 trips a day in the New Town on Gyeonggi railway and the regional motorway BRT route. The Gyeonggi line passes through Unjung New Town's two railway stations for a trip of about 35 to 45 minutes to Seoul. The two rail stations will play an important role in encouraging the new town residents to take public transit rather than driving, to travel to neighbouring cities such as Goyang, Ilsan New Town and Seoul. An additional regional public transit system will be added with BRT lines operating on the motorway, known as "the second freeway", which is planned to deal with potential traffic congestion from the new towns. The BRT lines are also planned along arterial roads in the city, either transferring travellers to rail stations or taking them directly to Goyang, Ilsan New Town and Seoul.

Source: Kim, K. (2006) "Policy issues of TOD in new town planning process", paper presented at the International Workshop Newtown Planning and Transit-Oriented Development in Seoul.

TOD planning should cover diverse scales, beyond small land development or spot development around a station. The experience of other OECD metro-regions shows the importance of creating TOD at a large enough scale to provide a sufficient number of public transit customers. The Hammarby Sjöstad neighbourhood in southern Stockholm, for example, set the ambitious goal for 2010 of increasing trips by public transit, foot or bicycle to 80%. By 2015, it is expected to house 20 000 residents in 9 000 apartments. The development was close to reaching its goal by 2008 when the overall share of public transit, walking and bicycle trips had increased to 79% (OECD, 2012c). The Finger Plan of Copenhagen's Capital Region is one of the best-known examples of urban containment land-use regulation and transit-oriented zoning (TOZ). Under the plan, the principle of accessibility, i.e. the rule that large office workplaces will generally have to be located within 600 metres of the closest public transport station, is a key element for controlling sprawl and maintaining a compact urban form (OECD, 2012c).

TOD strategies could integrate much broader regional goals, such as addressing traffic congestion, improving the local economy and enhancing public health. Regional socio-economic conditions, such as population growth and employment, and the structure of industry should also be considered at the planning stage. TOD at the corridor scale (TOC) could be considered to realise benefits from TOD at the regional level (Box 2.15). TOC in particular could be considered an effective method for creating green cities, as it would work with the existing TOD arrangements, and could fit into the local context with minor adjustments. TOC strategies could help avoid building high-rises scattered around a station, while maintaining local cultural and residential functions.

Box 2.15. **Three basic transit-oriented corridor types**

Three main types of corridor include: destination connector, commuter and district circulator. While the categorisation is less clear in reality, each type is defined by what it connects to and each connection's potential impact on transit-oriented development (TOD).

- Destination connector: This corridor suggests five implications for TOD. First, new development demand is likely to be anchored in areas near stations identified as "destinations", with high-intensity activities and connectivity to surrounding neighbourhoods. Second, higher density development is more likely to occur along destination connector corridors, due to the higher market demand for locations with access to job markets and activity centres. Third, destinations outside downtowns have potential for new development as long as they serve as an activity centre that people often want to visit. Fourth, existing malls and commercial centres that produce jobs, even if they are close to stations, may require a new urban design approach, including improved roads for pedestrians and better buildings, to function as a true transit centre. Last, a higher transit ridership can be ensured if access for pedestrians and bicycles is easier, in particular near employment centres where people are unlikely to walk long distances.

- Commuter: This type of corridor, such as heavy rail, connects to a single major activity centre for the commuting trip into and out of the central business district (CBD) every day. During peak business hours, transit service along commuter corridors is typically of moderate to high frequency, and tapers off otherwise. For commuter corridors, enhancing access to stations for pedestrians and cyclists is crucial to promoting ridership. Second, in terms of transit feeder services and park-and-ride lots, commuter corridor stations are more appropriate in suburban than urban neighbourhoods, since many riders in suburban areas will need to travel longer distances.

- District circulator: These corridors expedite movement within an "activity node", a downtown or a commercial, medical or educational centre. District circulator corridors enhance walkability and accessibility to amenities in a district without use of a car. They can also help reduce parking ratios and revitalise retail outlets, without providing more parking lots. The frequency of the district circulator service is the key element for transit connectivity, and must be incorporated early in the development process. District circulators connected to core destinations within exploitable areas where the real estate market is active are the best option for attracting market-rate development.

Source: Thorne-Lyman, A. and E. Wampler (2010), *Transit Corridors and TOD: Connecting the Dots*, Center for Transit-Oriented Development, www.reconnectingamerica.org/public/reports (accessed 13 August 2012).

A bold, long-term plan to consolidate urban planning and transport investment, in addition to laws that implicitly support TOD,[17] helps to keep TOD policies on track and sends a powerful signal to the private sector to support TOD projects. Massachusetts'

Department of Transportation is supporting TOD through funding and revising its road design standards. The state's 20-year transport plan commits fully half of future funding to transit and requires zoning reform in all new corridors (Center for Transit-Oriented Development, 2007). The "Integrated Transport and Spatial Development Concept for Luxembourg" (*Integriertes Verkehrs- und Landesplanungskonzept für Luxemburg*, or IVL), adopted by the Luxembourg government in 2004, offers guidance on how to translate the spatial planning principles set out in the *Programme directeur* into practice. By using integrated thinking and co-ordinated action plans for transport and spatial planning issues, the IVL constitutes a new planning approach that will have a major influence on planning practice in the long run (OECD, 2010). Government intervention can come in many forms, but creative ideas for raising funds can often be found (Box 2.16).

Box 2.16. **Examples of transit-oriented development funding**

The TOD Housing Program of California's Department of Housing and Community Development provides low-interest loans for gap financing for rental housing developments of 50 units or more; mortgage assistance for homeownership; and grants for the construction of infrastructure and mixed-income housing projects close to transit. Housing projects must be within half a mile of public transit, and at least 15% of units must be affordable.

The TOD Bond Program of the Connecticut Office of Policy and Management as part of a larger bond bill passed in 2007 features three primary components: *i)* bond issuance for project-specific TOD capital expenses; *ii)* funding for planning of TOD projects; and *iii)* facilitation grants that assist communities in setting the stage for TOD. Grants for planning and policy implementation are between USD 250 000 and USD 1 million. The bond legislation permitted USD 10 million over two years.

The Commercial Area Transit Node Housing Program of Massachusetts' Department of Housing and Community Development provides financing assistance to rental housing projects near transit, including zero-interest loans, 30-year deferred payment loans at zero interest for rental housing projects, or homeownership projects that carry a 30-year deed restriction that limits the sale price of the home to a percentage of area median income. Projects must be located within a quarter-mile of existing or planned transit stations. Priority is given to projects within existing tax-increment financing areas.

Minnesota Housing's Land Acquisition for Affordable New Development (LAAND) Program, also sponsored by the Metropolitan Council and the Family Housing Fund, provides loan financing to acquire land for affordable housing projects in places that are close to job growth areas or significant numbers of lower wage jobs. The goal is to allow for density that is consistent with achieving affordability, to minimise vehicle miles travelled, and make residents remain close to public transit.

Source: Center for Transit-Oriented Development (2007), "Realizing the potential: Expanding housing opportunities near transit", Center for Transit-Oriented Development, Oakland, California.

Clear guidelines or standards could be developed for planning, implementing and evaluating long-term plans at the national and local level. The Institute for Transportation and Development's (ITDP) recent proposal for the TOD Standard could offer insights for Korean policy makers (ITDP, 2013). The eight standards suggested are: *i)* develop neighbourhoods that promote walking; *ii)* prioritise non-motorised transport networks; *iii)* create dense networks of streets and paths; *iv)* locate development near high-quality public transport; *v)* plan for mixed use; *vi)* optimise density and transit capacity; *vii)* create regions with short commutes; and *viii)* increase mobility by regulating parking

and road use. Such standards could be used to evaluate TOD projects at the design or completion stage, and provide policy guidance and regulations related to urban planning, land use and urban design (ITDP, 2013). One effective way to facilitate TOD in Korea is for the national government and cities to build a geographic database to monitor and track data on development activity, demographic changes and property values at the station areas, on the lines of the United States' *National TOD Database* (Box 2.17). This could help fine-tune policies aimed at promoting TOD, and share information on trends and accessibility with various stakeholders, thereby involving them in the TOD projects.

Box 2.17. *National TOD Database* in the United States

The *National TOD Database* has been built by the Center for Transit-Oriented Development (CTOD). The database offers economic and demographic information for existing and proposed transit stations in the United States. The database, a tool for planners, developers, government officials and academics, included 4 417 existing stations and 1 583 proposed stations in 54 metropolitan areas, as of December 2011. Data are available at three geographic levels: the transit zone (the half-mile or quarter-mile buffer around the individual station); the transit shed (the aggregate of transit zones); and lastly, the transit region (aligned with the Metropolitan Statistical Area boundary). Nearly 70 000 variables are derived from nationally available data sets including the 2000 and 2010 Decennial Census, the 2009 American Community Survey, the 2000 Census Transportation Planning Package and the 2002-2009 Local Employment Dynamics.

Source: Center for Neighborhood Technology (2013), *TOD Database*, http://toddata.cnt.org (accessed 5 November 2013).

Combine with strong traffic demand management strategies

Traffic demand management (TDM), encouraging private car users to use more public transport, will help maximise the effectiveness of TOD strategies (Box 2.18). Specifically, TDM could provide a helpful tool to combat potential adverse effects such as traffic congestion, which could detract from the positive impact of compact city policy. It should be noted that in developing TDM strategies, policy makers should pay special attention to identifying whether the increase in mass-transit ridership can be attributed to walking and cycling commuters or private car users.

Several policy initiatives to reduce the use of private car have been widely discussed (Box 2.19). As the OECD notes (2012b), their success depends on how to generate broad public support. One way is to provide the public more options, by car sharing, for example. In Paris, Autolib' is a station-based electric car-sharing service allowing users to pick up and drop off cars at any of the system's stations for short-term use. As of May 2012, subscribers had access to 1 700 self-service electric cars (3 000 at full deployment) docked at 1 000 stations in Paris and 45 surrounding communities. The service was inaugurated in December 2011 and is operated under a public service delegation concession, currently granted to the Bolloré group. Autolib', and other car-sharing systems, give young professionals living in city centres flexible options that increase their choices without tying them down to a car (International Transport Forum, 2012).

Box 2.18. **Transit-oriented development strategies help reduce greenhouse gas emissions**

Transit oriented development (TOD) can be an effective tool for reducing greenhouse gas (GHG) emissions in the transport sector. The Centre for Transit-Oriented Development (2010) showed that for every household the number of cars owned and the number of miles driven is largely determined by where that household is located. This study analysed vehicle miles travelled (VMT) per household for six different types of location in US cities. It noted that the average GHG emissions per household can vary by more than 4.5 times according to development density and accessibility to public transport. It also calculated that a household living in the most efficient transit zone can reduce GHG by as much as 78% compared with those living in an average location. Application of these emission factors to the Chicago metropolitan area showed that a household's VMT and carbon footprint can be dramatically reduced by living in a location-efficient neighbourhood, with compact development within half a mile of a transit stop. Living in a central city near transit, the average household can reduce its GHG emissions by 43%.

Source: Centre for Transit-Oriented Development (2010), "Transit-oriented development and the potential for VMT-related greenhouse gas emissions growth reduction", Centre for Transit-Oriented Development.

Box 2.19. **The restated policy initiatives to achieve green transport**

Parking tariffs. Parking tariffs can help promote a shift from private to public transport modes and/or discourage non-residents from using their automobiles, resulting in lower greenhouse gas emissions. Some parking tariff schemes increase the hourly cost of parking and/or limit the available parking time; others distinguish between residents and other users of public urban parking spaces (Calthorp, E., S. Proost and K.V. Dender, 2000). In Korea, local governments have the authority to apply parking tariffs in cities. Most Korean local governments operate their own parking tariff policies, although the policy structure is relatively simple in most areas (e.g. a single tariff charged in proportion to the time parked, with an exemption for the disabled). Change in the tariff policy often encounters opposition from residents. Depending on the source of the vehicles (e.g. residents or non-residents), one solution could be for local governments to consider more flexible parking policies that distinguish between residents and non-residents. In Paris, residents are given the possibility of parking for longer periods than non-residents. Alternatively, the pricing may vary based on the location or time of day. Lower parking tariffs could be adopted for low-emission (hybrid and electric) vehicles, which may be effective in promoting the modal shift towards less polluting modes of transport. To generate broader public support for parking tariff policies, this approach should be combined with other instruments and incentives that discourage private vehicle use and encourage public transit, walking and cycling.

Road charges. Taxing the use of roads is an old idea (Henderson, 1974) that has been implemented in different urban contexts: Singapore, Norwegian municipalities and most recently London and Stockholm. Congestion pricing can take different forms, but most commonly consists of setting a price on busy roads during peak hours or levying a charge to access a specific zone, such as city centres. The Area License System, which charges a fee to traffic that flows in and out of designated zones in Singapore, and the congestion charges in Stockholm and London, are notable examples. Further reductions in traffic volume in urban areas could be achieved through the implementation of a Vehicle Quota System, to directly control the growth of the vehicle stock (as in Singapore). To increase the political acceptability of these types of fiscal disincentives, complementary measures to improve public transport should also be implemented to limit redistributive inequities. Fees collected could be invested for improvements in public transit, as they are in London. Singapore promised revenue neutrality by reducing vehicle taxes, while the Dutch proposed to replace vehicle ownership-based charges with usage-based charges (OECD/ITF, 2010).

Box 2.19. **The restated policy initiatives to achieve green transport** (*cont.*)

Land use tax. An increasing number of municipalities have replaced taxes on the value of buildings with taxes on the value of land sites, resulting in a decoupling of land value from the value of real estate improvements (Cohen and Coughlin, 2005). With the most famous example in Pittsburgh (Pennsylvania) (Oates and Schwab, 1997), nowadays more than 700 cities worldwide use a "two-rate" taxation system, whereby the majority of property values is represented by land, whose value is often increased as a result of public investment in the surrounding area (e.g. attractive neighbourhoods and services). As a result, property owners benefit from increased value for which they bore none of the cost. Empirical and theoretical studies have shown that the "two-rate" scheme can lead to a higher quality of residential buildings, greater production output, higher rates of employment, increased urban security, less speculation, lower land prices and ultimately higher population densities, which can contribute to reducing commuting distances and transport-related GHG emissions.

Command-and-control measures (e.g. land-use [zoning] regulations, fuel efficiency standards). Zoning regulations that limit vehicle access (or the access of certain types of vehicles, such as heavy trucks) in certain zones is a clear example of a command-and control measure at the urban scale. These types of policies can be implemented to address externalities like noise and pollution intensity (including GHG emissions) associated with heavy cars and trucks. Zoning may influence the demand for transport volume, notably by reducing traffic by heavy cars in urban centres, which can in turn help to reduce GHG emissions per kilometre driven. Only recently, some metropolitan governments in Korea (for example, Daegu, Busan and Incheon) have introduced "transit mall districts", which are only accessible to public transport and bicycles. The policy has met with some resistance, however, due to uncertainty about the effect on congestion levels in nearby districts and on local businesses. To expand this type of zoning and generate greater public support, cities could increase the flexibility of these instruments, for example by allowing low-emission cars into the district at certain hours, and by committing to investing revenues from fines in public transport improvements and urban amenities. London's Low Emission Zone (LEZ) is a good example. Since 2008, public authorities have operated a LEZ that prohibits access by most polluting heavy diesel vehicles, and tighter standards were applied in 2012, under which more vehicles were affected (Transport for London, 2013).

Spatial planning. A number of studies have provided evidence of the positive role of physical (urban) planning in effectively curbing long-term urban GHG emissions (notably from transport), although this type of instrument has not been shown to be effective in the short term (Greene and Schafer, 2003; Rietveld, 2006). Cities' reactions to changes in the spatial structure (involving the relocation of activities, new buildings and new infrastructure) involve a certain time lag. Mismatch between land use and transport policies has all too often aggravated traffic congestion around metropolitan cities.

Sources: Calthrop, E., S. Proost and K.V. Dender (2000), "Parking policies and road pricing", *Urban Studies*, Vol. 37, No. 1, SAGE, London; Henderson, J.V. (1974), "Road congestion: A reconsideration of pricing theory", *Journal of Urban Economics*, Vol. 1, No. 3, Elsevier; OECD/ITF (2010), "Implementing congestion charging; Summary and conclusions", *OECD/ITF Joint Transport Research Centre Discussion Papers*, No. 2010/12, OECD Publishing, Paris, http://dx.doi.org/10.1787/5km4q8jw1vzp-en; Cohen, J.P. and C.C. Coughlin (2005), "An introduction to two-rate taxation of land and buildings", *Federal Reserve Bank of St. Louis Review*, May/June, Vol. 87, No. 3, Federal Reserve Bank of St. Louis, St. Louis, Missouri; Oates, W.E. and R.M. Schwab (1997), "The impact of urban land taxation: The Pittsburgh experience", *National Tax Journal*, Vol. 50, No. 1, National Tax Association, Washington, DC; Transport for London (2011), "Low Emission Zone", www.tfl.gov.uk/roadusers/lez (accessed 24 May 2011); Greene, D.L. and A. Schafer (2003), "Reducing greenhouse gas emissions from US transportation", Pew Center on Global Climate Change, Arlington, Virginia; Rietveld, P. (2006), *Transport and Environment, The International Yearbook of Environmental and Resource Economics 2006/2007*, Edward Elgar, Cheltenham, United Kingdom.

Congestion fees to tax the use of roads could be expanded to discourage private car use, and the revenues generated by the charge could be used to improve public transport networks. Seoul is the only city to have introduced road charging in Korea, with a limited approach that was launched in 1996. It charges KWR 2 000 (approximately equal to

USD 2) to private automobiles with fewer than two passengers. It operates on weekdays (7 a.m.-9 p.m.) and on Saturdays (7 a.m.-3 p.m.). Between 1996 and 2006, the traffic volume of private vehicles decreased by 20.8% in the tunnel and increased by 1.4% on detour roads, because drivers chose to take bypass roads in order to avoid the charge (Mo, 2009). At the same time, the average traffic speed through the Namsan Tunnel increased by 115%. This type of congestion charge could be expanded to other areas of Seoul and to other cities (OECD, 2012b). Several attempts have been made to increase charging fees and expand to other congested major arterial roads, such as urban expressways, but these failed owing to public opposition and concerns over stagnation of the local economy. A better-designed approach could help win support from the city government and citizens. Diverse approaches to congestion pricing, including value pricing and area pricing, could be examined with a view to diversifying congestion fees in Korea, reflecting the characteristics of different urban development patterns (Boxes 2.20 and 2.21).

Box 2.20. **Two approaches to congestion fees: Value pricing and area pricing**

Several European countries and Singapore implement congestion fees under an area-pricing system to charge for entry or travel to a congested area. The United States, by contrast, charges congestion fees by value pricing for travellers on a particular segment of a facility. For example, drivers may be offered the option of slower, free lanes or faster lanes with tolls. Each pricing system has evolved out of a different urban context and philosophy. The spatial structure of European cities tends to be monocentric and sometimes radial, with a "natural" boundary, and are more likely to introduce a *cordon*, or corridor around the urban area, while typical US cities are polycentric and are based on a grid structure. Another reason for the difference in pricing systems lies in different perspectives on congestion fees. The area-pricing approach emphasises maintaining reasonable service levels overall, whilst value pricing emphasises the supply of premium service on the premise of an easy switch to a lower quality. In an economic sense, both pricing systems result in better outcomes than when there is no extra charge. However, in terms of maximum benefits according to a user's willingness to pay, a value pricing system can perform better.

Source: OECD/ITF (2010), "Implementing congestion charging; Summary and conclusions", *OECD/ITF Joint Transport Research Centre Discussion Papers*, No. 2010/12, OECD Publishing, Paris, http://dx.doi.org/10.1787/5km4q8jw1vzp-en.

Parking, both in costs and time spent looking for a place, have significant effects on mode choice (Axhausen et al., 2011). Parking management could be one of the most critical elements of a TDM package. Free parking is one of the biggest incentives for driving, and encourages people to own a vehicle. Parking regulations as a maximum parking requirement, public parking fees and burden fees for large-scale private buildings that contribute to an increase in traffic volume do not seem to be enough to control traffic, as is evident in the growing volume of traffic in Korea. Most large cities continue to regulate the minimum requirement, paying less attention to identifying real parking capacity in cities, even though parking spaces may exceed the parking demand (Figure 1.34). This calls for scientifically rigorous parking policies using an analysis of supply and demand for parking space in the market. For instance, separating parking costs from rent is a feature of the new development plan for San Francisco's Balboa Park station, which excluded parking from the base price of new neighbouring housing units (close to the station) to avoid overcharging tenants who do not own or may not need a car. An increasing number of small-scale developments have been selling well even with little or no parking space in Berkeley, California, and the Seaboard Building in Seattle (Tumlin and Millard-Ball, 2003).

Box 2.21. **Selected urban congestion charges**

Central London introduced the congestion charge as an economic measure to lessen congestion, but it evolved into an environmental and economic regulation in 2009. The charge, applied from 7 a.m. to 6 p.m., is GBP 10 for cars with high CO_2 emission levels, while registered electric vehicles are exempted. The policy has helped reduce traffic by 60 000 car trips a day and cut fuel consumption by 20% in 2008.

Stockholm has enforced the congestion charge as a *cordon* around the city, with gantries across all entries and exits. The fee varies by the time of day, with an exemption for hybrid and electric vehicles. The charge has reduced car use by 25%, congestion by 14% and local greenhouse gas emissions by 2.7%, while public transport use has risen by 60 000 passengers daily. The frequency of public transport has meanwhile improved, which both encourages modal shift and guarantees quality of service.

In 1975, Singapore replaced its Area Licensing Scheme (ALS) with electronic road pricing, a levy on trips into the central business district (CBD), by using an electronic in-vehicle unit and a cash card. The charge depends on time, congestion levels and vehicle types, and the results have been encouraging. Traffic volumes in the CBD have decreased by 10-15% compared to the former ALS.

Sources: Ang, G. and V. Marchal (2013), "Mobilising private investment in sustainable transport: The case of land-based passenger transport infrastructure", *OECD Environment Working Papers*, No. 56, OECD Publishing, Pairs, http://dx.doi.org/10.1787/5k46hjm8jpmv-en, cited from "Implementing congestion charging; Summary and conclusions", *OECD/ITF Joint Transport Research Centre Discussion Papers*, No. 2010/12, OECD Publishing, Paris, http://dx.doi.org/10.1787/5km4q8jw1vzp-en; United Nations Environment Programme (UNEP) (2011), "Transport: Investing in energy and resource", UNEP, Nairobi; Sakamoto, K. and S. Belka (2010b), "Financing sustainable urban transport", Module 1f in *Sustainable Transport: A Sourcebook for Policy-makers in Developing Countries*, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, www.sutp.org/index.php/component/phocadownload/category/23-1f?download=23:1f-fsut-en; Tochtermann, L. (2008), "Congestion charging: A tool to tackle congestion in UK cities?", Centre for Cities, www.centreforcities.org/assets/files/Congestion%20Charging.pdf; PricewaterhouseCoopers (PwC) (2008), *Urban Transportation Financing, A Strong Case for Public-private Partnership,* Government Reform and Infrastructure Development (GRID) practice of PwC India, PricewaterhouseCoopers, London; Eliasson, J. (2006), "Cost-benefit analysis of the Stockholm congestion charging system", http://siteresources.worldbank.org/INTTRANSPORT/Resources/StockholmcongestionCBAEliassonn.pdf; Christiansen, G.B. (2006), "Road pricing in Singapore after 30 years," *Cato Journal*, Vol. 26, No. 1, www.cato.org/pubs/journal/cj26n1/cj26n1-4.pdf.

Provide accessible public transport

Providing public transport or, more specifically, developing a public transport network to enhance accessibility, could be an effective way to reduce private car use, and therefore should be the backbone for sustainable urban transport. This is aligned with the OECD's argument that linking urban areas with public transport is one of the three key characteristics of the compact city (OECD, 2012a). Several policy initiatives to promote public transport, in particular as expressed in government documents including the "Greening Urban and Building Initiative" announced by Korea's Ministry of Land, Transport and Maritime Affairs in 2009, should be continuously implemented, to send a consistent signal to local government and private investors. The key policy initiatives stated are: *i)* prioritising low-carbon infrastructure investments by increasing the share of national social overhead capital (SOC) spending on railways from 29.3% to 50% by 2020 and restricting road investments from 57.2% to 40% by 2020; *ii)* promoting public transit by expanding bus rapid transit (BRT) lanes; *iii)* expanding the metropolitan-wide railway and completing the second bullet train line connecting Seoul to Gwangju; and *iv)* introducing a Green Traffic Priority Region to manage areas of heavy traffic[18] (Ministry of Land, Transport and Maritime Affairs, 2009a).

Enhancing the public transport network requires transport planners to take decisions about the appropriate scale of the road network and to seek balanced transport investment between transport modes. More roads could invite more traffic. "The volume of car traffic almost everywhere is more or less arbitrary, depending on the available transportation infrastructure. Because we can always find new ways to increase our car use, building extra roads is a direct invitation to buy and drive more cars." (Gehl, 2010). Since the 1989 earthquake, San Francisco has converted certain freeways to city streets, which has turned the Embarcadero into a city boulevard with trolley cars, trees and wide sidewalks. The city of Copenhagen has reformed its road network by removing driving lanes and parking places in order to provide better conditions for bicycle traffic. This has resulted in a drastic increase in bicycle traffic[19] (Gehl, 2010). The key to increasing public transport use is service-based network planning: more frequent buses, better co-ordination with existing rail services and more convenient transfers (OECD, 2012d).

Provide affordable housing near transit corridors

TOD could help combat potential adverse effects, including rising land values around development sites. The recommendation of the Center for Transit-Oriented Development (CTOD) to expand housing opportunities near transit provides useful insights into establishing a comprehensive TOD strategy in Korea. Strategies proposed by the CTOD include: *i)* identify and utilise opportunities for TOD; *ii)* provide incentives for mixed-income market response; *iii)* remove regulatory barriers to higher density and transport plans and investments; *iv)* improve local capacity and partnership (Center for Transit-Oriented Development, 2007).

Identifying and utilising opportunities for TOD could be realised through examining what percentage of future growth is likely to be situated close to transit, and assessing the potential areas of low-income household displacement for TOD opportunity sites. This includes examining which portion of regional housing growth can be located around transit-accessible locations, and providing transit service to under-served areas. The Center for Transit-Oriented Development (2007) provides steps to identify opportunity sites to: *i)* identify the "type" of transit corridor according to the corridor typology; *ii)* identify transit zones and the market demand for new housing and jobs; *iii)* identify potential for (re)development within the transit zones; *iv)* identify the barriers to encourage or attract housing and affordable housing development to transit zones; *v)* identify the tools available (and try to develop missing tools) to help attract mixed-income housing in transit zones; and *vi)* identify and utilise publicly owned properties along transit corridors for mixed-income housing (Center for Transit-Oriented Development, 2007).

Incentives could be provided to form mixed-income communities in line with TOD. Offering density bonuses for developers that provide affordable housing near transit is one potential strategy. Density bonuses are a common tool used in TOD. For example, bonuses have been introduced to create housing and retail spaces in buildings near the Ballston Metro station in Arlington, Virginia. Another option are fiscal incentives to support the private housing market for low-income citizens. This can include introducing a value-added tax (VAT) or income tax cuts for homeowners to rent serviced apartments for the low-income group, along the lines of the Student Housing Programme in France[20] (OECD, 2002). Third, active land acquisition around transit could be adopted to secure developable land, and to supply affordable housing near transit. The South Corridor Land Acquisition Fund in Charlotte, North Carolina, is a good example. It was built for the purchase of land near transit stations to create TOD (Center for Transit-Oriented

Development, 2007). The purpose was to encourage private sector TOD by supporting land acquisition, removing inappropriate land uses and assisting in mixed-income housing development. Fourth, less restrictive land uses such as allowing accessory dwelling units (ADUs) with some incentives could help provide affordable housing. Bellevue, Washington, allows the development of ADUs. As an incentive, the city requires a low registration fee of only USD 25 for homeowners retrofitting their house with an ADU (Center for Transit-Oriented Development, 2007). Lastly, coupling affordable housing policy with affordable transport policy is a more active way to achieve this goal. The Metrovivienda programme in Bogotá, Colombia, provides a good example of reducing the joint costs of housing and transport, which account for two-thirds of the income of the poor in Bogotá (Box 2.22).

Box 2.22. **Bogotá's Metrovivienda programme: Bundling low-cost housing and public transport**

Metrovivienda, an innovative land bank and poverty-alleviation programme introduced in Colombia in 1999, aims to serve low-income groups living in informal housing clusters. The programme acquires plots at relatively low prices, establishes development plans and provides public facilities. Recently, four Metrovivienda sites have been established near one of Transmilenio's terminuses, planning to build 440 000 new housing units to relocate peripheral illegal settlements in transit-served areas. The project allows new residents to enjoy closer access to jobs, along with improved housing. The programme strategically acquired land before the land price rose with the arrival of the Transmilenio, helping to provide affordable housing. Under the programme, housing and transport are treated as a bundled package.

Source: Cervero, R. (2011), "State roles in providing affordable mass transport services for low-income residents", *International Transport Forum Discussion Papers*, No. 2011/17, OECD Publishing, Paris, http://dx.doi.org/10.1787/5kg9mq4f4627-en.

Improve multi-level governance to achieve compact city goals

The compact city model is multi-level, multi-sectoral and integrated. Well-organised, networked governance is an essential prerequisite if the strategy is to be successful (OECD, 2012a). However, as noted in OECD (2012b), co-ordination gaps in delivering a coherent response to current economic and environmental pressures are one of the key challenges of multi-level governance. Several governance gaps observed in the context of green growth in Korean cities can be applied to the implementation process of compact city strategies in the same way; gaps can exist in terms of administrative boundaries, policy, information, capacity, funding, objectives, accountability and the market (Table 2.6). This section describes several policy initiatives to reduce such gaps.[21]

The need for a functional approach beyond administrative boundaries

The compact city concept should include strong relationships between cities, outside existing administrative boundaries. Seoul and many of its surrounding cities are part of a polycentric system of cities. The policy goal should not necessarily be to encourage cities like Daejeon to become self-sufficient but to become more interdependent, so they add value to each other as part of a wider city-system. Compact city policy in Korea can work within a polycentric city-region, as it does in South East England. In the United Kingdom, London's position in South East England benefits hugely from a strong pattern of polycentricity with neighbouring urban centres (Boxes 2.23 and 2.24).

Table 2.6. **Governance gaps for delivering compact city strategies in cities**

Type of gap	Description	How does this occur in Korea?
Administrative gap	Occurs when there is a geographical mismatch between the green growth challenge or opportunity and administrative boundaries. Most of the time, administrative boundaries (municipalities, regions and states) are not fixed according to the greening challenge/opportunity logic and frontiers, resulting in a mismatch at the sub-national level that hinders the coherence of policy making and makes the relationships between elected representative, local authorities and end-users more complex.	Existing administrative boundaries do not always correspond to the delimitations of functionally integrated economic regions. For example, it can be difficult to address air pollution sources that are generated across administrative boundaries.
Policy gap	Refers to the sectoral fragmentation of policy tasks and powers across ministries and public agencies within the central government administration, as well as among different departments within sub-national government administrations. Silo approaches in policy making foster incoherence between sub-national policy needs and national level policy initiatives and reduce the possibility for cross-sectoral policy coherence and implementation at the sub-national level. They also create uncertain market conditions that may inhibit companies from entering the marketplace in a city-region, or create conditions that make it difficult to obtain capital for infrastructure investments, business operations or expansion.	Fragmentation of urban policies in general exists at the central level in Korea, as well as for tasks related to compact city efforts involving different government ministries and agencies. At the urban scale, there is also a need to harmonise compact city policies in the fragmented local development policy framework, a result of separate plans for municipal economic development, spatial development and sectoral development. To a limited extent, local and regional governments have incorporated compact city goals and policies into urban development plans. For example, Daejeon included compact city goals as one of the key urban development goals. However, such plans are separate from spatial development and sectoral plans, and economic development plans resulting in fragmented local development policy.
Information gap	Occurs when there is an asymmetry of information across ministries, between levels of government and across local actors involved in specific policy areas. An asymmetry of information may also occur when national and sub-national authorities do not share their knowledge of what is happening on the ground, creating win-lose situations by use of information not in the possession of the other party.	Inconsistent, or non-existent, methodologies for establishing compact city-related performance, including local emissions inventories, hamper the ability of cities to assess progress toward the compact city over time and across locations.
Capacity gap	Is generated by insufficient scientific and technical expertise, know-how and infrastructure to design and implement policy. The capacity gap is particularly acute in issues related to environment and green growth. When there is a difference between the capacity required for carrying out certain responsibilities and the organisational, technical, procedural, networking and infrastructure capacity available within the local authority, an impact on the implementation of desired policies is unavoidable. The capacity gap also applies to the national level in terms of managing multi-level relations, allocating responsibilities and funds, and ensuring co-ordinated, coherent policy approaches among central level actors.	A lack of compact city expertise at the local level (especially in small and medium-sized cities) hinders the effective implementation of compact city strategies at the urban scale.

Table 2.6. **Governance gaps for delivering compact city strategies in cities** *(cont.)*

Type of gap	Description	How does this occur in Korea?
Funding (or fiscal) gap	Refers to insufficient or unstable revenues for implementing policy across ministries and levels of government. This gap reflects a mutual dependence between levels of government, where sub-national authorities depend on higher levels of government for funding support, while central government depends on sub-national authorities to deliver the policy goals and meet both national and sub-national priorities. A funding gap can also occur if private capital is too costly because of perceived implementation risks or other factors that make private lenders or investors wary of entering the local marketplace. In the case of green growth initiatives, there may also be a disconnect related to the return on investment requirements of the project sponsor, who may seek a shorter payback period than the project is capable of delivering.	Most compact city initiatives have been heavily financed by the central government, given the generally low levels of self-reliance of local governments.
Objective gap	Occurs when diverging or contradictory objectives between levels of government or departments/ministries compromise the adoption of convergent targets over the long run. Frequently, when clear priorities are not formulated at the highest political level, conflicting interests prevent any consensus on common and aligned targets towards effective policies. Overall, the objective gap underlines the difficulties governments face in fostering strategic and territorialised planning that engages all relevant stakeholders over the long run, beyond political changes and electoral calendars. The objective gap may also arise if local political or policy interests do not align with the interests or needs of private sector stakeholders, causing them to leave the local market entirely or restrict efforts to expand in the city/region.	The economic, environmental and social aims of the compact city can at times lead to conflicting objectives. For instance, physically dense development was acknowledged as a compact city goal, while inducing environmental degradation.
Accountability gap	Refers to a lack of transparency in policy making, integrity and institutional quality issues. Ensuring transparency practices across different constituencies is crucial for effective implementation of policies. In addition, with the development of private sector participation in some sectors related to green growth, the traditional government accountability is changing. In this context, the accountability gap can be reflected in the market entry process, award criteria and contract provisions for unforeseen contingencies.	There is no public entity at central level responsible for building accountability on compact city projects, resulting in a potential gap in accountability at the local scale.
Market gap	Arises when policy goals or ambitions do not align with the ability of private sector stakeholders to deliver on these goals. The private sector is a critical partner in horizontal co-ordination efforts to advance green growth, because businesses serve many different roles in delivering this growth, such as: direct service providers contracted by government to carry out certain greening functions (e.g. transport providers, energy suppliers, water treatment plant operators, contractors responsible for energy efficiency or climate adaptation upgrades, etc.) or innovators designated to address green growth challenges or opportunities. If certain green business sectors in a city-region have not reached maturity, this can inhibit the success of certain policy solutions and clarify the need for policy action or improved co-ordination between different governmental entities.	The market for green technology is still at an early stage in Korea, and could be hampered in the long run by the current limits on small and medium-sized businesses in participating widely in the green growth industry.

Source: Adapted from OECD (2012a), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Strong, mutually supportive economic, infrastructure and labour market links between these cities and the capital are desirable. Facilitating inter-city connectivity between Seoul and other cities in the wider metropolitan area and beyond should be a key objective. This will maximise the connectivity needed to help promote mutual economic advantage. The concept of the city-region can provide insights for expanding policy efforts toward a wider area with a wider policy agenda, while avoiding unnecessary competition between cities. City-regions are thought of as a more appropriate level at which to operate economies in European countries. Neighbourhoods and local authority areas are too small and regions are too big to deliver on the urban economic competitiveness agenda (Parkinson et al., 2006).[22]

Box 2.23. **Polycentric urban form**

Since the 1980s, the reconfiguration of metropolitan areas' physical urban form has been increasingly debated among both theorists and practitioners. The monocentric model, in which central city locations are considered the sole functional focal point for all types of social and economic activity, is no longer seen as the norm in the evolving spatial patterns of urban Europe. This is also the case in North America, Australia and increasingly in Asia. Central city locations are becoming components of a wider spatial functional entity that comprises headquarters complexes, back offices, airport cities, logistics management, different kinds of housing areas and entertainment facilities. Cities (or even clusters of neighbouring cities) are integrating with their hinterlands to form multi-centred functional city regions or metropolitan areas.

Changes in metropolitan areas occur not only in inner cities but also in their hinterlands. There is increasing evidence that a new phase of development in terms of the urban periphery is emerging that is not characterised simply by growth in terms of population and the extension of the urban fabric. It also involves a wider array of economic functions and qualified jobs. The "new spaces of growth poles" take a broad variety of spatial forms and functional specialisations to create, in line with infrastructure networks, "new intermediate zones" with new centralities and peripheries. Such decentralisation processes may even lead to a hollowing-out of the traditional city (Knapp and Schmitt, 2003).

It can therefore be argued that almost all metropolitan areas, even so-called monocentric ones, can also – albeit to different degrees – be considered polycentric urban configurations, because of the morphological and functional differentiations taking place in and between neighbouring cities and towns within metropolitan areas. The role of cities is embedded in a spatially wider polycentric organisation of socio-economic activities.

This is not without consequences for spatial planning in metropolitan areas, as it entails many challenges and calls for new trade-offs and tailor-made solutions. These challenges and the resulting experience in dealing with such issues can be linked to the notion of "intra-metropolitan polycentricity" (i.e. polycentricity within metropolitan areas).

Sources: OECD (2012a), cited in METREX (2010), "Intra-metropolitan polycentricity in practice: Reflections, challenges and conclusions from 12 European metropolitan areas", Nordregio, Glasgow, United Kingdom; Knapp, W. and P. Schmitt (2003), "Re-structuring competitive metropolitan regions in north-west Europe: On territory and governance", *European Journal of Spatial Development*, http://nordregio.shotcode.no/EJSD/refereed6.pdf (accessed 20 November 2011).

The experience of many cities demonstrates the benefit of working within broader boundaries, which more accurately reflect the economy of the city-region rather than the narrower administrative boundaries of the municipal city. This is evident, for example, in Helsinki, which has created a metropolitan-wide agency to cultivate innovation; in Lyon, which has given responsibility for economic development to the Grand Lyon agency; in Barcelona, which is introducing strategic planning at the level of the metro-region rather

than the city, and Munich, where the region played a major role in incentivising networks between universities, the private sector and the city of Munich (Parkinson et. al, 2012).

Compact city policies are best carried out in such wider geographical units. The "water bed" effect noted in urban regeneration policies often means that problems are shifted from the target area to other parts of city. Residents may move out of the area to the next poorest neighbourhood, or even poorer people may flood into deprived areas after the existing residents decide to leave[23] (Colini et al., 2013). In the same vein, the national government's policy to induce "competition" between cities in pursuit of urban regeneration may need to be introduced with caution and with close co-operation from the cities.

Towards more decentralisation with appropriate resources ...

Compact city policies tend to be viewed as the responsibility of local governments. Decisions related to dense and proximate development, linking urban areas by public transport and local services and jobs are under local jurisdiction (OECD, 2012a). Korea's decision-making structure is no exception. As noted in OECD (2012b), spatial plans are developed at each administrative echelon: the National Comprehensive Development Plan, spearheaded by the Minister of Land, Infrastructure and Transport (MOLIT), followed by provincial plans, metropolitan area plans and, at the local level, urban master plans and urban management plans (Table 2.9). Such urban master plans and urban management plans have a practical influence on the spatial structure of local areas, which increases the importance of local decisions on urban policies. Again, effective implementation of compact city policies depends on local capacity. Additional powers to determine policy goals and resources should be made available to local governments.

Table 2.7. **Ministries and levels of government engaged in regional and urban policy in Korea**

Type of plan	Lead(s) for implementation	Lead(s) for approval of plans
Comprehensive National Land Plan	Minister of Land, Transport and Maritime Affairs (MOLIT)	President
Province comprehensive plan	Provincial governor	Minister of MOLIT
Metropolitan area plan	City mayor, provincial governor (Minister of MOLIT)	Minister of MOLIT
Urban master plan	City mayor, county governor Metropolitan city mayor	Provincial governor Metropolitan city mayor
Urban management plan	City mayor, county governor	Provincial governor

Source: Framework Act on National Land, www.law.go.kr/lsInfoP.do?lsiSeq=137144#0000 (accessed 20 August 2014).

In general, some decentralisation has occurred since the late 1980s. During the 1990s, local authorities were given increased responsibilities and council, mayors and governors were directly elected. Before this reform, local governments were local administrative districts of the central government. Their heads were appointed by the central government, and their capacity for autonomous decision making was virtually non-existent (OECD/KIPF, 2012). Article 117 of the Constitution of Korea states that "local governments have to focus on matters pertaining to the well-being of local residents, manage properties and may establish their own rules and regulations regarding local autonomy as delegated by national laws and decrees". To fulfil this mandate, the

Box 2.24. **London and the English Core Cities**

In England over the past few years, a dialogue has developed between London and the major regional cities (Core Cities) on how to realise their collective economic potential. The emphasis is now on cities and regions building on their own assets and opportunities to strengthen local productivity and competitiveness in the global economy, rather than relying on the redistribution of national economic growth from more prosperous regions like London and the South East.

The Core Cities Group (covering England's eight major regional cities – Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield) was founded in 1997. Its aim is to strengthen and promote the role of the Core Cities and their city-regions as drivers of regional and national economic growth. They have always recognised, however, the special role that London plays, as the national capital and a world city, in the UK economy. Similarly, London appreciates that strong regional capitals can help it to grow sustainably, so there has been a mutual interest in understanding better how their economic roles can complement each other to create higher growth in all the cities and their wider regions.

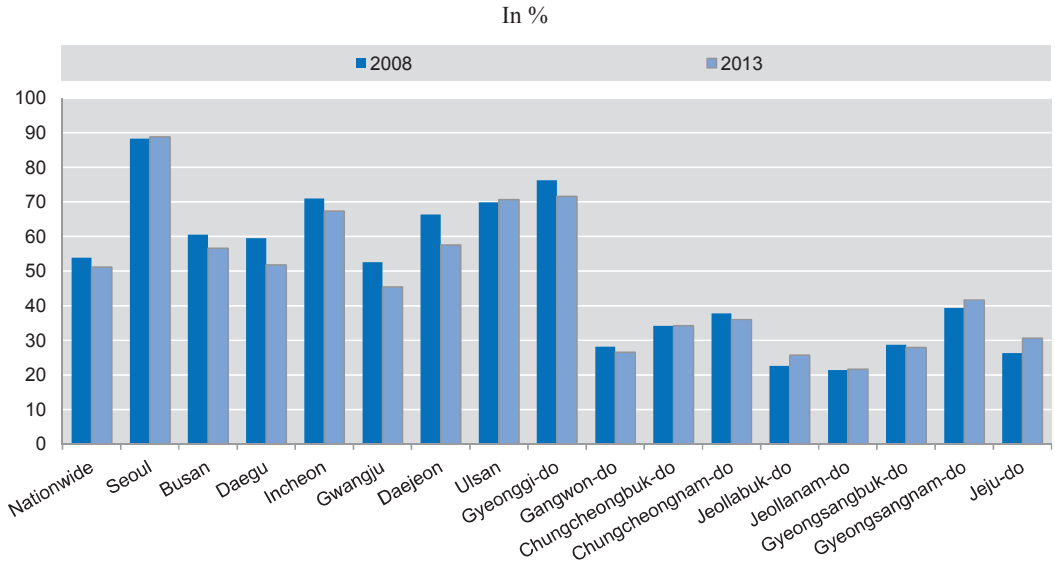
In 2002, the Core Cities and the main economic departments of central government, the Government Offices for the Regions and the regional development agencies, formed a Core Cities Working Group. This explored the policy changes and practical actions needed to enable the major regional cities to fulfil their potential as drivers of regional and national economic growth. A key commitment was to develop the Core Cities and their regions as "additional cylinders to the UK's economic engine, giving London more space to excel in the functions only a global city can bring to the UK." In 2003, the Core Cities, together with the Greater London Authority, commissioned a research study on the current and potential future linkages between London and the Core Cities. The report provided a robust analysis of economic opportunities and comparators. It also provided useful pointers to the issues that the central government and the cities needed to address to realise their potential, and also to help deliver the government's regional economic performance target (to reduce the persistent gap in growth rates between the English regions). The report confirmed that London's pre-eminence in business and financial services is tied to its role as a global centre for trading, but also identified strong financial sectors in some of the Core Cities that have potential to grow further. It touched on broader opportunities for collaboration by London and the Core Cities, particularly the importance of increased investment in transport infrastructure to support competitiveness. It also noted the need for strong city governance and decentralised powers that can take strategic decisions and be more outward looking and entrepreneurial.

The scale of the challenge facing the Core Cities in maintaining and improving their position is huge, given that most lag behind the economic performance of London and South East England. However, London's role as a global city is seen as an opportunity, not a constraint on their efforts to drive up their economic performance. London's successful bid to host the 2012 Olympics, for example, was widely welcomed by the Core Cities, which were eager for businesses in their cities to exploit the opportunities it offered. The Greater London Authority (GLA) has recognised publicly the mutual interdependence and benefits of London and other UK cities. In spite of the economic downturn, London remains a net contributor to the national economy. Between 1994 and 2004, the GLA estimates that London contributed GBP 35-89 billion more in tax to the UK economy than it received in public spending. Their analysis shows that London's tax export to the rest of the country is greater whenever London's economy is stronger. This benefits the rest of the United Kingdom, by helping to fund better public services throughout the country. Investment in London to support its continuing economic vitality thus not only benefits London but the United Kingdom as a whole. London's economic specialisation, with a much larger concentration of financial, professional and business services and a smaller manufacturing and public sector than the rest of the United Kingdom, allows London and the wider United Kingdom to gain a mutual benefit from inter-regional trade. London's pre-eminent position as a world leader in financial and related business services links it to all major regions of the global economy. London acts as a gateway for investment and people, both international migrants and tourists, and its international services are available to help businesses across the country. This is an asset to all cities and regions.

Sources: Simmie, J. et al. (2005), *Realising the Full Economic Potential of London and the Core Cities*, Oxford Brookes University Publishing, Oxford; Greater London Authority (2005), "Growing together: London and the UK economy", Greater London Authority Publishing, London.

Presidential Committee on Government Innovation and Balanced Decentralisation has pursued its goals through innovation policy, regional policy, industrial policy, spatial policy and the Seoul metropolitan management policy. It is generally agreed that these measures are a step in the right direction towards a more decentralised system. Some successes have been noted. For instance, it has been argued that fiscal decentralisation has improved the flexibility and quality of local public services. However, as Berg (2011) has argued, despite the formal changes, the system remains centralised, especially in the sphere of regional innovation policy, which is relevant to regional and urban performance. After the fiscal crisis of 1997, greater budgetary and financial powers were passed on to local governments, and in 2004, they also took on many central government functions. These changes, however, did not do much to limit central power. The borrowing powers of local government are closely regulated by the central government, and local authorities have limited financial capacity and responsibility.[24] In fact, the average fiscal autonomy of local governments decreased, as shown in Figure 2.2. The potential risk is that the regions' development priorities may be warped by the need to align with central agendas: all regions pursue the same (central) priorities, whether they are appropriate or not (OECD, 2011).

Figure 2.2. **Self-reliance ratio of finances in Korean metropolitan/*do* regions, 2013**



Source: Ministry of Security and Public Administration (2013), "Overview of local government financing structure", Ministry of Security and Public Administration, Seoul, www.index.go.kr/egams/stts/jsp/potal/stts/PO_STTS_IdxMain.jsp?idx_cd=2458&bbs=INDX_001&clas_div=C&rootKey=1.48.0 (accessed 1 September 2013).

The national government can play a more critical role in addressing this issue. As noted by the OECD (2012b), it could expand pricing mechanisms such as congestion charges and road taxes, so that local government could mobilise existing urban revenue sources. Redesigning grants to sub-national governments could encourage compact city policies, in particular preventing urban sprawl and extending public transport. The Ministry of Land, Infrastructure and Transport's attempt to establish the Urban Regeneration Fund is a good start for promoting urban regeneration projects at the local level. However, local representatives must be involved in the decision-making process, to prevent local governments from pursuing place-blind policies set by national government.

Policy dialogues are a useful tool. In Canada, for instance, the provinces meet to determine investment priorities, while the federal arm of the government is represented in the provinces in the regional federal councils and regional development agencies (OECD, 2013a).

To overcome weakness on the revenue side at the local level, public-private partnerships (PPP) could allow private sector participation and risk sharing associated with compact city projects. However, the OECD's experience shows they are no panacea, and need to be designed carefully to maximise their effectiveness (Box 2.25). Furthermore, appropriate projects for PPPs should be decided; Ang and Marchal (2013) suggest they are well suited to BRT systems, specific rail and metro links, and bicycle-sharing systems.

Box 2.25. **Principles for transparent and competitive public-private partnerships**

- Estimation of projects' affordability. Public-private partnerships (PPPs), which are considered an alternative to traditional public sector procurement, should be used whenever they provide a higher benefit-cost ratio than conventional public procurement. This is defined as the "value for money" (VfM), or as the "efficiency" of infrastructure provision (OECD, 2008). Examples of tools to measure the VfM include the public sector comparator, a tool widely used to calculate *ex ante* the VfM of viable projects.
- A competitive bidding process in tendering procedures and project allocation.
- Full disclosure of conditions in the bidding stage to facilitate negotiations and limit future conflicts.
- Clear responsibility sharing, through detailed agreements between public authorities and private investors, on the allocation of responsibilities and risk.
- Flexibility in sub-contracting to encourage innovation and future adjustments.
- Clear rules on project cancelation and compensation.
- Pricing regulations to secure revenue flows and incentivise new entrants.
- Independence of PPP operators, through a clear separation of operating and regulatory functions.
- Competitive markets with a level playing field whenever feasible (e.g. the appropriate level of competition for bus services supply varies, from liberalised entry in small cities to franchises in large ones).
- Creation of PPP units (e.g. in Australia, the Netherlands and the United Kingdom) to create effective institutional capacity to plan, implement, manage and evaluate PPP projects.

Sources: Ang, G. and V. Marchal (2013), "Mobilising private investment in sustainable transport: The case of land-based passenger transport infrastructure", *OECD Environment Working Papers*, No. 56, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k46hjm8jpmv-en cited in Merk, O. et al. (2012), "Financing green urban infrastructure", *OECD Regional Development Working Papers*, No. 2012/10, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k92p0c6j6r0-en; OECD (2007), *Infrastructure to 2030 (Vol. 2): Mapping Policy for Electricity, Water and Transport*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264031326-en; OECD (2008), *Public-Private Partnerships: In Pursuit of Risk Sharing and Value for Money*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264046733-en; OECD/ITF (2008), *Transport Infrastructure Investment: Options for Efficiency*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789282101568-en; Amaral, M., S. Saussier and A. Yvrande-Billon (2008), "Auction procedures and competition in public services: The case of urban public transport in France and London", paper submitted to the Working Party No. 2 on Competition and Regulation on 25 February 2013, Competition Committee, OECD, Paris; ADB and the World Bank (2006), "Best practices for private sector investment in railways", prepared by TERA International Group, Inc., Final Report.

Horizontal and vertical integration of compact city policies is needed

Partnership, which engages on an equal footing the public, private and community sectors, should be encouraged in order to avoid the problems cited by the OECD (2012b), which states, "Korean urban policy is characterised by strong fragmentation at both the ministerial and local levels". Building a strong partnership is desirable but difficult. Different partners have different resources and often different interests. Successful policies require contribution from government, the community and the private sector together if they are to succeed. The goals should be to encourage partnership between state, market and community; attempting to integrate government policies at horizontal and vertical level; attempting to empower communities; linking area-based initiatives to metropolitan-wide strategies; focusing upon the economic dimensions of exclusion, all of which are increasingly the policy objectives of other European countries when addressing social exclusion. This requires, from local authorities, regional agencies and central government:

- visionary city leadership, effective partnerships and a strategic approach
- secure commitment of mainstream departmental spending
- strong links between regional economic strategies and neighbourhood urban development
- the need to co-ordinate funding streams and consultations with communities
- the need to provide a strong national lead on compact city policies that ensure the co-operation of key departments, greater policy integration at neighbourhood level and effective monitoring and dissemination of good practices.

Higher level government could incentivise co-operation between different tiers of government. This should be the goal of urban policy. Securing long-term financial and political support for special initiatives, achieving inter-agency partnership, blending main programmes and resources, getting the right fit between area-based initiatives and strategic conurbation level responses, engaging the private sector and empowering communities are increasingly goals of urban policy in many European countries and cities (Box 2.26). For instance, as a top-down approach, British Columbia increased the number of institutions to promote co-ordination between municipalities and seek efficient scale for service delivery and public investment (regional districts, Trans Link, Columbia Rail Company, etc.) (OECD, 2013a).

Engage all stakeholders: Strong community involvement

Active and creative involvement of local communities in decisions is necessary to enhance and improve places. Neighbourhood planning and inquiry by design can help them contribute directly. Local government must act as community leaders who take the lead from local communities, rather than the other way around. For the general public to buy in to compact city policies, understanding will be necessary. Because the policies have yet to be fully recognised at the level of ordinary citizens, each local government must be responsible for continued communication of the importance and necessity of the compact city policies to residents. Another important approach to involving local communities in developing compact cities is design coding or inquiry by design. Design coding has been developed in the United States as a way of giving coherence to new housing schemes that reflect high-quality design principles, local architecture and towns or cityscapes. Inquiry by design is an important tool in developing sustainable

communities. It involves bringing together key participants in a master plan or development of a site (local community, planners, local politicians, landowners, etc.) and actively involving them in the planning and design of their community. The approach has been used in a number of growing communities in England, such as Upton in Northamptonshire, north of London. The process and time spent on inquiry by design can vary from several days to a few weeks. It offers a positive way of engaging local communities, so that the process is built on consensus rather than conflict over what a compact city should be.[25]

Box 2.26. **Germany, Spain and France: Cross-jurisdictional co-ordination for public investment**

Collaboration between adjacent regions in Germany has emerged to establish integrated spatial planning. Brandenburg and Berlin, for example, have established a joint transport network to co-operate on the new airport project with the federal government. Additionally, in a combined effort to develop an innovative industrial power, the two *Länder* have designed a co-operative innovation strategy. The joint strategy has attracted participation from individual organisations across the regions, whereas it is not underpinned by shared financing. For example, a biotechnology centre, financed by both *Länder*, was founded to perform as a platform for collaboration among companies and research institutes across the regions. However, the two parliaments involved appear reluctant to approve shared budgets for the regional innovation. Furthermore, a crucial portion of the external funding for innovation is EU Structural Funds, which at present may have a limit on allocations to two *Länder*.

A number of dispersed small municipalities with limited institutional capacity in the region of Galicia, Spain, have lost competitiveness in terms of the cost of providing public services. The regional government has promoted economies of scale by improvement of flexibility of and financial incentives for voluntary ("soft") inter-municipal co-operations. Joint investment projects among several local governments have priority claims on regional funds. The projects involving water, in particular, tend to be processed under the "soft" inter-municipal agreements. The urban mobility plan for mass transport, collaborating with the seven largest cities in the region, is another issue to be encouraged. The regional government also defined a ("hard") co-ordination arrangement. For example, it organised the metropolitan area of Vigo, an association of 14 local governments based on the history of "light co-operation" with 12 municipalities out of 14. Voluntary inter-municipal co-ordination may be promoted in the future.

There are more than 36 000 communes (the basic unit of local governance) in France, as compared to the more typical 8 000 municipalities in countries of a similar size. Although many are too small to be efficient, France has long opposed mergers of communes, because of their political value in the French democratic system. France's central government has promoted mergers among local governments for more than three decades for two goals: allowing small rural municipalities to merge to a size where they are large enough to be provided with public services; and allowing fragmented urban areas to be managed coherently. Around 19 000 joint-communal structures, in which 88% of total communes are involved, aim specifically at horizontal collaboration. There are three major types of supra-communal bodies: communities of communes (groupings of small rural communes), "agglomeration" communities (groups of 50 000 inhabitants subject to a single business tax) and the urban communities (groups of 500 000 inhabitants or more). Each structure organises a "public establishment for inter-communal co-operation" (EPCI), which represents the member communities' limited, specialised, exclusive powers by delegates of municipal councils. Nevertheless, there are two important roles for the central government in this system. First, legitimate EPCIs require the central government's approval. Second, in order to boost communes to constitute an EPCI, the state provides basic subsidies and an "inter-communality grant" to those local governments that agree to a single business tax. This measure is to prevent member communes from competing on tax rates. EPCIs are dependent on the budgetary contributions from participating municipalities (for the syndicates) and/or their own tax revenues (for the EPCIs).

Sources: Mizell, L. and D. Allain-Dupré (2013), "Creating conditions for effective public investment: Sub-national capacities in a multi-level governance context", *OECD Regional Development Working Papers*, No. 2013/04, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k49j2cjv5mq-en: Charbit, C. and C. Vammalle (2010), "Modernising government", in *Making Reform Happen: Lessons for the Future*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264086296-9-en.

It often requires government to actively encourage and facilitate the engagement of the community and private sectors. In particular, the engagement of "community" in urban policy can give both legitimacy and effectiveness to government actions. But community groups frequently lack the resources of more powerful partners and hence must be empowered and supported by those partners. The community will have an important role in sustaining regeneration beyond the initiative. This is quite relevant, as the Korean government commits to encouraging community participation in the urban regeneration process. One test of a regeneration initiative should be that it should identify clear outcomes in terms of building the community infrastructure. The community is unlikely to become an effective guardian of the regeneration process unless it has significant involvement throughout the whole process. This can include establishing structures, remits, terms of reference and operating practices of urban regeneration initiatives; designing the strategy; performance monitoring and evaluation; allocating partnership resources and suggesting special initiatives and programmes. In addition, developing a sense of ownership of the process and the improvements is imperative (Parkinson, 1996). The United Kingdom's experience in increasing community involvement can provide several insights to Korean urban policy makers (Box 2.27) and the key principles that should guide the involvement of local communities include:

- recognising the diversity of communities – mechanisms should reflect that diversity
- representation and accountability – community involvement should be based upon democratic, representative and accountable community structures
- resourcing communities – community involvement will be more effective if local people have access to independent resources that can support the participation process
- capacity building – effective community involvement will only be achieved if local authorities invest in building the capacity of local communities to become involved in regeneration in the ways that they wish
- time scale and process – involving the community should begin at the earliest stage of the process, and time scales should be set that allow community involvement but also allow progress on some issues more quickly than others.

Developing monitoring and evaluating tools

Monitoring and evaluating the performance of compact city policies in Korean cities should be reinforced. No serious evaluation has been made of the extent to which the numerous regulations have been implemented and/or followed in Korean cities (OECD, 2012b). For instance, as noted in Chapter 1, to avoid imbalance of accessibility within a city and between cities, the Korean national government should identify bottlenecks in the public transport network of each city, and provide public transport service to address them in a timely manner. Accumulating available data to assess accessibility is important in this regard. In addition, developing indicators that are internally comparable could be critical, as shown in Chapter 1.

Box 2.27. **Community-based regeneration in England: Lessons from the Estates Action Programmes**

In many respects, the positive lessons about community involvement in local regeneration also underline the need to link estate-based initiatives to wider regeneration frameworks.

- Although communities face many problems and pressures, they remain a crucial resource for regeneration. However, circumstances vary and shape the rate of progress. A solid foundation of local activity and organisation experience is a prerequisite. It is hard to start from scratch.
- The most effective community partners need access to technical aid and professional support. The resources may be a small proportion of the total amount spent on regeneration, but communities cannot be expected to turn estates around on their own.
- Targeted strategic initiatives give an essential kick-start to regeneration. But lasting change requires new approaches to mainstream services, which encourage inter-agency working, local delivery and give residents the opportunity to participate at whatever level they choose.
- Partnership is welcome – but it cannot be done on the margins. Genuine partnership will require fundamental and challenging shifts in the ways that partner agencies and authorities operate.
- Sustainable regeneration is unlikely unless it creates employment opportunities and community-controlled assets, which can generate income in the long term.
- Regenerating estates, and especially tackling poverty and unemployment, requires a strong national and regional policy framework to counter the economic and social exclusion they face. It cannot be left to the market.
- Regions and authorities need to develop strategic plans for tackling concentrations of poverty in their area that are firmly linked into wider regeneration strategies in the area.

Source: Parkinson, M. (1996), *Strategic Responses to Area Regeneration*, Joseph Rowntree Foundation, York, United Kingdom.

Relevant data at the sub-national level should be the basis for development of strategies and measurement of results and potential bottlenecks. The national government and local authorities should both have a critical role in developing relevant but comprehensive data collections within the framework of regional development policies, as in France and Mexico. In France, the *Délégation interministérielle à l'aménagement du territoire et à l'attractivité régionale* (DATAR), the French inter-ministerial delegation to promote regional development, has developed a good practice guide. It has also initiated close co-operation with regions to improve regional innovation strategies to overcome the problem that existing regional strategies were too similar and not sufficiently tailored to the local context. Acknowledging the importance of data collections, it has supported the efforts for collecting data at the sub-national level and supporting the EuroLIO (*Observatoire Européen des Données Localisées de l'Innovation*), which brings together several French research centres for sub-national data and analysis on innovation (OECD, 2013b). In Mexico, the National Institute of Statistics and Geography (*Instituto Nacional de Estadística y Geografía*, INEGI) established an integrated approach to accumulating geo-referenced data, matching information from different sources and on different geographical characteristics. Budgeting based on

indicators from this system enable budget allocations to be matched with socio-economic variables of regions and to provide simulations of further funding, according to policy objectives such as fighting poverty.[26]

Planning and assessment of compact cities require adequate data, monitoring and data to support the planning and assessment. Such data must be developed consistently for several years. However, this task is difficult for a city government to conduct alone, given the administrative burden and need to identify related expertise. A solid support system from the central government to national research institutions such as the Korea Research Institute for Human Settlements must be established.

Notes

1. Dongtan 2 New Town, next to Dongtan 1 New Town, is located in Hwaseong, one of the two selected case cities.
2. Jeong, Y. and J. Lee (2013) argue that the compact city concept invoked in Korean urban development policy is a supplementary strategy for economic growth, not environmental conservation. This led to high-density urban development driven by the land and housing markets. To address this, the compact city should explicitly recognise the contribution of sustainability in development strategies for the planning and management of cities.
3. The Korean government has introduced several alternative regulatory tools to address this problem, for instance, redesignating a Priority Removal of Restriction Area as either a social housing complex area or a green area for conservation. Developers have to convert part of the damaged areas in the greenbelt into parks. If they have difficulty providing such public facilities, developers must pay "conservation fees" of 20% of the appraised value of land in the deregulated areas.
4. For instance, the Korean government has introduced several impact fees, including development impact fees for new and additional urban facilities, fees for facilities induced traffic and fees for urban parks.
5. Individual factories tend to prefer locating management facilities in the suburbs, due to the relatively low price of land, rather than in existing residential areas within cities (Im, 2010).
6. For example, the Happiness Housing project in Gajwa district (26 000 km²) plans to develop a Bridge City connecting the communities separated by railways. Public housing in this district will be provided for university students, as several universities are clustered in the surrounding areas.
7. The Ubiquitous City integrates ubiquitous technology into an urban space. All inhabitants have access to any and all information they need from anywhere at any time, and urban infrastructure is managed through an intelligent system. Korea's Ministry of Land, Infrastructure and Transport has invested in developing Ubiquitous City-related technology and has incorporated the concept into new town development.

8. Four key urban development strategies were laid out by the Ministry of Land, Infrastructure and Transport at a presentation to the OECD mission team on 23 April 2013.

9. As will be discussed below, the policy framework for urban regeneration should help to encourage this, but will also have to embrace policies such as education and health by providing facilities that will help bring people back to live in city centres.

10. This is a general concept of mixed land use in Korea. Without full consideration of functional linkages between urban elements, this mega-structure has raised the price of real estate and aggravated traffic congestion.

11. The SmartCode, developed by Duany, Plater-Zyberk and Co. is a form-based code that incorporates Smart Growth and New Urbanism principles, as well as the rural-to-urban transect theory. This open-source programme is a unified development ordinance template, addressing development at all scales of design, from regional planning down to the building signage (including zoning, subdivision regulations, urban design, signage, landscaping and basic architectural standards).

12. It includes several rules on possible incentives, such as deregulation of floor area ratio to promote public open space, street wall and joint development, but shows no explicit incentives for mixed land use.

13. Those are pronouns of the Korean districts corresponding to TL5. There are no English interpretation going with the pronouns.

14. The most recent reform of land-use zoning under the revised National Territory Planning Act in 2003 integrated quasi-agricultural and quasi-urban areas into the "management area". Before the reform, this category of land was a hotbed for urban sprawl, since local governments accepted both as "developable". The integration aimed to prevent urban sprawl and deregulate areas under development pressure, while accommodating demand for urban development demand into a planned development system. To properly control the suburban areas, the management area was subdivided into three zones: the planned management area, production management area and conservation management area. The subdivision of zones is decided in accordance with as assessment of land suitability.

15. For example, current zoning permits construction of residential-commercial complexes (with a floor area ratio of residential use not to exceed 0.9) in central and general commercial areas. In addition, detached houses are permitted even in neighbourhood commercial areas, and almost all small-sized commercial and retail buildings (referred to as neighbourhood convenience facilities) are allowed in residential areas.

16. In fact, this similar concept was actively argued in the early 1980s in Korea to accommodate the growing population in Seoul within the station area, while setting up a 1 000-metre boundary from a rail station, including all urban economic activities. This concept aimed to: *i)* prevent urban sprawl by redevelopment of multi-family housing for the urban area; *ii)* accommodate future population by forming a multi-nucleate urban spatial structure from the single-nucleate one; *iii)* prevent downtown decentralisation resulting from the policy for population decentralisation in the 1970s; *iv)* sustain balanced transport policy through inner circle/ring road construction; *v)* restructure the subway-oriented urban form, which is more efficient than a road-oriented one in personnel and social costs; *vi)* promote subway operation earning and expenses through developing high-density mixed use of land at a nearby

railway station. The urban comprehensive plan in Seoul reflected such concerns, but it lost impetus after new towns were developed around Seoul (Sung et al., 2008).

17 . Several Korean laws govern TOD-type development. One is the Special Act for the Promotion of Urban Renewal, which aims to redevelop declining areas and promote more efficient use of land in urban areas, targeting major rail stations or transit-friendly areas with mixed-use development. Another is the Act for Nationally Integrated Transport System Efficiency, to allow projects for mixed-use transfer centres for major rail stations or transit centres. Under the law, large-scale mixed-use development projects with residential, commercial, office, cultural and lodging facilities can be developed in a centre with inter-city, inter-regional transfer functions, but the focus is more on station development.

18 . The national government has announced a goal to increase the share of rail ridership from 18% (2009) to 26% by 2020, according to the Presidential Committee on Green Growth (PCGG) in 2009.

19 . In 2008, 37% of transport for personal work and educational purposes was by bicycle.

20 . The Student Housing Programme was developed in France to satisfy the housing needs of a growing number of students in cities. Since public funds were insufficient, the option was to encourage private investors to create an expansive housing market for student renters, through substantial tax breaks for homeowners. In return, qualifying dwellings were to be provided with services including daily house cleaning, downstairs laundry, round-the-clock reception and cafeterias.

21 . The overall recommendation to improve multi-level governance in urban policies was proposed in OECD (2012a). This section will describe topics specific to compact city strategies.

22 . Collaborating at the level of the city-region is often challenging for local partners. While this has been achieved in some cases, it is still in its infancy elsewhere. Any city-region confronts potential conflicts over turf, personalities and party politics, as well as the location of resources, infrastructure and economic development. Resolving these conflicts requires political compromises, which in turn require good local and regional leadership. Government should provide further resources, support, freedom and flexibility to reward cities making progress and to encourage those that still face challenges. City-regions do not always seek further subsidies. Often, they want greater freedom for manoeuvre. They also seek greater influence over national resources spent in regions, for example on infrastructure, transport, education, housing and regional development. A city-regional development fund might achieve this, aligning local, regional and national resources. This could include, for example, some regional economic development, housing and transport budgets; seed corn funding from the national government; a proportion of the business rate and matching resources from local partners. It would create long-term agreed funding strategies between the government, regional development authorities (RDAs) and local authorities. It would have the advantage of being a contract that primarily uses existing public resources, with modest support from government.

23 . Urban redevelopment projects in Korea have often experienced this effect, which has sometimes become a serious social problem.

24 . This is typical in many countries. Poland, for example, has implemented an extensive decentralisation reform in the past decade, but it gave its regions limited financial autonomy, despite devolving extensive responsibilities to them. Even a relatively

strong region, like Wielkopolska, still complains of persistent underfunding and over-reliance on central government funding (OECD, 2013a).

25 . The websites below give further details of design coding and inquiry by design in England: www.udg.org.uk/publications/udg-publication/design-coding-diffusion-practice-england, www.princes-foundation.org/sites/default/files/enquiry_by_design_ebd_pdf.pdf, www.northamptonshireobservatory.org.uk/docs/doc_Uptoncasestudy.pdf_113342150306.pdf.

26 . For further details, see: www.inegi.org.mx/geo/contenidos/geografia/default.aspx.

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Annex 2.A1
A history of land-use zoning and onset of mixed land use

Zoning is a device for land-use planning used by central and local governments in two main ways: regulations and incentives (Urban Land Institute, 2003). The primary purpose of zoning is to segregate uses that are thought to be incompatible and to prevent unsuspected or unplanned new developments in the national territory. Modern zoning was first applied in German cities by Napoleon's decree of 1810, with the intent to protect "specific urban districts from the invasion of injurious uses" (Hirt, 2012 cited in Buscher and Green, 2005). The need for separation of incompatible uses was also widely advocated by city planners in European industrial cities to separate smoke-producing industry from residential areas (Duany et al., 2001). Likewise, the "earliest [zoning] regulations were intended to avoid or minimise the worst consequences of uncontrolled development and noxious land use" (Parolek et al., 2008). It was also used to limit the spread of fire and provide access to sunlight and air (Parolek et al., 2008).

Land-use segregation in Europe was introduced into North America through the City Beautiful movement (Duany et al., 2001). However, planners have repeatedly attempted to separate distinct categories of buildings from each other, and therefore, this segregation is now applied to every use, even though it once applied only to incompatible uses (Duany et al., 2001). The earliest examples of exclusive single-family residential zones appeared in both Berkeley, California, and New York City in 1916 (Parolek et al., 2008; Hirt, 2012). The exclusive single-family residential zones derived from the "widespread perception that multi-family housing was inherently substandard and undesirable at the time" (Parolek et al., 2008). "This public bias that has lingered for decades was even reinforced by the 1926 U.S. Supreme Court case, Village of Euclid [(Ohio)] v. Ambler Realty Company (272 U.S. 365), which otherwise validated the constitutionality of comprehensive zoning, and eventually led to the coining of the term Euclidean zoning" (Parolek et al., 2008). Since then, Euclidean zoning codes have been the most prevalent land-use regulation in all major US cities, except for Houston, Texas (Hirt, 2012). Euclidean zoning is characterised by the land-use segregation into specified geographic zones and designations of permitted and restricted development activities within each type of zone. This tool allows governments to predict future development types and intensity throughout a city, so they can effectively implement land-use control. Nonetheless, it has attracted criticism for its various negative impacts on urban sustainability.

Zoning in itself is not necessarily problematic, but the type of zoning and how it is applied are more important (Carmona et al., 2003).[1] Krier (1990) illustrates two types of zoning as follows.

In inclusive zoning, where "all is permitted and promoted that is not strictly forbidden", exclusion is based on environmental "nuisance" or incompatibility ("bad neighbours") and, in principle, various uses can occupy the same area. By contrast, under exclusion zoning, all that is not specifically obligatory is strictly forbidden. "This is often zoning for its own sake, a routine and largely unquestioned process of mechanical

separation of differing land uses and functions for no real purpose other than a misguided sense of order".

Generally, criticism of zoning concerns the limitations of this exclusive zoning. Talen (2013) suggests five dimensions of exclusive zoning's negative impacts on urban environments (see below). Zoning promotes:

- a random and disorganised pattern of land use
- larger lot sizes, by requiring minimum unit size rather than maximum unit size
- single-use subdivisions (e.g. corner stores and mixed-use buildings are not permitted in the residential areas)
- an absence of connectivity (separation) through subdivision regulation
- limiting the ability of open space to create "enclosure", which is an essential aspect of walkable streets and compact urban form.

In addition, exclusive zoning is sometimes unsuited to accommodate long-term changes in local and regional areas (Parolek et al., 2008), frequently frustrates or interrupts the creation of urban places due to its inflexible application (Duany et al., 2001; Carmona et al., 2003), and consequentially creates monotonous urban form and streetscapes (Parolek et al., 2008).[2] One of the most significant problems of zoning is that it does not allow mixed land use or mixed-use developments (American Planning Association, 2007). These negative impacts of zoning on the urban environment not only discourage mixed-use development, but functionally result in mechanical segregation of urban land uses rather than their organic integration, even in the appropriately mixed-use areas on the surface (Krier, 1990). In terms of urban function, a lack of mixed land use raises two main issues. First, the segregation of land uses decreases the vitality of urban centres and streets, and finally results in the phenomenon of inner-city decline. Secondly, it entirely separates workplace and commercial areas from exclusively residential areas. This segregation of uses inevitably increases travel between them (Krier, 1984; Parolek et al., 2008). As a result, it facilitates motorisation (auto-dominated society) in suburban areas. Among the two problems, the former may be a more significant issue in stagnant or declining cities, and the latter may be more critical in growing cities. These problems have a ripple effect on urban sustainability.

- Environmental sustainability: Segregation of uses increases travel demand (travel time, distance and frequency) and auto-dependency, and as a result consumes more transport energy, generates more greenhouse gas and vehicle emissions and aggravates air quality and global warming (Krier, 1984).
- Social sustainability: Segregation of uses artificially excludes specific social groups from the specific communities, and leads to social, economic and racial exclusion. Particularly, exclusive zoning excludes the socially disadvantaged (lower income groups and specific ethnic groups) from the expensive single family residential areas (Ihlanfeldt, 2004). It also deconstructs the sense of community and social capital (especially, bridging social capital) (Krier, 1984; Putnam, 2000). Moreover, lower social capital and lower vitality respectively increase crime rates in the suburban neighbourhoods and city centres (Nam and Choi, 2010).
- Economical sustainability: A decreased vitality in the city centre, stemming from land-use segregation also decreases tax revenue and leads to economic decline,

diminishing the regional or global competitiveness of the city and county. Exclusive zoning is also one of the causes of the spatial mismatch in the labour market, particularly among lower skilled and less-educated workers (Ihlanfeldt, 2004). Finally, it sometimes even violates property rights.

Exclusive zoning approach, the key principle of modernist urban planning and design, has been much criticised (Carmona et al., 2003). The mixed-use concept emerged as an alternative approach to counteract these negative impacts of conventional zoning. This idea was first advocated by Jane Jacobs in 1961 (Jacobs, 1961), who argued that a balanced mix of urban functions (such as living and working) and overlapping and interweaving of activities in an urban block leads to liveable, safe and viable neighbourhoods (Jacobs, 1961; Carmona et al., 2003; Koster and Rouwendal, 2012). She defined "exuberant diversity" in city streets and districts as one that must meet four conditions:

- mixed primary uses: the district must serve more than one primary function (preferably more than two)
- small blocks: most blocks must be short; that is, streets and corners must be frequent
- aged and diverse buildings: the district must mingle buildings that vary in age and condition
- concentration: a sufficiently dense concentration of buildings is needed.

Applying this new trend, many conventional zoning codes started to update and allow a broader mix of uses in the 1980s (Parolek et al., 2008). Most planners and policy makers have regarded the mixed-use principle and philosophy as a valuable methodology to meet the goals of sustainability; more recently, the idea has been widely accepted in various urban paradigms such as Compact City, New Urbanism, Smart Growth (Hirt, 2012) and the Urban Village movement. Indeed, "promoting mixed-use development is the most fundamental land use principle" (Grant, 2002).

Notes

1. Kropt (1996) argues that, rather than the general principle of defining areas controlled by particular regulations, what is important is the specific content of zoning ordinances" (cited in Carmona et al., 2003).

2 . The American Planning Association (2007) suggests that the particular shortcomings of Euclidean zoning include "their inflexibility, their failure to allow for mixed-use and mixed-housing development, their disconnection from growth management issues, their exclusionary nature and their inability to address design issues".

Chapter 3

Compact city policy in Daejeon and Hwaseong, Korea

This chapter performs narrative case studies of two cities (Daejeon, Hwaseong) with the corresponding urban simulations seeking applicability of compact city policies on the cities. Daejeon is the fifth biggest metropolitan city, a representative of developed urban areas. Hwaseong is a local city showing a trend of rapid development. The first part assesses the two cities in terms of compact city policies. It examines current relevant policies, such as the Daejeon Green City Plan, the Urban Renaissance Project of Daejeon and the Hwaseong-Dongtan New Town project, and suggests policy recommendations in terms of compact city policies. The second part addresses the importance of an integrated urban modelling in selecting the customised set of compact city policies for a city. In the same vein, it suggests a framework to develop an integrated urban model and performs two pilot simulations of the two cities. The simulations were performed using a newly developed model and a modified version of the current model based on parts of the framework.

The following case studies shed light on how to cope with challenges in implementing compact city policies. To illustrate the trends and challenges in Korean cities, the case studies focus on two cities at different developmental stages, demonstrating different policy approaches; one for rapid growth and the other for stagnated growth. Hwaseong was selected as a local city (not yet at the metropolitan level) exemplary of a rapidly growing urban centre; its population doubled between 2005 and 2010, much faster than the national average (0.3%)[1] and its gross regional domestic product (GRDP) growth rate is roughly 120.1%, much higher than the national average (5.89%). Daejeon was selected from the seven metropolitan cities in Korea as a typical instance of stagnated growth. Its population growth rate over the period between 2005 and 2010 was stable (0.65%), and its GRDP growth rate (5.21%) over the same period was the lowest among large metropolitan areas, which average 5.94%. The two cities also show varying urban growth patterns, size and urban problems, which help to examine how compact city strategies can help deal with complex urban issues.

Policy examples from Hwaseong and Daejeon have been collected to identify challenges and assess current compact city policy practices. The major policies to be reviewed include measures to limit and manage urban sprawl, promote inner-city revitalisation and promote mixed land uses and mass transit linkages. The following points are of interest:

- Are the existing compact city policies appropriate in the local context? How effective are they? How does the combination with other policies work?
- What is the resistance to the regulations and the adverse effects of compact cities, for example, congestion problems, escalating housing prices even in the most modest areas, and strong opposition from landowners and developers, who face limitations of greenfield exploitation in suburban areas?
- What kind of vertical and horizontal governance arrangements are being implemented by the different levels of government? What tools are being developed and adopted for monitoring and evaluating compact city policies at the city level?

Assessment of compact city policies in Daejeon and Hwaseong

As shown in Table 3.1, the two cities vary widely in terms of geographical location, population size, policy tools, etc. Examining the case cities[2] in view of the five key compact city strategies proposed by the OECD (2012a) suggests that each city has unique policy challenges, and more importantly, that most would be best addressed in close co-operation with the national government. The survey eliciting reaction in the case cities to the compact city strategy was instructive. In general, the concept of the compact city was accepted, but the assessment varied depending on how the cities recognise urban challenges and on their policy priorities.

Daejeon

City profile

Daejeon is the fifth-largest city in Korea after Seoul, Busan, Daegu and Incheon, with a population of 1.5 million people and an area of 540 km². Roughly 150 kilometres from Seoul, it was upgraded to metropolitan city level[3] in 1995 and built a central government

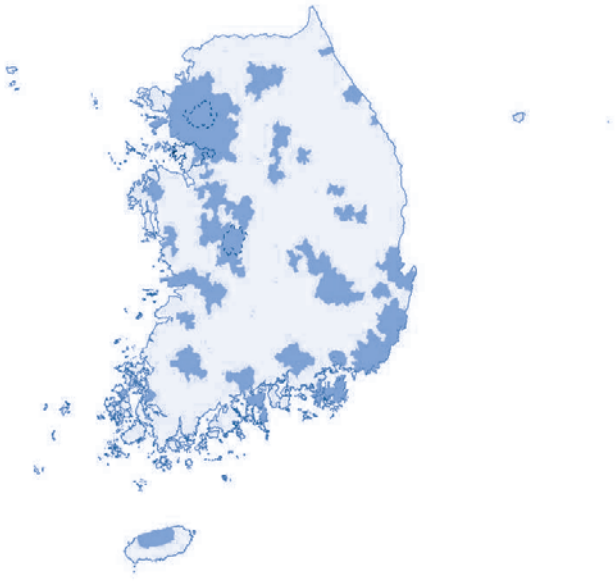
complex in 1997. Located in Korea's geographical centre, Daejeon serves as a nationwide transport hub. Major expressways and railways connecting the country from north to south pass through the city (Daejeon, 2013b).

Table 3.1. **Summary of the case city profiles**

	Daejeon	Hwaseong
General information	– Population: 1.5 million (stagnant over the past 10 years) – Size: 539.9 km² – Location: 150 kilometres from the centre of Seoul	– Population: 532 000 (doubled over the past 10 years, due to the new development aiming to help accommodate the population of Seoul) – Size: 689 km² – Location: 40 kilometres from the centre of Seoul
Urban challenges	– Expansion of built-up areas and restructuring of the town – Development of Sejong City New Town, close to Daejeon – Establishment of the International Science and Business Belt (ISBB)	– An exponential increase in population led to delays in infrastructure provision – Disparities in residents' living conditions, due to scattered development – Lack of infrastructure in the suburban area after large-scale development
Key urban policies	– Providing attractive and sustainable public transport – Reducing the rate of greenfield development and restoring brownfields for settlements – Minimising development gaps between the centres of the new and old towns	– Promoting urban centres to address the city's scattered development – Developing infrastructure to improve access to urban and suburban areas – Reinforcing urban management strategy and controlling suburban sprawl

Sources: Own elaboration based on Daejeon (2013a), "Introduction of compact city-related policies in Daejeon", presentation by Daejeon to the OECD mission team in April 2013; Hwaseong (2013a), "Policies for compact city in Hwaseong", presentation by Hwaseong to the OECD mission team in April 2013.

Figure 3.1. **Location of the two case cities**



Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

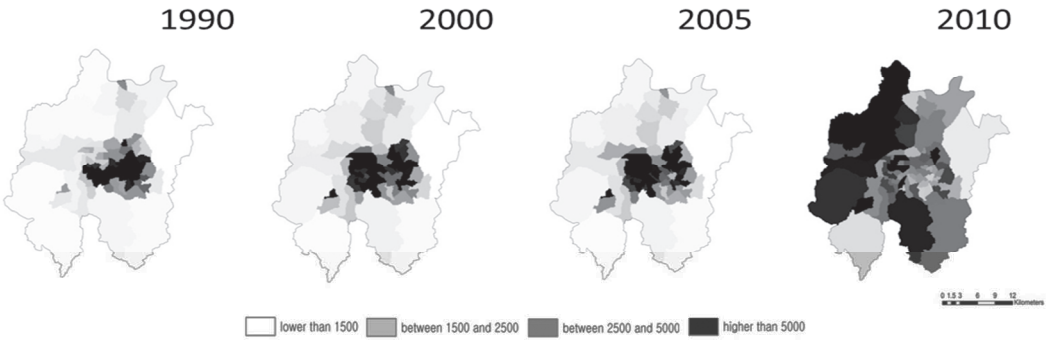
Source: Own elaboration based on OECD (2012b), *OECD Urban Policy Reviews, Korea 2012*, OECD Publishing, Paris, http://dx.doi.org/10.1787/10.1787/9789264174153-en

Daejeon is also a major centre for cutting-edge science and technology in Korea and home of several key institutions for research and education, including the Daedeok Science Complex, comprised of the Korea Advanced Institute of Science and Technology (KAIST), the Electronics and Telecommunications Research Institute (ETRI), the Korea Aerospace Research Institute (KARI) and the Korea Atomic Energy Research Institute (KAERI). The success of the Daedeok Science Complex led to new development projects: the Daedeok Valley Development project, providing research facilities, manpower and administrative assistance, and strong linkages with surrounding areas; and the Daedeok Techno Valley Development Project, for the construction of a new industrial park equipped with residential and leisure facilities and an industrial zone for foreign investors. The projects are expected to boost the local economy.

Urban challenges

Expansion of built-up areas and relocation of the town centre[4] resulted in various problems, such as the decline of retail businesses in the old downtown, the need for new settlements in the suburban area and the decay of the old urban centres with poor (or uneven) access to local services. This accelerated a redistribution of population in the city (Figure 3.2). Development of Sejong City, a new administrative city surrounded by Daejeon, Cheongju and Gongju, was also a significant challenge (Box 3.1). Daejeon is now in competition with its adjacent cities, and requires strong urban policies to prevent the resulting urban sprawl, in co-operation with surrounding cities, including Sejong.

Figure 3.2. **Population distribution change in Daejeon, 1990-2010**



Note: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on National Geographic Information System Data and Korea Statistical Information Service, www.kosis.kr.

The Integration of International Science and Business Belt (ISBB) project with urban policy offers Daejeon a big challenge and a great opportunity. The project aims to build a National Innovation Cluster that will serve as an engine for national economic growth. The central district of the ISBB will function as a basic science and research hub that hosts the national Institutes for Basic Science and a Rare Isotope Accelerator, a large-scale research facility promoting science-based, cutting-edge business and the research development service industry (Daejeon, 2013a). This project, led by the national government, is expected to transform the urban structure of Daejeon and offer an opportunity to enhance its potential for growth.[5] The challenge is now to find a way to

restructure the city's urban space to accommodate this change and effectively communicate with the national government to take advantage of this opportunity.

Box 3.1. **Sejong City**

To address such social problems as the shortage of housing, rising housing prices, congestion and pollution due to over-concentration in the capital area, the Korean government adopted a balanced national development strategy, one of whose principal initiatives was the construction of Sejong City, a multifunctional administrative city (MAC). Located in the centre of the country, 120 kilometres from Seoul, it has an area of 72.9 km², and its population is expected to have reached half a million by 2030. The Multifunctional Administrative City Construction Agency (MACCA) was set up on 1 January 2006 to build the city. The formal name for the MAC, Sejong, the name of the great Korean king who invented the Korean alphabet at the time of the Chosun Dynasty, was chosen in 2006 with the help of preference surveys and a special naming committee. The Korean government planned to relocate 36 of its organisations to Sejong City by 2014. According to the Master Plan, green space in Sejong City will take up more than half of the entire city area. A massive Central Park will be located in the middle of the city and six major functions, such as the central administration, cultural and international activities, the local administration, university and research, medical and welfare and cutting-edge industry will be established along its ring-shaped public transport network.

Source: Korean Multifunctional Administrative City Construction Agency (2010), "Multifunctional administrative city", English brochure, Korean Multifunctional Administrative City, Sejong, Korea.

Another key challenge for Daejeon is to balance its growing and declining areas and to create a genuine partnership between the key stakeholders. Policy makers, academia and citizens must come together to find a mutually acceptable way forward. City authorities will be called upon to show strong leadership in this initiative. With a clear understanding of the issues of the compact city, they must develop the appropriate policies and a creative programme to educate the local population on the benefits of the new policy and to win public support.

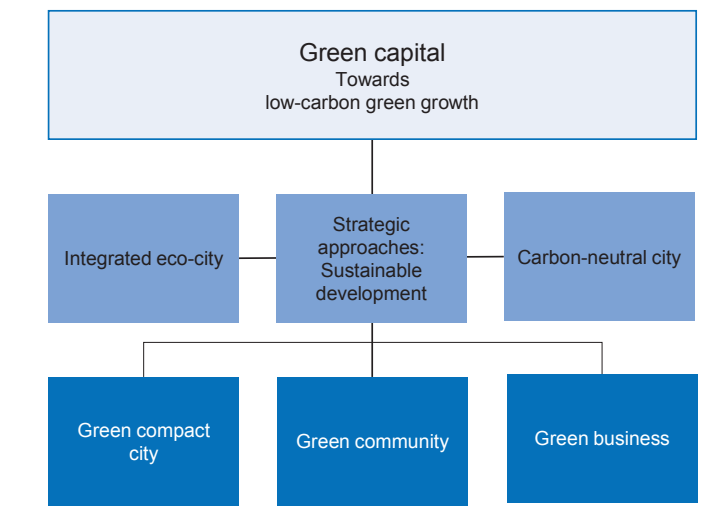
Assessment of compact city policies

The framework of Daejeon's urban policy incorporates the three core aspects of compact city policies: "environment," "society" and "economy". While the term "compact city" is not widely presented as an explicit theme, the concept implicitly underlies the city's current urban policy. Meanwhile, from the local governments' perspective, the central government is not necessarily leading the compact city policy, which suggests the need for more active communication between the central and local governments. In Daejeon, policies such as the Green City Plan (Box 3.2), transport-oriented development (TOD) and the Urban Renaissance Project have already been set in place. Packaging these policies as compact city policies, supplementing their inadequacies and setting clear goals will help the project move forward. Although Daejeon can itself be regarded as forming a certain independent urban area, it will be necessary to build a vision with a broader perspective in co-operation with its new neighbour, Sejong City.

Box 3.2. **Daejeon's Green City Plan (2010)**

The Green City Plan, set up in 2010, proposes to integrate spatial restructuring and physical redevelopment and match urban planning strategies with environmental sustainability. The plan is inspired by the three Gs: the green compact city, green community and green business, which are believed to contribute to a more sustainable urban form. Special action plans to achieve the green compact city include: *i)* establishing a polycentric, compact transit-oriented structure and promoting land use that avoids urban sprawl; and *ii)* building an environmentally sound urban plan to preserve green fields, for instance through increasing reuse of land.

Vision the plan



Source: Adapted from Daejeon (2013a), "Introduction of compact city-related policies in Daejeon", presentation by Daejeon to the OECD mission team in April 2013.

Daejeon's land-use regulations maintain a certain flexibility, reflecting the conditions prevailing in Korea. Urban centres are crowded with a dense mixture of residential, commercial and other uses. The city's Urban Basic Plan also suggests a fine-meshed mix of uses, combining living, retail and/or office uses at the level of floors, buildings and blocks as one of its subsidiary goals. This is partially supported by the evidence that average commuting distances in Daejeon are shorter than in several metropolitan cities, including Seoul, Ulsan and Incheon (Table 3.2). However, as discussed in Chapter 2, the mixed land use is limited to the vertical plane and concentrated in residential areas, typical of a new town development with a less clear goal of mixing urban functions at a larger scale.

Table 3.2. **Average commuting distance in metropolitan cities in Korea**

Kilometres per trip

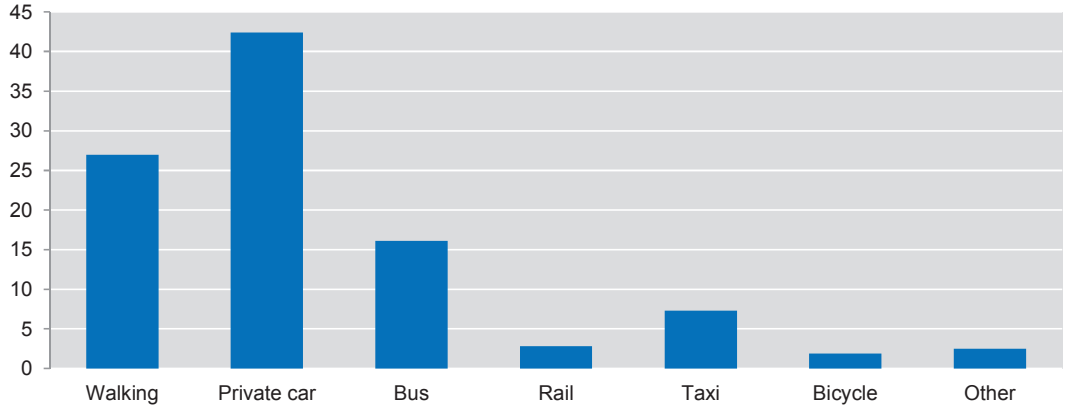
Daegu	Gwangju	Busan	Daejeon	Incheon	Ulsan	Seoul	Average of metro cities
4.76	4.87	5.32	5.60	5.82	5.96	7.54	5.7

Source: Adapted from Korea Transport Institute (2012b), *Korea Transport Database*, Korea Transport Institute, Korea.

TOD concepts could be more fully applied to urban development strategies in Daejeon. The goal is for an urban structure linked by public transport, with 2 urban cores, 7 local cores and 17 community centres. Ten projects were recently selected for the initial phase. Daejeon has already presented a proposal for its TOD plan, but it is worth noting that the appeal of TOD may be limited if it is not fully supported by better access to public transport. The connection between the Daejeon KTX Station and the subway station is not particularly convenient because they are so far apart. Better connections between inner-city transports must be explored. Notably, the share of railways as a transport mode in the city is only 2.8%, while the share of buses is 16.1% (Figure 3.3). This reflects inadequate railway service, including the subway in the urban area, and a lack of co-ordination of public transport services. The subway has only one line at present, which suggests the need for rapid development of a railway network.

Figure 3.3. **Modal share in Daejeon, 2010**

In %



Source: Korea Transport Institute (2012b), *Korea Transport Database*, Korea Transport Institute, Korea.

Urban renewal attempts are reflected in several urban renaissance projects and relevant urban development programmes. The city government has invested considerable resources in the renewal projects, as the declining urban centres have become a challenge[6] (Figure 3.4). However, successful urban renewal will require further analysis. Large scrap-and-build urban development projects around Daejeon Station are planned,[7] but better use of existing urban assets must be examined.[8] The main industrial policies support high-tech industries benefitting from the convenience of broad-area transport. However, the redevelopment of brownfields and active infill approaches to urban renewal must be thoroughly explored if such an industrial policy is to prevent scattered development. Establishing explicit density targets and concentrating urban functions in the city centre might help revive the urban centres. Toyama's policy initiatives to increase population in residential promotion districts with grant programmes could provide useful guidelines (Box 3.3).

The growth of the urban area in Daejeon has slowed in the centre and increased at the outskirts of the city, as shown in Figure 3.2. Emphasis has already shifted to improvements in quality, including diversity, rather than geographical expansion. Meanwhile, the districts that have been neglected during development in both the centre and suburbs require attention. Among these areas, some consideration has been given to the city centres. The principles guiding regeneration of the housing complexes, however,

are not clear from the existing policy framework, although the Daejeon city government's Rainbow projects aim to provide affordable housing in the inner city (Box 3.4). This requires the city government to develop policy measures as residents grow older and buildings deteriorate, and incorporate them into the urban planning process.

Box 3.3. **Toyama's density target and grant programme**

Toyama City has set a density target along bus routes of 40 persons/hectare (the current density is 34 persons/hectare) with a 20-year plan to increase the population in the residence promotion districts. The plan specifically aims to raise the density along the railways to 50 persons/hectare (the current density is 44 persons/hectare) The city expects to expand the residence promotion districts from 2 927 to 3 489 hectares by improving the frequency of bus and railway service. The city's total population is expected to be 389 510 and the districts are expected to house 42% of the city's predicted total population (389 510) in 2025.

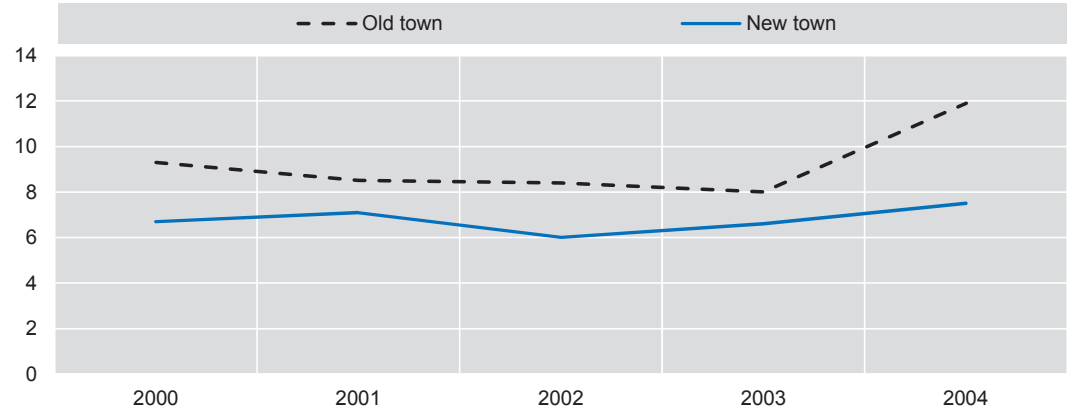
To expedite this process, Toyama City has implemented two subsidy systems, the City Centre Dwelling Promotion Scheme and a scheme to promote housing along the public transport axes:

- City Centre Dwelling Promotion Scheme (2005): The city has promoted the purchase or rent of housing in the city centre through a subsidy for construction companies and citizens. The average subsidy provided is JPY 199 438/house. Approximately 3 000 houses were to be provided in the city centre between 2004 and 2014 to achieve the target population density in the city centre (from 55.7 persons/hectare in 2004 to 65 persons/hectare in 2014).
- A plan to promote residential housing along the public transport axes (2007): The city has promoted the purchase or rental of a house in the designated areas easily accessible to public transport through subsidies for construction companies and for citizens (see table below). The average subsidy provided is JPY 691 071 per house. The city plans to raise the share of the population in these areas from 28% in 2005 to 42% by 2025.

Target areas	Beneficiary	Types of cost to be subsidised	Subsidy limit (JPY)
City centres	Construction companies	Construction cost of apartment buildings	1 million/house
		Construction cost of high-quality houses for rent	500 000/house
		Conversion of office/commercial buildings to apartment buildings	1 million/house
		Construction costs of installing stores, medical and welfare facilities in apartment buildings	20 000/m²
	Citizens who purchase or rent a house	Loans for purchasing houses or units in apartment buildings	500 000/house
		Rents for transferring to a downtown area	10 000/month (maximum three years)
Public transport axes	Construction companies	Construction costs of collective housing	700 000/house
		Construction costs of high-quality houses for rent	Two-thirds of the cost of the shared space
	Citizens who purchase or rent a house	Building/purchasing a house/unit in an apartment building	300 000/house
		Special supplement for two-family houses	100 000/house
		Special supplement for residents moving in from outside areas	100 000/house

Source: OECD (2012a) based on City of Toyama (2010), "Toyama City's efforts toward compact urban development", presentation to the OECD delegation, Toyama, 12 October 2010.

Figure 3.4. **Vacancy rate of office buildings in Daejeon**



Source: Daejeon (2013a), "Introduction of compact city-related policies in Daejeon", presentation by Daejeon to the OECD mission team in April 2013.

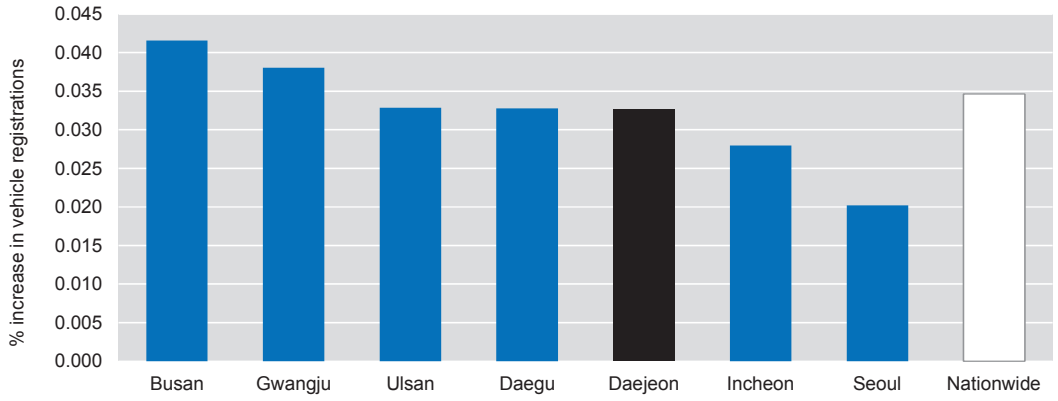
Box 3.4. **Daejeon's Rainbow Project**

The Rainbow Housing Project, initiated in 2006, is one of the Daejeon city government's initiatives to expand affordable housing. Including improvement of the residential environment and an urban renewal project, it has several goals: *i)* providing appropriate housing for different lifestyles, income levels and household types; *i)* providing housing for low- to middle-income workers in the redevelopment area, through provision of public rental housing or financial support for residents relocated from their original dwellings; *iii)* providing public housing for the lowest income households and special needs groups; and *iv)* revitalising the urban community by offering such social infrastructure as cultural and welfare services, healthcare services, housing for the elderly, sport and other leisure facilities.

Source: Daejeon (2013a), "Introduction of compact city related policies in Daejeon", presentation by Daejeon to the OECD mission team in April 2013.

Major road development has helped ease traffic congestion. However, vehicle ownership has increased in the past decade, at a rate even higher than that of other metropolitan cities (Figure 3.5). Moreover, traffic congestion is increasing as the urban areas expand. The Urban Renaissance Project, in particular, is expected to increase urban concentration. Measures to ease traffic congestion as a result of compact-sizing of the city must be considered now. This could be achieved by increasing the modal share of non-motorised transport, and public transport in particular.[9] Other local governments' strategic plans have been successful. The Portland Bicycle Plan, established in 2010, sets the stage for expanded bicycle transport in Portland, highlighting key principles such as attracting new riders, forming dense networks of bike routes and increasing parking lots. As a result of the city government's efforts, Portland ranks first among the United States' 51 largest cities for bike commuting (Alliance for Biking & Walking, 2010).

Figure 3.5. **Rate of increase in vehicle registrations in metropolitan cities in Korea, 2000-10**



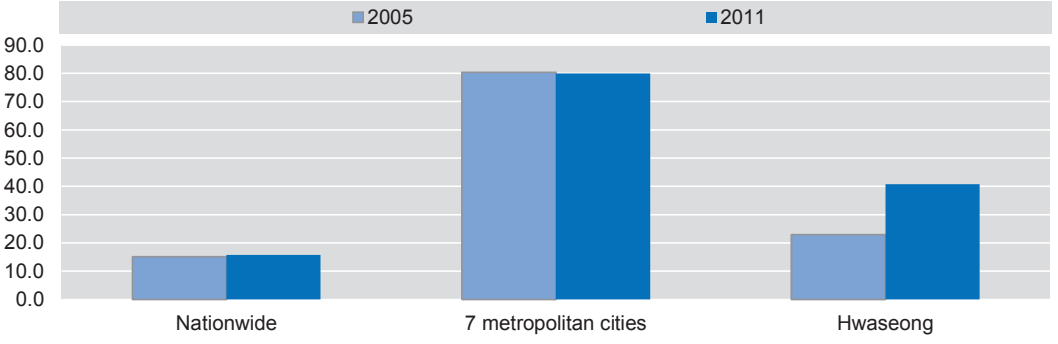
Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Service, www.kosis.kr.

Hwaseong

City profile

Hwaseong is located on the southwest coast of Gyeonggi-do. Surrounded by several cities, it also faces the West Sea of Korea. It is the 5th-largest of the 27 cities in Gyeonggi-do, with an area of 689 km², which is larger than Seoul (605 km²), and its rapidly growing population has reached nearly 500 000 (the annual population growth rate was roughly 17% between 2000 and 2010). Hwaseong, nearly 40 kilometres from Seoul, is the location of large development projects, such as industrial facilities and in particular housing sites, developed to accommodate the population of Seoul and Gyeonggi-do. Urban, rural, fishery and mountain areas are distributed evenly throughout Hwaseong, but the urban area's population has dramatically increased in recent years (Figure 3.6).

Figure 3.6. **Change in share of urban land in total land**

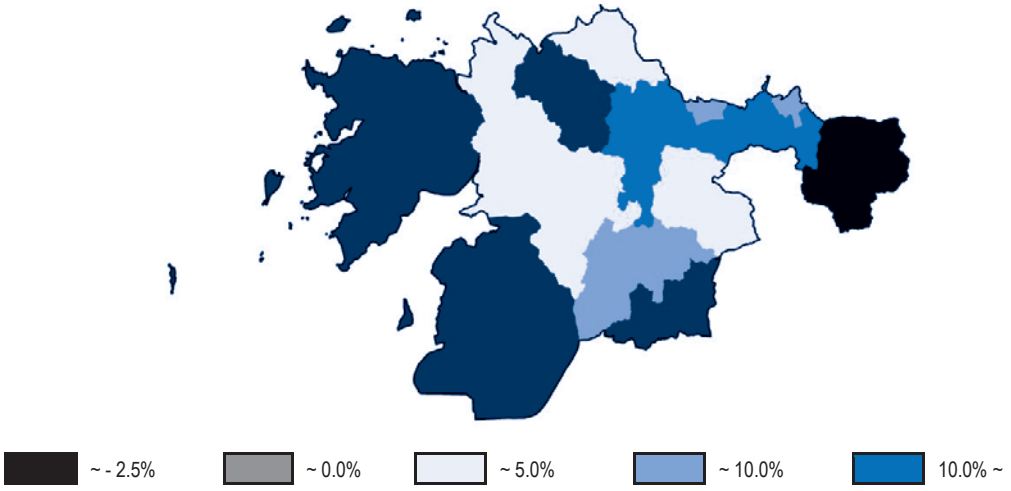


Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Service, www.kosis.kr.

Urban challenges

Improving a disorderly urban spatial structure is Hwaseong's biggest challenge. Large-scale development and the Gyeongbu Express and high-speed railway crossing eastern Hwaseong from north to south have created a development gap between eastern and western parts of the city, and between its urban and rural areas. Of its total population, 67.5% is now concentrated in the eastern area, thanks to several new town developments, including the Dongtan New Town (Figure 3.7). The non-urban area has been rapidly developed in a haphazard fashion inimical to organised and balanced spatial development. Individual developments have sprung up around large-scale development projects, and factories have been randomly located in non-urban areas. Warehouses, industrial plants and apartments in rural areas have spoiled the city's landscape (Figure 3.8). A lack of urban infrastructure is also problematic. Insufficient transport between east and west, as compared to that between south and north, has distorted its spatial structure.

Figure 3.7. **Discrepancies in population growth rates across Hwaseong between 1990 and 2010**



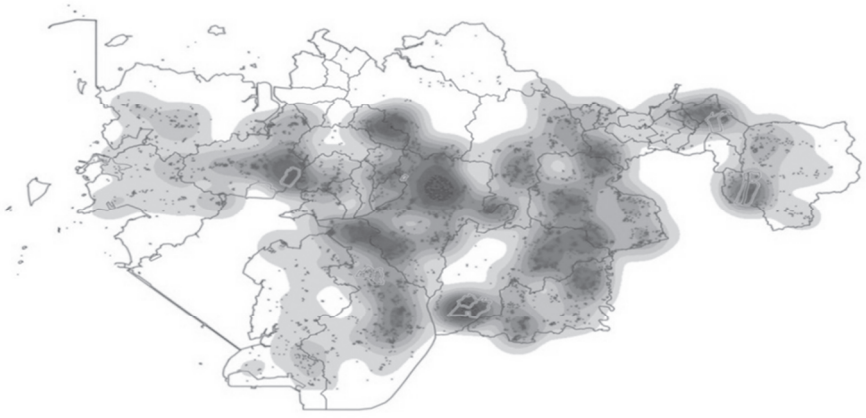
Notes: The units analysed in this map are based on the TL5 administrative borders of Hwaseong in 2010. The map does not reflect the changes in Hwaseong's administrative borders since 2010. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Own elaboration based on Korea Statistics Office (2013), Korea Statistical Information Services (in Korean), www.kosis.kr.

Assessment of compact city policy

Hwaseong covers a large area, and part of its territory is included in the Seoul Metropolitan Area. This puts it under strong pressure to urbanise, following the type of urban structure promoted in the Seoul Metropolitan Area. Hwaseong must strategically take systematic action while devoting full attention to the policies of the central government and the Seoul Metropolitan Area, building on its ambitious Urban Master Plan and the numerous guidelines for policy embedded in it (Box 3.5). The Gyeonggi-do government, under whose jurisdiction Hwaseong falls, maintains a horizontal network of local governments through, for example, transfers of deputy mayors within the region. Hwaseong could maximise this opportunity to achieve compact city goals by close co-operation with neighbouring cities.

Figure 3.8. **Distribution of factories across Hwaseong**



Note: The dark shaded areas represent the areas where industrial plants are concentrated. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Hwaseong (2013a), "Policies for compact city in Hwaseong", presentation by Hwaseong to the OECD mission team in April 2013.

Beyond such ambitious plans, it should be noted that there is a major mismatch between the central government and local governments on the approach to urban development. The national government, and the government-funded Land and Housing Corporation, are conducting large-scale new developments and infrastructure to support such developments. Meanwhile, local governments are establishing their own urban development/management plans, which often come into conflict with the national plan. In Dongtan New Town, Hwaseong requested that the national government build more cultural and multi-purpose facilities (e.g. sharing school yards with the public to provide cultural facilities, sports facilities and welfare facilities). The national government, however, declined to comply, due to increasing costs and security problems. Meanwhile, the financial resources at the disposal of the city government are not adequate for urban development on the scale envisioned by their plan. The delicate issue of how much decision-making power and financial resources can be transferred to the local government has occasioned considerable debate. However, before any change is made in the decision-making system, quantitative information should be gathered on the extent of gaps in infrastructure development to avoid unnecessary investment and obtain further support from the national government.

Hwaseong may need to improve its urban policies to reshape its urban form. Its urban areas are crowded with high-rise buildings (e.g. Dongtan New Town) especially in the east, and conventional villages are scattered throughout its broad territory. However, a wide area of the city is still covered largely by agricultural land and forests.[10] In addition, about 73.5% of its small factories have sprung up randomly with poor infrastructure. To address these challenges, built-up areas, conventional villages, farmland and forests must be clearly defined in the development plan to establish a long-term vision for the city. Particular attention must be paid to deregulating land use, as a similar deregulation of land use is often demanded in other districts within the city for reasons of social equity. Such deregulation would lead to an overall easing of regulations within the city area, resulting in low-density developments scattered throughout the area, the typical experience of many cities that have many undeveloped areas. The risk of such a shift

away from a compact city calls for careful strategic examination to avoid scattered developments and design based on a wider polycentric city system beyond its administrative boundaries. Powerful instruments to protect land resources, such as the Agricultural Land Commission created by the Province of British Columbia (ALC), could be helpful. The ALC is responsible for the Agricultural Land Reserve (ALR), a provincial zone in which agriculture is recognised as the priority use, and has protected farmland and helped promote more compact communities (OECD 2012a).[11]

Box 3.5. **Hwaseong's Urban Master Plan**

The key urban challenges Hwaseong faces are the distortion of its urban spatial structure caused by the development concentrated mostly in its eastern district; a strong dependency on neighbouring large cities in terms of socio-economy and culture; and its lack of infrastructure due to the speed of recent urban expansion. To address these problems, the city has established a vision for the future and promotion strategies by examining changes in the domestic and foreign environments as well as the urban one in the Urban Master Plan. Three goals of city development have been set: a high-tech industry/research/education city aiming to cultivate the new industries of the 21st century; a historic, cultural and tourist city, involving a comprehensive plan for tourism development; and an environment-friendly, ecological city, through the conservation of shore and tideland. Numerous policy initiatives have been set up to achieve these goals, as laid out in the following table. Finding the resources to realise them may present a challenge.

Policy measures illustrated in the Urban Master Plan of Daejeon

Policy goals	Policy measures
"High-tech industry/research/ education city" by cultivating the 21st century's new industry	– Encouraging infrastructure industry, the automobile parts industry and other conventional manufacturing industries to locate in the collective district – Creating an automobile parts cluster (Songsan-Namyang-Jangan-Ujeong) – Creating a biological and health cluster (Bibong-Maesong-Bongdam-Hyangnam) – Creating a semiconductor and IT cluster (Suwon-Dongtan-Osan-Pyeongtaek) – Building a human resource-based network, forming a consultative group between industry, the university and government for collaboration – Ensuring widespread synergies through the research of Dongtan New Town, created into a ubiquitous city and by promoting self-sufficiency – Expanding the competitive educational infrastructure of the region to ensure excellent educational conditions
"Historic, cultural and tourist city through a comprehensive tourism development plan	– Promoting traditional culture and tourism clusters (Gungpyeong-Hyangnam-Byeongjeom) – Using the theme of filial piety and reform to promote the city, based on the Yung-neung and Geon-neung Royal Tombs – Creating a marine tourism and recreation cluster (Gungpyeong port-Jebu island-Jeongok port-Songsan green city) – Developing theme park-style tourism (Hwaseong USKR, Autopia, etc.) – Creating spa/health resorts by using spa resort tourism resources (Wolmun spa, Hwaseong spa and Annyeong spa) – Connecting farming special zones, silver villages and weekend/tourism farms – Creating cultural experience space for the agricultural and livestock industries by using agricultural reclaimed land
"Environment-friendly, ecological city through the conservation of shore and tideland	– Creating a "green-blue" network connecting ocean scenery and mountains on the western coast – Ensuring the city's appeal by ensuring sufficient green area – Realising a future-oriented, self-sufficient city by building ubiquitous amenities – Providing a vital, attractive residential environment by creating mid and low density, environmentally friendly housing complexes

Source: Hwaseong (2013a), "Policies for compact city in Hwaseong", presentation by Hwaseong to the OECD mission team in April 2013.

The number of factories scattered around Hwaseong might deepen concern that further development will take place around such factories. Pressure for expansion and relatively low land prices are compelling factories to relocate either within or outside the city. This would result in more sprawl and increase workers' commuting time. Factories contribute to the city's economic and employment base (the share of employment in the manufacturing sector is 56.6% of the total). Compact city policies should be carefully designed so that dense and proximate development does not reduce economic activity. Vancouver's new Regional Growth Strategy provides a useful example, where industrial areas are located not only in suburbs but also in the city core. In this instance, Metro Vancouver monitors demand for and supply of industrial-purpose land (Metro Vancouver, 2011).

Dongtan New Town is expected to house a substantial population of workers for large factories in the city. This policy is an effective way of rapidly establishing the new town. Relocating factories outside the city, however, could strongly affect the new town. To reduce this risk, diversifying economic activities in the region is called for. One way of attracting new residents to the new town might involve incorporating state-of-the-art schools or clinics. This approach has been used in the regeneration of parts of Manchester in England, where the new Millennium Community of New Islington is using the creation of a new school to draw professional and high-income residents to a previously deprived area of the city.[12]

Because Hwaseong is undergoing a growth spurt, the renewal of its urban centres does not appear to be as urgent a policy priority as other issues. Without well-prepared development strategies, however, tailored to the city's potential for growth, the social costs could be great. Providing a transport network for the large populated area and connecting the east to the west side of the city in a timely manner are imperative. The time lag between the development of the Dongtan New Town and introducing public transport will otherwise generate serious problems, including heavy traffic congestion due to commuting between Seoul and Dongtan New Town.[13] Public transport planning must be carefully timed with development. Before finalising any plan for public transport, a quantitative analysis of the level of current demand for the connection of the urban centres must be conducted.

Dongtan New Town's land-use plan shows intentionally mixed land use, which seemingly satisfies the compact city requirements (Box 3.6). However, an adequate block size should be applied to avoid large-scale, automobile-dependent developments and maximise the positive impact of mixed-use development. What types of use should be mixed, at what scale and whether appropriate mixed land use is applied within the living scale of walking distance must be determined by analysis of residents' actual lifestyles. Mixed-use development should not be encouraged if it results in greater car use, and care needs to be taken to encourage public transit, cycling and walking.

The concept of TOD is reflected in the city's plan to develop a transit network around a new KTX (Korea Train eXpress) station to be built in Dongtan New Town. Hwaseong plans to build multi-unit dwellings near the station, and connect the other transport modes to the station (Hwaseong, 2013a). It also aims to attract the headquarters of multinational companies, conventions, hotel and shopping malls to the station. This plan could be a good start for combining land-use policy with transport policy, but the success of such projects will depend on how construction of a new KTX station conducted by the central government is proceeding. The city's plan appears to be oriented toward physical development, without an overall strategy for maximising this opportunity to enhance the city's competitiveness.

Box 3.6. **Mixed land use in Dongtan New Town**

The first Dongtan New Town, completed in 2007, included a multi-use complex, located in the centre of the town. At the centre of this complex, a multi-level mixed-use building cluster, called MetaPolis (114 000 m²), was developed under the Special Planning Areas of District Unit Planning. This high-rise model complex included residential units, office and commercial space and a retail shopping centre, multiplex theatre, ice-rink, fitness centre, medical service and restaurants, as well as parks and open space. The District Unit Planning determined that the six-story commercial buildings in the neighbourhood commercial areas in this multi-use complex could introduce residential use on the fourth floor and above.

The second Dongtan New Town, which is currently under construction, also aims to achieve mixed land use, using seven special planning areas, such as the Metropolitan Business Complex. It adopts the TOD concept and a mix of residential, business and commercial uses. The second Dongtan New Town project covers the Seoku-dong, Bansong-dong and Dongtan-myeon areas (about 24 million m²) with the goal of a population of 285 878 (119 persons/ha), or around 115 323 households (2.5 persons/household). The project aims to not only create a self-sufficient hub city where residence, education, culture and business as well as high-tech industries exist in harmony but also to absorb the housing demands of the southern metropolitan area, contributing to the stabilisation of the housing market. With development concepts such as a "business hub city of the southern metropolitan area", "Mecca of high-tech industries", "Korean-style new town" and "a healthy and sustainable evolving city", the project has proposed implementation strategies including high-density development, job-housing proximity, mixed land use and housing diversity, green traffic support programmes (such as an Intelligent Transportation System type rental bicycle project), enhancing links among public transport, introducing new transport modes, and so on. The project's development objectives and concepts for a sustainable urban development are reflected in its land-use planning.

Sources: Korea Land and Housing Corporation (LH) (2013a), "Introduction of Dongtan New City", http://dongtan.lh.or.kr/dongtan_1/02_Introduction/01_1_business.asp?key1=1&key2=1&key3=0; Korea Land and Housing Corporation (LH) (2013b), "Move to the second Dongtan" (English brochure), LH, Gyeonggi-do, Korea.

Adverse effects such as traffic congestion from compact development are expected to be minimal for the moment within the city, if transport infrastructure is provided in a timely manner. However, since it is located on the outskirts of the Seoul Metropolitan Area, it could increase highway congestion. Possible bottlenecks should be identified through analyses such as traffic simulations. This will require the city government's strong commitment to reducing traffic congestion, using existing policy instruments such as fees for facilities-induced traffic (Box 3.7).

Box 3.7. **Fees for facilities-induced traffic**

The fees for facilities-induced traffic were introduced to reduce traffic and provide the budget to improve public transport. Unlike a general congestion charge, these fees are imposed on the owners of facilities with total floor area of each story exceeding 1 000 m², which cause traffic congestion in any urban traffic improvement districts on an annual basis. Local authorities run the programme, and Hwaseong is encouraging the facilities to run traffic congestion relief programmes such as car-free days by reducing their charges if they operate them.

Source: Hwaseong (2013b), "Introduction of fees for facilities-induced traffic", www.hscity.net (accessed 1 September 2013).

Simulation of compact city policy toward sustainable cities

Why urban modelling?

As the OECD (2012b) noted, there is an apparent disconnect in Korea between the highly advanced planning concepts presented in the various framework documents and the current state of spatial planning and territorial governance on the ground. Urban modelling could increase the awareness of future consequences and support long-term strategic decision making. In particular, urban modelling is important for compact city policies because a developed urban model[14] can identify the best combination of compact city policies for each city. Policy makers need to select compact city policies with the best output available. Urban models are useful because they can simulate the impact of multiple combinations of policies so that policy makers can choose the best combination based on the simulations outputs. They are also effective for communicating with citizens by incorporating their voices into the simulation process and visualising the output on a map.

Given the complexity of compact city policies, and the interconnectivity/interaction between their impacts, an integrated urban model is required to help explain the complicated relationship in a holistic manner. For example, compact city policies have various impacts on land use, travel behaviour, economy, environment and society. They affect decisions of households and businesses, so-called agents, their behaviour changes the pattern of land use and travel behaviour, and the resulting economic viability, environmental and social impacts associated with the change. Furthermore, land use interacts with transport because transport access encourages development while urban expansion requires more transport infrastructure (Hansen, 1959). A model for assessing compact city policies should consist of several sub-models representing each part, such as land-use changes and transport, and interacting with each other.

Developing a comprehensive urban modelling framework

The goal of the modelling work in this report is to find the best combination of compact city policies that maximise the benefit of urban development. In the context of each city's institutions, culture and physical environment, the policy package it pursues must be different. In addition, a single policy by itself does not work effectively, because compact city policies are naturally complementary. Multiple packages of compact city policies should be tested to identify the most promising combination. A model needs to capture different relationships and interconnectivity for each scenario.

Several modelling tools capable of being used for examining compact city policy effects partly have been developed. These models cover different styles of urban modelling theories, such as spatial interaction models, economic models and micro-simulations. Table 3.3 illustrates urban modelling approaches and reviews urban models. Examining the applicability of assessing compact city policies, several topics for further discussion suggest themselves.

The models in Table 3.3 are able to evaluate the impact of compact city policies to some extent, but from different angles respectively. While ITLUP, PECAS, UrbanSim and ILUTE can evaluate the impact of different policy scenarios by relocating the spatial distribution of households, employment and the transport network, SLEUTH and CLUE can only perform such evaluations by establishing spatial and/or socio-economic constraints on a land-use map. In this case, a partial examination of compact city policy impacts is possible, but identifying the overall policy impact may be very difficult.

Table 3.3. **Classification of different urban models**

Approach	Model theory	Models
Top-down approach[1]	Spatial interaction	ITLUP
	Spatial econometrics	PECAS, UrbanSim
Bottom-up approach[2]	Cellular automata	SLEUTH, CLUE
	Multi-agent systems, or agent-based model	ILUTE, UrbanSim

Notes: 1. It is called "spatial interaction and spatial econometrics". A spatial interaction model specifies its relations between transport networks and locations as a cluster of aggregate relationships based on the behaviour of a representative individual, usually the average calculated from a representative sample of population (Iacono et al., 2008). A spatial econometric model is a statistical method analysing the relationships between the variables related spatially considering the spatial auto correlation (Jiyeon, H. et al., 2003)). Several models addressing auto correlations have been developed by statistical theories. 2. It is called "cellular automata and multi-agent system (or agent-based model)". A cellular model is comprised of discrete cell space representing real attributes such as population, environment and is known as the simplest way of modelling in that they combine entirely their populations with their environment (Batty, 2012). The agent-based model simulates agents, such as individuals, households, entrepreneurships or developers which are regarded to have autonomy to interact with others, to adapt and to modify, with some restrictive theories, to see the results judged by average responses of the agents (University, R., 2014).

Sources: Own elaboration based on Iacono, M. et al. (2008), "Models of transportation and land use change: A guide to the territory", *Journal of Planning Literature on line*, Vol. 22. No°4, SAGE, pp. 324-340; Jiyeon, H. et al. (2003), "Application of spatial econometrics analysis for traffic accident prediction models in urban area", *Proceedings of the Eastern Asia Studies*, Vol. 9, pp. 390-397; University, R. (2014), "Lecture 9: Agent based urban models", Centre for advanced spatial analysis, www.casa.ucl.ac.uk/rits/rits-lecture-9.pdf (accessed 6 July 2014).

The generic models are developed for use in many different regions, which have similar policy problems that the model can handle, and are not designed to address place-specific unique policy problems and modelling resources in different regions. Indeed, because OECD countries are at different stages in building databases for modelling, flexibility in the modelling frameworks is required, as the degree of available data varies. For example, some countries have land price data by the parcel whereas others may not even have the aggregate data by zone. In such cases, the model using sophisticated data such as PECAS, UrbanSim and ILUTE cannot be applied. Unfortunately, generic urban models do not have the flexibility to be applied to all OECD countries and their varying conditions.

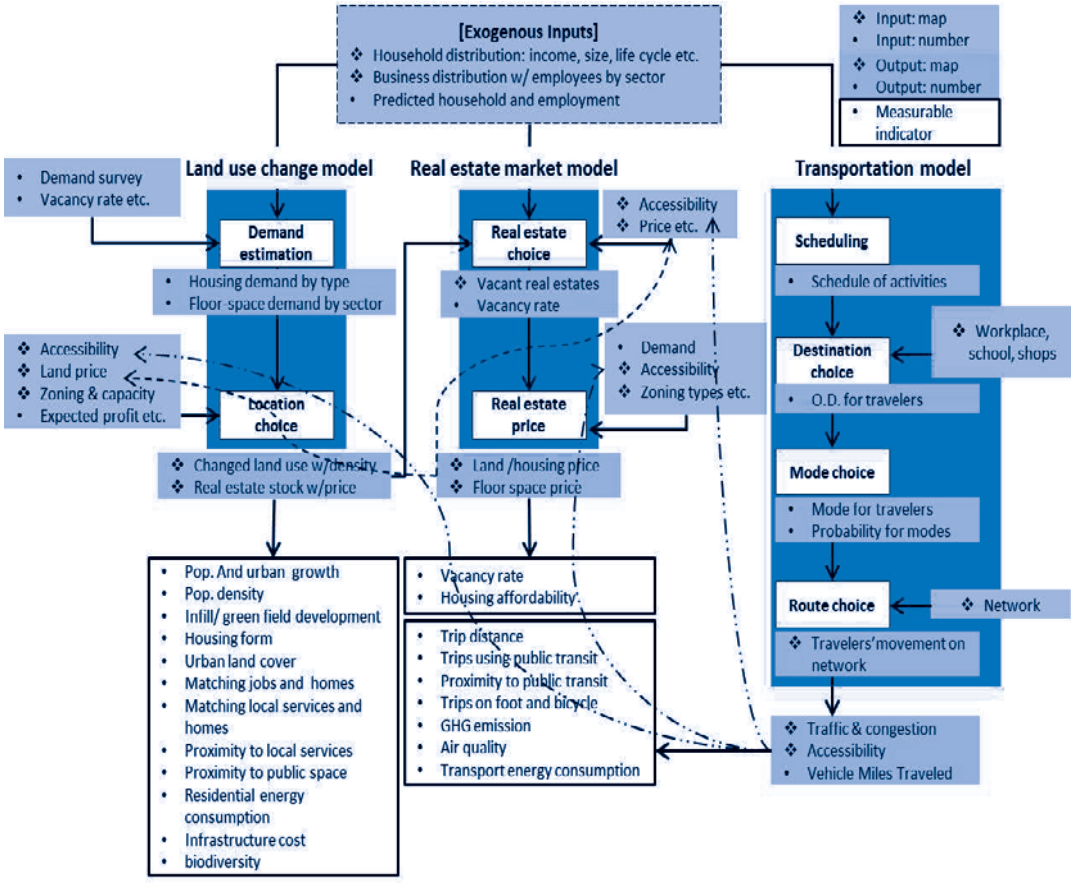
"Agent-based modelling" (ABM), which defines and simulates the behaviours of agents and their environments, fits the purpose of evaluating compact city policies. ABM has also been known as "one of the most exciting practical developments in modelling since the invention of relational database" (Macal and North, 2005) due to these features. Each activity regarding an agent's decision making requires different functions, algorithms and procedures, and needs to be modelled into a sub-system as well as the interactions between the sub-systems so that the whole integrated urban model describes the real world more effectively. The integrated urban model also responds to policy scenarios and processes the inputs using data, and produces results or outputs.

The integrated urban model adopts "demand-supply" interaction and profit maximisation principles to explain the real world's brief mechanism. Current and predicted population and businesses create demand, for which developers formulate plans to provide real estate products to meet. They tend to choose sites that will maximise development profit. As a result of developers' activities, land is changed due to greenfield

development or infill development (redevelopment), thereby increasing the stock of real estate.

Meanwhile, households and businesses also move to maximise their profits and the price of real estate in specific places is determined at which the demand and the supply meet. Price varies among different locations because a preferred location attracts demand while a less desirable location attracts less demand. An oversupply of vacant real estate will depress prices because it indicates that consumers, suppliers and developers do not value it. The price of real estate is also influenced by such factors as accessibility, zoning types and conditions. Housing affordability can be computed using the price and income of agents. The land-use change model and the real estate market model in Figure 3.9 illustrate this mechanism. The interactions and relations among indicators need to be verified by further justifiable researches in process of a comprehensible model development.

Figure 3.9. **Proposed conceptual framework for examining compact city policy impacts**



Source: Own elaboration based on Korea Research Institute for Human Resources (2013), "Conceptual framework for urban simulation model to assess impacts of compact city policies", presentation to the OECD expert seminar on 14 May 2013.

A transport model, a subsidiary model, maps individuals' travels. The first variable concerns time, as decisions are made when to travel, according to a daily schedule. Some commuting abides by routine patterns, such as to the workplace or attending school. Location is the next variable. A hospital, for instance, may be a destination for a household. Next, the mode of transport is chosen, and whether to walk, bike or take a car or the metro. Finally, travellers determine which route to use. Mapping these decisions (for the transport model) makes it possible to model traffic volume on the road network and to identify potentially congested areas. Based on the congestion, accessibility to public services can be calculated for each location where agents live and work. Vehicle miles travelled can also be calculated for each agent and can be used to compute CO_2 emissions, air quality and energy consumption.

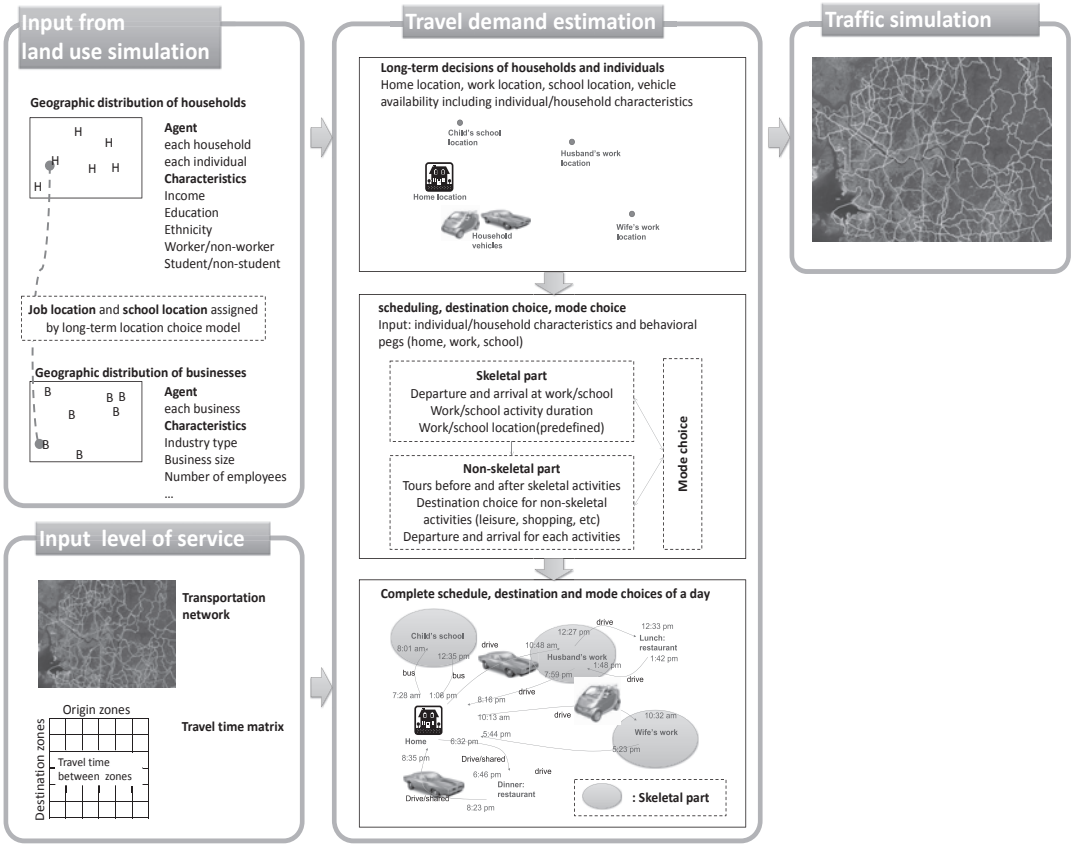
This report suggests the "activity-based transport model" as the most appropriate model in that it explains overall individual behavioural patterns rather than just fits the traffic volumes on the transport networks as traditional modelling has done. ABT induces traffic demands from the individual decision-making mechanisms of the activities so that it can provide outputs with richer details with higher disaggregation in time and space than traditional transport models. Figure 3.10 shows the general flow of ABT, in which land-use agent-based models interact closely to coup with the agents' activities.

The development of comprehensive models should include inputs and outputs as far as possible while considering interactions between sub-models, but should be followed by a long-term research effort. This involves the development, application and examination of a knowledge framework to address the problem at hand, i.e. the impact of compact city policies. Such a knowledge framework can be collapsed into a more tangible form, such as a computer programme. The conceptual framework for examining compact city policy impacts is proposed in Figure 3.9. In this framework, integrated urban modelling could be developed by testing existing models, building sub-models reflecting different policy environments.

Designing a conceptual model is the next step after this conceptual framework, in which computational algorithms are produced reflecting the relevant analytical methodologies as well as inputs to the data management procedures. Then we can develop a real model with specific computer languages checking if the language codes satisfy the algorithms and the codes work on the data properly. We also need to develop appropriate Data Base Management System (DBMS) fitting the analytical methodologies and algorithms. Eventually, the model needs to calibrate the parameters before the main simulations through repetitive comparison between the simulated and the data observed in reality.

This study proposes selecting the appropriate strategy, either an entirely new development, utilisation of existing models or a combination of the two, in order to develop a model based on data and resource availability. An approach based on a combination of the two is more appropriate to the further development of this study in that a new method requires data, money, time and resources and no generic existent model fits all cities. In the same vein, this research operated two pilot urban modelling simulations through compromised approaches in order to see if the urban areas are developed in a compacted manner when some compact city policies are introduced. More specifically, we developed a new urban modelling tool adopting ABM with restricted resources to simulate compact city policies on Daejeon and we used SLEUTH, an existing modelling tool, to simulate them on Hwaseong. These pilot simulations are good examples of integrated urban modelling justifying compact city policies at a basic level. The simulation results are described in the following sections.

Figure 3.10. **General procedure of travel demand modelling using an activity-based model**



Sources: Own elaboration based on Korea Research Institute for Human Resources (2013), "Conceptual framework for urban simulation model to assess impacts of compact city policies", presentation to the OECD expert seminar on 14 May 2013; Arente, T. and H. Timmermans (2000), *Albatros: A Learning Based Transportation Oriented Simulation System*, Elirass, Eindhoven; Pendyala, R.M. et al. (2012), "An integrated land use transport model system with dynamic time-dependant activity travel microsimulation", *91st Annual Meeting of the Transportation Research Board.* Vol. 2012/1, Washington, DC.; Goulias, K.G. et al. (2012), "Simulator of activities, greenhouse emission, networks, and travel (segment) in Southern California", *Annual Meeting of the Transportation Research Board*, Washington, DC.; Salvani, P. and A.E. Miller (2005), "ILUTE: An operational prototype of a comprehensive microsimulation model of urban systems", *Networks and Spatial Economics*, Vol. 5, No. 2, pp. 217-234.

Simulation exercise (1): The impact of compact city policies on Daejeon

As an example of a basic level's integrated urban modelling based on the framework in the previous chapters, an agent-based urban simulation model was developed for this study to assess a set of compact city policies for Daejeon.[15] As noted earlier, the nature and impact of the compact city is multi-dimensional, and only a purpose-built comprehensive model will cover all the necessary aspects of the compact city. The development of such a model is a long-term project, and this research offers an experimental pilot model with a focus on a particular component of the compact city – new development, redevelopment and densification, which scenario 2 addresses in Table 3.4. Dense development is often considered a critical component of a compact city. The impact includes mitigation of urban sprawl, as well as reduced commuting and shopping trips.

An agent-based model integrated with microeconomic location choice theories is a good fit with the study of compact city in this context in that it simulates agents' interactions with each other and with their environments based on their realistic behaviours (Macy and Willer, 2002; Gilbert, 2008). This research adopts and extends the urban simulation model developed in the work of Kim and Batty (2011) and Kim (2012). These studies extended the bid-rent theory of Alonso (1964), Mills (1967) and Muth (1969), in order to define the location choice behaviour of households. To make a more comprehensive model, this research will define urban location choice behaviour of households with a reference to the random utility maximisation principle in place of the bid-rent theory, which reflects more heterogeneity and stochastic features of agents (Abraham and Hunt, 2007). In addition, this model introduces multi-level submodels to describe more realistic socio-economic features such as "global restriction on total urban growth" and "allocation of urban demand based on population". The preference for urban development will be considered as a part of the utility function, and the model will present the formation of resulting urban growth.

As regards the study of the compact city, this pilot model focuses narrowly on the impact of dense urban development on urban growth. This study will pay attention to developing and testing model behaviour with the use of geographic data for Daejeon. A logistic regression to determine model variables is conducted on an empirical basis, but at a limited scale, due to the constraints of time and budget. The model and results are both experimental and exploratory. However, since the land-use model is the core of any comprehensive urban model and the impact of dense development is not as thoroughly studied by existing urban models, the pilot model in this research will provide useful implications for the further development of a compact city model.

Box 3.8. **Comparison between "bid-rent theory" and "random utility maximisation theory"**

Bid rent theory

According to this theory, householders all compete for the most accessible dwelling within the central business district (CBD) and choose it in a way that maximises its utility within the budget constraints. "Bid rent" means the amount that households are willing to pay for the location. The bid rent maximizing utilities of a specific place is determined by the Cobb-Douglas utility function. Households always face a trade-off between transport costs and land rent. The bid rent always decreases as the distance from the CBD increases.

The Cobb-Douglass utility function is:

$$U = q^{\alpha} g^{1-\alpha} a(u,v)^{\gamma}$$

U is utility, *q* is the floor space of a household, *g* is non-housing good, *a (u,v)* is the amenities at location *(u,v)*. The CBD's location is (0,0). α(0< and <1), γ (>0) are parameters. Land developers choose the location and density of development to maximise the profits, the amount after the costs are deducted from the benefits of the developer.

The procedures for a city to be developed until equilibrium are as follows: *i)* housing prices are bid up in desirable locations such that no household wants to move; *ii)* the price that households are willing to pay equals the price that developers are willing to accept at each location; *iii)* land prices are bid up in desired locations such that development profits are zero everywhere and developers are indifferent to the locations of development; *iv)* the total demand for floor space equals the total supply; *v)* at the city boundary, the land rental price equals the exoneous agricultural rent.

Box 3.8. **Comparison between "bid-rent theory" and "random utility maximisation theory"** (*cont.*)

Random utility maximisation theory

This theory assumes that each agent, such as a household or a business, decides to maximise its utility on finite alternatives and that the utility is composed of an observable deterministic part and an unobservable stochastic part. The utility that individual *i* is associating with alternative *a* is defined by:

$$U_{ai} = \sum_{s=1}^{S} \beta_s x_{ai} + \varepsilon_{ai}$$

Where *S* is a choice set, β_s is a vector of *s* estimable coefficient, x_{ai} is a vector of an observed independent attribute of individual *i* on alternatives *a*, and ε_{ai} is an unobserved random disturbance that is assumed to follow a Gumbel distribution, which models the distributions of the maximum (or minimum) of a number of samples of various distribution such as the distribution of maximum level of river of a particular year. From this, a multinomial logit model, *P*, for the probability of choosing an alternative *a* out of the choice set S_n. The key model behaviour is defined by a short run random utility maximising location choice of spatial agents.

$$P_{ai} = \frac{e^{x_{ai}}}{\sum_{k \in S_n} e^{x_{ki}}}$$

Sources: Kim, D. and M. Batty (2011), "Modeling urban growth: An agent based microeconomic approach to urban dynamics and spatial policy simulation", *CASA Working Paper Series*, No. 165, University College London, London; Abraham, J.E. and J.D. Hunt (2007), "Using random utility theory in spatial economic modelling: Recent advances", 10th International Conference on Computers In Urban Planning and Urban Management, Iguassu Falls PR, Brazil; Wu, J. and A.J. Plantinger (2003), "The influence of public open space on urban spatial structure", *Journal of Environment Economics and Management Issue*, Vol. 46, Issue 2, pp. 288-309; Mcfadden, D. (1973), "Conditional logit analysis of qualitative choice behaviour", in P. Zarembka (ed.), *Frontiers in Econometrics*, Academic Press, New York, pp. 105-142.

Forecasts of future urbanisation for Daejeon have been conducted on the basis of two scenarios: business as usual and compact development. The first scenario focuses on the extension of current trends, and the second on the effect of a compact city policy. Unlike the compact development scenario for Hwaseong, we assume the promotion of urban redevelopment and densification for Daejeon. Urban redevelopment and densification can reduce urban sprawl and loss of open space, and this is considered an important characteristic of compact city development. However, few urban models can simulate such urban redevelopment and densification practices. Thus, we introduce the notion of spatial redevelopment and densification into the agent-based modelling framework. Since the estimation of the amount of redevelopment and densification requires the development of relevant empirical models, we simply utilise random stochastic effects to determine them. Nevertheless, this simulation will show how urban redevelopment and densification will change overall urban structure. Table 3.4 shows the key assumptions in the two scenarios.

Figure 3.10 shows comparisons of urban development in 2030 between the current trends scenario and the alternative scenarios for a compact growth. Daejeon is not a rapidly growing city, but it will experience a certain degree of urban expansion and

sprawl. The simulation results show that the new urban growth will occur near the existing urban areas in the case of the business as usual scenario. Mid- to large-scale new development will take place in the western part of the city, where most mid- to large-scale developable lands are available. This simulation proves that the residential development districts like Doan, Dukmyung, Gubong and Hakha will see intensive new development. On the other hand, small-scale spontaneous development will occur in the south-western and south-eastern part of the city, especially around the foot of the Bomun Mountain. These areas are now mainly filled with detached and semi-detached houses, agricultural barns and small manufacturing firms. This type of development is likely to expand in the future.

Table 3.4. **Key assumptions of the two scenarios (Daejeon)**

Scenario 1	Business as usual scenario: – Assume no changes in policies or land-use change drivers
Scenario 2	A compact city with promotion of dense urban development: – Assume continued protection of all existing protected lands – Assume no new roads in or near existing villages – Assume growth will occur near transport networks such as primary roads or rail stations – Assume urban redevelopment around old town centre – Encourage urban development to occur near urban amenities such as cultural facilities – Assume high-density development – Retain existing population growth trends

In the case of the compact growth scenario, urban redevelopment and densification will actively take place around the old town centre. Generally, urban models assume the urban development is irreversible and tend not to consider redevelopment of urban areas. Therefore, existing urban models keep those which had been once converted to urban land as urban land during the rest of the model run even if some of them contained areas of redevelopment. This model assumes the redevelopment of old town centres, and thus reduces new development in the urban fringe areas. Certainly, this will not remove the need for a large-scale urban development, and thus the overall spatial structure is similar to that of the business as usual scenario. But small-scale sprawling developments are clearly reduced in this scenario. Figure 3.11 and Table 3.5 present and compare the results of the simulation.

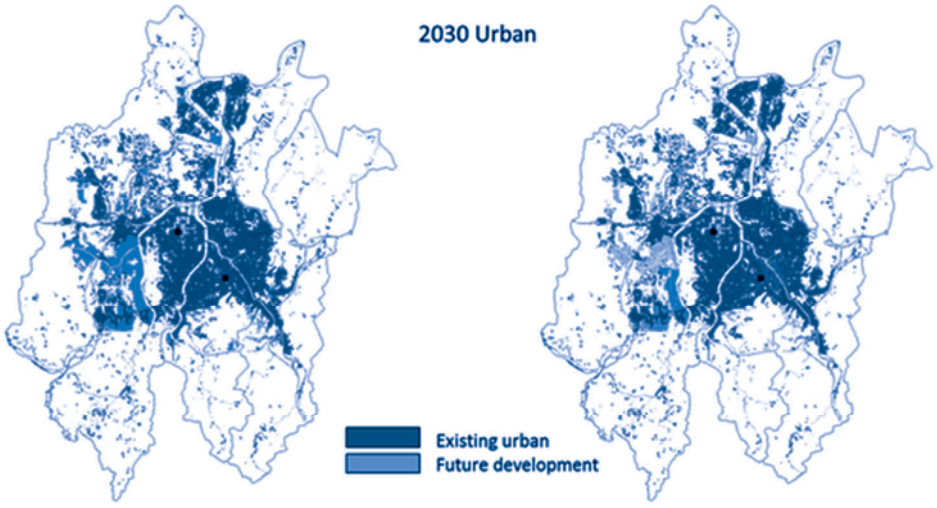
Table 3.5. **Comparison of results between different scenarios (Daejeon)**

	Business as usual	Compact development
Urban development within 2 500 metre buffers from the new and old central business district	0.25 km²	1.6 km²
Urban development outside 2 500 metre buffers from the new and old central business district	21.85 km²	17.9 km²

Note: The location of the new central business district is assumed at the point of Daejeon City Hall (upper left black point in Figure 3.11), and the location of the old central business district is assumed at the point of Junggu Borough Hall (bottom right black point in Figure 3.11).

Figure 3.11. **Different development patterns according to different scenarios (Daejeon)**

(a) Business as usual (b) Compacted development



Note: The grey area is the existing urban region and the blue area is the future development region.

Source: Own elaboration based on National Geographic Information Data and Korea Statistical Information System Data.

Simulation exercise (2): Impact of compact city policy on Hwaseong

To estimate the compact city policy effect for Hwaseong, the SLEUTH model[16] was applied in this study. The model is built upon the core notion of cellular automata, as well as other statistical methods, and is one of the most widely used cellular urban models for simulating land-use change and urban growth (Clarke, 2008; Jantz et al., 2010; Rafiee et al., 2009; Silva and Clarke, 2005). One of the most important strengths of this model is its "compact" data requirement, and even without the intensive use of socio-economic data, this model efficiently simulates the land-use change and urban growth process. Although the model is not designed to study the impact of the compact city itself, it is one of the most widely used urban growth simulation models capable of offering some insights for the study of the compact city.

This model offers opportunities to simulate some compact city policies, such as land-use regulations and the provision of transport, and to examine the impacts of those policies on the urban and environmental landscape. It is important to note that, due to the nature of the model, SLEUTH has certain limitations for considering more diverse socio-economic determinants, and it creates the results of land-use change and urban growth in a physical perspective. To compensate for this, this study implements various factors with scores according to the degree of attraction (5: attraction; 90: strong resistance) as simulation input data.

To simulate urban development patterns over the next 20 years under different conditions, this study designed two urbanisation scenarios for Hwaseong: business as usual and compact development. The first scenario assumes that current urban patterns will continue 20 years into the future, and no specific policy actions are assumed in this scenario. The second scenario reflects the concept of compact city. Along with conservation of natural resources and the environment, a denser, clustered development is assumed in this scenario. Table 3.6 explains the key assumptions of the two scenarios.

Table 3.6. **Key assumptions of the two scenarios (Hwaseong)**

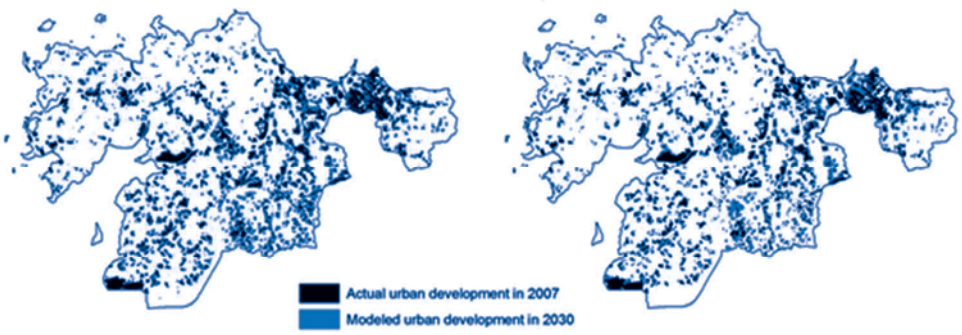
	Scenario 1: Business as usual	Scenario 2: A compact city with strong protection of natural resources and the environment
Assumptions	Assume no changes in policies or land-use change drivers	1. Assume continued protection of all existing protected land
		2. Assume a protected buffer (of 300 metres) around bodies of water, streams, wetlands and coastal areas
		3. Assume growth will occur in or near existing villages and near primary road networks or rail stations
		4. Assume no new roads in or near existing villages
		5. Enhance proximity to the Suwon region as a driver
		6. Retain existing population density trends
		7. High-density development
		8. Encourage development to occur in or near existing villages, expanded by adding a 300-metre buffer

The simulations for Hwaseong show a continuation of scattered urban development over the next 20 years. Spontaneous and edge growth dominates the pattern of growth in Hwaseong. This is largely due to the current urban form and spatial structure of the city. However, the results indicate that the overall amount and detailed spatial pattern of urban development between the two scenarios is different. The business as usual scenario resulted in a higher level of urban growth, with a more dispersed growth pattern, but the compact growth scenario generated a lower level of growth, with a more clustered pattern.

The result of the business as usual scenario presents an intensification of scattered urban development across the region. Some notable urban clusters occur around the Dongtan and Bongdam New Town development areas, but some areas with sprawled development, like Songsan, Hyangnam, Balan and Paltan, are likely to experience further scattered development in the future. On the other hand, the results of compact growth show reduced urban sprawl. Major urban clusters will form around Dongtan and Bongdam in this scenario, but sprawling development around Songsan, Hyangnam, Balan and Paltan are reduced. Figure 3.13 shows comparisons of urban development in 2030, between the current trends scenario and the alternative scenarios for compact growth. Table 3.7 shows more detailed urban growth trends under the two scenarios. The business as usual scenario increases urbanised areas by 188%, to 173 km². The compact growth scenario leads to a 150% growth, to 138 km². The net increase in case of the business as usual scenario is 88 km², with 49 km² for the compact growth scenario.

Figure 3.12. **Different development patterns according to different scenarios (Hwaseong)**

(a) Business as usual (b) Compact growth



Source: Own elaboration based on the National Geographic Data and Korea Statistical Information System Data.

Table 3.7. **Comparison of results according to the two scenarios in 2030 (Hwaseong)**

	Scenario 1 Business as usual	Scenario 2 Compact growth
Total urban area by 2030 (km^2)	173	138
Percentage of urban land (%)	31.6	27.2
Projected population by 2030	576 745	576 745
Urban population density	3 334	4 206
Urban population within 500 metres of local services	255 683	259 862

Source: KRIHS and OECD elaboration based on the aforementioned simulation.

Conclusions of the simulations

This research suggests a conceptual framework of the integrated urban model (Figure 3.9) to assess compact city policy scenarios to find the one that is the most adapted for each city as well as the further works to complete the model development. Considering the limited resources, we developed and simulated a smaller version of the integrated model, based partly on the framework, using one of the most advanced theories in order to see if a set of compact city policies (Table 3.4) will induce compacted development of the Daegeon area. To better support the results of the simulation on Daejeon, we simulated another set of similar polices (Table 3.6) on the Whaseong area using a current advanced urban modelling tool with additional comprehensible factors scored by attraction for development.

Both simulations confirmed that compact city policies can develop urban areas compactly. Encouraged by the result, this study strongly recommends developing a more comprehensive and concrete urban model to find the best set of compact city policies for each urban area.

Notes

1. This rapid increase in population is mainly due to the new town developments built to accommodate the population from the Seoul Metropolitan Area.

2. This analysis is based on background reports from each city, and meetings with city governments.

3. This put the city on the same footing as the next level of government (*do*) and gave it broader autonomy.

4. The relocation was accelerated when the City Council and the City Hall moved to a new downtown in 1998. Since then, Daejeon has had two city centres.

5. Tsukuba, a well-known Science City in Japan, could offer some insights to Daejeon. It was established by the national government in the 1960s to facilitate research and development and improve the quality of scientific discovery. Its population growth rate of 2.6% over the last 40 years (1970-2010) was much higher than the national average (0.53%), possibly thanks to such policies as the provision of public housing for researchers, the development of a commercial complex near the railway station and a welcoming city centre, and more recently, the establishment of Tsukuba Express in 2005, connecting the city with Tokyo. This has improved its accessibility to major cities (OECD, 2012, Country Statistical Profiles Tsukuba City (2012), Statistical Data, Tsukuba city).

6. In the late 1990s, new downtowns were created, and the city's population and functions were moved from existing urban areas to a new urban area. A typical pattern of urban expansion, with the construction of suburban new towns, transfer of public agencies to suburban areas and large-scale shopping centres, have led to the decline of the old urban area. This has resulted in a dispersed spatial structure with low density.

7. This project aims to regenerate the old district around Daejeon station. The designated area, which covers 887 000 m², includes a population of 7 250 and much old housing stock (73.8% of its housing was built before 1980). Convention and cultural facilities, transfer centres, hospital and commercial centres will be built to replace old buildings.

8. The recent economic recession has forced Daejeon to reconsider its ambitious redevelopment projects. The plan is now to reduce the number of candidate projects after examining the feasibility of the proposed projects, and to target investment at community-based redevelopment (discussion with Daejeon officials during the OECD mission, 11 October 2013).

9. The Daejeon city government's efforts to reduce private car use include the "One Day Without A Car" campaign, started in 2012. Target vehicles are fewer than ten-seater, non-business purpose passenger cars. Participants in the campaign who refrain from driving from 7 a.m. to 10 p.m. one day a week receive benefits including a 10% reduction of the car tax, 30% off public parking fees, an 8.7% discount on auto insurance premiums and 10% discounts on car inspection fees and the Public Transport Free Insurance Service. The benefits of those who are found to have

infringed the ground rules more than five times in a year are suspended. As of December 2012, the number of the car-free day participants exceeded 10 000 people (Daejeon, 2013c).

10 . Population is concentrated in the eastern residential area, which houses 67.5% of the total population.

11 . Despite strong population growth, the urbanised land in Metro Vancouver has increased by only 149 hectares since 1986, primarily as a result of the constraints of the Agricultural Land Reserve.

12 . For more details, see www.urbansplash.co.uk/residential/new-islington.

13 . A mismatch between land use and transport policies has all too often aggravated traffic congestion around metropolitan cities. The introduction of a beltway around Seoul in 1999 was succeeded by the construction of five new cities (Bundang, Ilsan, Pyeongchon, Sanbon and Jungdong) three years later, leading to considerable traffic congestion (OECD, 2012b).

14 . Urban modelling is the process of abstracting the complicated and interdependent processes of the real world into a simplified computer model. Important components and interconnectivity are identified and illustrated using a mathematical or formal model, which is developed into a computer system. Urban models represent processes of components of a city and their functions and interaction. Typically, urban models are built using GIS (geographic information system) technologies and analytical methodologies. Citizens and physical environments such as roads and houses can be effectively represented as entities on the map using GIS.

15 . A description of this model and application process are described in Annex 3.A1.

16 . SLEUTH is a cellular automata urban model developed by Keith Clarke at the University of California, Santa Barbara (Clarke et al., 1997). A description of this model and application process are described in Annex 3.A2.

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Annex 3.A1
Modelling process for Daejeon

Modelling description

Agent-based modelling is a simulation method composed of agents that interact with each other and their environments. It is a computational modelling approach, in that it takes the form of a computer programme and in that there are inputs and outputs for the programme. The programme holds attributes of agents and environments and defines the behaviour of agents as well as the interaction with their environment (Macy and Willer, 2002; Gilbert, 2008). On the conceptual level, the agents and environments are simply generic terms describing their general characteristics, and there are no fixed definitions of their forms, attributes and behaviours. These are rather defined by a specific target system of modelling, and thus there could be widely different operational definitions of agents and environments. Many different academic domains, such as biology and economics, can use the agent-based modelling for their own research focus.

Agent-based modelling as an approach to the study of land-use change and urban growth is a relatively new idea. The urban modelling field has continuously adopted theories and methodologies from varying academic domains, and agent-based modelling is one of the latest techniques in urban modelling. It is gaining in popularity in the urban modelling field, but fully fledged generic models have not yet been well developed (Parker et al., 2002; Matthews et al., 2007).

One of the most important challenges of developing agent-based urban models is the specification of agents' behaviour and their interaction with the environment. Although the approach provides a useful framework for understanding the temporal dynamics of complex urban systems at a fine scale, it does not provide substantive knowledge of how urban systems change and evolve. In the past, these applications have been mainly centred on the study of self-organising urban morphologies, with a focus on generative knowledge discovery (Batty, 2009; Crooks et al., 2008; Matthews et al., 2007; Manson and O'Sullivan, 2006; Epstein, 2007), and this has limited their applicability in real planning.

Recently, a new approach to integrating urban economic theories into agent-based modelling frameworks has emerged through the study of land-use change. The main benefit is not only stronger explanatory power from the perspective of agent-based modelling, but also a greater behavioural/spatial heterogeneity with respect to how the urban economy is modelled and represented. Taken together, these developments have the potential to offer a new type of dynamic and operational spatial policy support system to planning practice.

The model in this research integrates the random utility theory (McFadden, 1973) into the agent-based modelling framework. Random utility theory models the choice of individual entities such as households and businesses on a finite alternative, and it breaks the utility down into observable deterministic elements and unobservable stochastic elements. Then, the land-use change and urban conversion occurs as a result of such agents' location choices.

The utility that individual *i* associates with alternative *a* is defined by:

$$U_{ai} = \sum_{s=1}^{S} \beta_s x_{ai} + \varepsilon_{ai}, \qquad \varepsilon_{ai} = a - b[\ln(-\ln \delta), \qquad \delta \in [-\delta_i, \delta_i]$$

Where S is a choice set, β_s is a vector of s estimable coefficient, x_{ai} is a vector of an observed independent attribute of individual i or alternative a, and ε_{ai} is an unobserved random disturbance that follows a Gumbel distribution.

Assuming that the unobserved random part varies with the Gumbel distribution, we are led to the multinomial logit model for the probability of choosing an alternative i out of the choice set S_n.

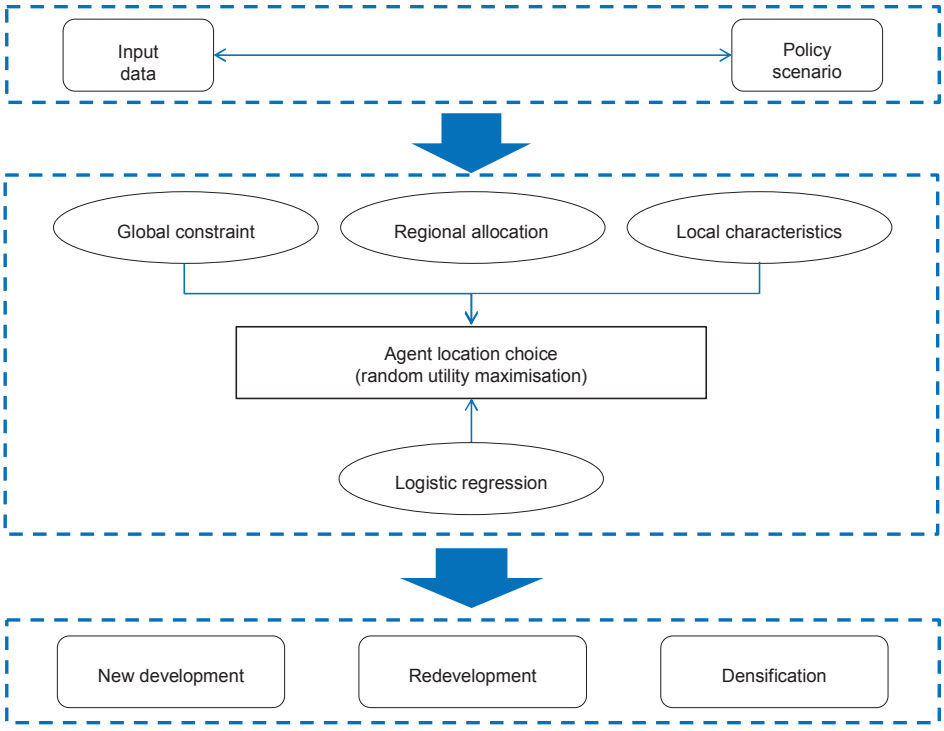
$$P_{ai} = \frac{e^{x_{ai}}}{\sum_{k \in S_n} e^{x_{ki}}}$$

The basic spatial and behavioural configuration of the model to be developed here conforms to the fundamental assumptions of the random utility theory. The random utility theory is used to model location choice behaviour of spatial agents. However, urban systems are affected not only by location choice behaviour of individual agents but also by various socio-economic factors. Thus, this study introduces a multi-level modelling framework comprised of "global" and "regional potential" micro-level submodels into an agent-based modelling system, which distinguishes this approach from the existing models. The global potential is controlled to prevent unrealistically excessive urban growth quantity. On the other hand, such urban demand is regionally allocated with a reference to the regional potential (or population). Then, each agent makes location choices at a local level. Combined with further policy assumptions, the resulting patterns are new development, redevelopment and densification. The overall model structure is described in Figure 3.A1.1.

Input data

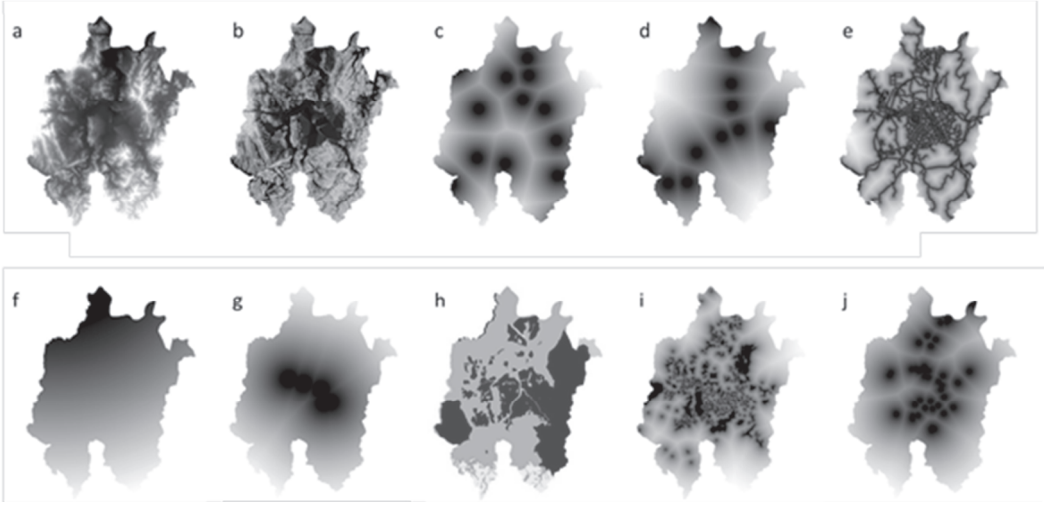
The model is designed to have a multi-level structure, and each level requires different types of input data. The macro level acts as a global constraint, and it defines a quantity of total urban demand by the target year. The total urban demand can be derived from an internal or external economic model, but this study used a number from a previous study.[1] It estimated the future urban demand of Daejeon city by 2030 as 22.1 km², and adopted this figure as a macro-level constraint. The meso level acts as a means to calculate sub-regional attractiveness or developmental potential. Total urban demand is not uniformly distributed for the whole of Daejeon, but is differently allocated according to this factor. It can also be calculated by an external or internal model, but it is calculated by the ratio of population growth rate in each of Daejeon's sub-administrative levels (*gu*). The micro level acts as a location choice model, under the influence of the total demand and regional attractiveness, and individual spatial agents make location choice with a reference to their preference on different factors. Geospatial input data to define local determinants of location choice are depicted in Figure 3.A1.2.

Figure 3.A1.1. **Overall model structure (agent-based model)**



Source: KRIHS and OECD elaboration.

Figure 3.A1.2. **Input layers used for a micro-level location choice**



Note: a) elevation; b) slope; c) distance to nearest motorway junction; d) distance to nearest railway station; e) distance to nearest road; f) distance to Sejong City; g) distance to town centres; h) zoning; i) distance to nearest open space; j) distance to nearest cultural facility. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: KRIHS and own elaboration based on National Geographic Data and Korea Statistical Information System Data.

Model calibration

The purpose of the model calibration is to find better fit parameters and hence to make the model work properly for a given study area. Different models adopt different calibration methods, and some models adopt a quantitative calibration method while some use a qualitative one. Nevertheless, the model calibration requires an analysis and examination of intensive empirical data, and this is one of the most time-consuming tasks of urban modelling. The methodology for calibrating a microscopic urban model is not yet fully developed, and more research will be required in the future (Batty and Torrens, 2005).

To calibrate the pilot model, quantitative and qualitative methods are used together. First, a binomial logistic regression to determine empirically justified model variables is conducted. Table 3.A1.1 presents the results of the regression. Next, a utility function with the selected variables is formed. The simulation is then conducted and the results examined to find if it matches with the reality.

Table 3.A1.1. **Results of logistic regression**

Variable		B	Significant.	eExp(B)
Topography	Elevation	-0.129	0.000	0.879
	Slope	-0.794	0.000	0.452
Transport	Distance to nearest motorway junction	-0.113	0.000	0.893
	Distance to nearest railway station	-0.349	0.000	0.706
	Distance to nearest road	-0.530	0.000	0.589
Socio-economic	Distance to Sejong City	-0.873	0.000	0.418
	Distance to town centres	-0.696	0.000	0.499
	Zoning	-1.126	0.000	0.324
	Distance to nearest open space	-0.038	0.000	0.963
	Distance to nearest cultural facility	-0.362	0.000	0.696
Constant		26.576	0.000	3.480E+11

Source: KRIHS and OECD elaboration based on the aforementioned simulation.

Note

1 . For example, please refer to Korea Research Institute of Human Settlements (2011).

Annex 3.A2
Modelling process for Hwaseong

Modelling description

The SLEUTH model is an urban growth and land-use change model developed around the notion of the cellular automata system. The model's name is derived from the model's input data requirements: slope, land use, excluded area, urban area, transport and hillshade. The model captures changes in land uses, which are represented as individual cells, with a set of transition rules. The growth rules, i.e. cell transition rules, form the core of urban growth dynamics in SLEUTH. These rules regulate how individual cells become "urban" or remain "non-urban" when they meet certain conditions.

The urban growth process in SLEUTH is represented by four types of growth rules: spontaneous growth, new spreading centres, edge growth and road-influenced growth. Spontaneous growth represents the new urbanisation occurring without pre-existing urban areas and transport networks. New spreading centre controls whether such spontaneous growth will further expand and become a new urban centre for continued urban development. Edge growth defines urbanisation from the surroundings of existing urban areas. Road-influenced growth represents urbanisation, along with transport networks.

The above four growth rules are controlled by five growth coefficients: dispersion, breed, spread, slope and road gravity. Each parameter has a range of 0 to 100 and controls one or more growth rules. Together, these parameters control the importance and amount of each growth rule.

The SLEUTH model simulates future urban growth with the above input data, growth rules and parameters. The model uses the random stochastic disturbance factor in the growth rules to increase the reality of model outcomes, and the model produces final outcomes after multiple Monte Carlo runs. The overall model structure is illustrated in Figure 3.A2.1.

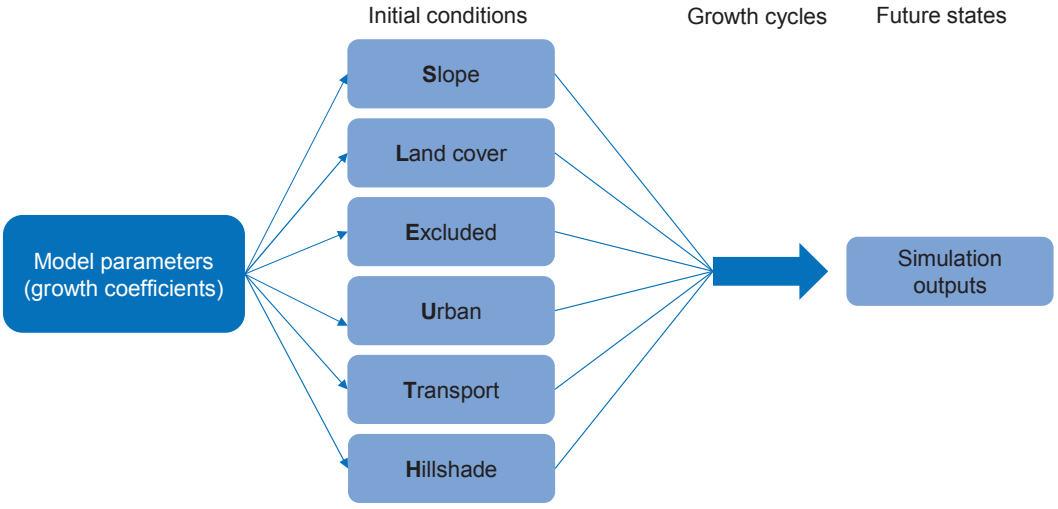
Input data

The model requires six types of input data layers: slope, land use, exclusion, urban, transport and hillshade as Figure A3.2 shows. These layers should be greyscale 8 bit GIF image format, and each layer holds relevant cell values, which range from 0 to 255. All layers should have the same extent and resolution.

The strength of the SLEUTH model is that it requires less data compared to traditional urban models, but this also limits the consideration of various factors affecting urban growth. One possible remedy for this is to take various factors into account when making the exclusion layer. To do so, exclusion/attraction layers were further developed for the study region. This study identified factors that would either attract development or repel development. These exclusion and attraction factors were combined using GIS overlay modelling and the class values of the resulting map ranged from 5 (attraction) to 90 (strong resistance), with 50 representing a neutral value. This study then identified lands that would be completely excluded from development, such as bodies of water and

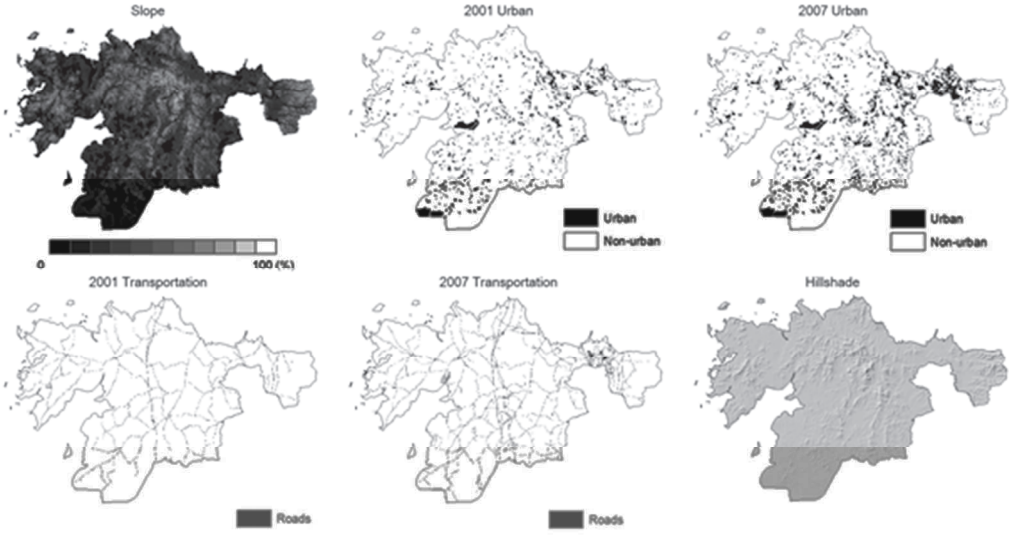
protected zones (Table 3.A2.1) and assigned a value of 100 to indicate complete resistance and added those features to the final excluded/attraction layer. Overall inputs layers for the Hwaseong simulation are depicted in Figure 3.A2.2; Figure 3.A2.3 illustrates all the data layers that were included for the exclusion and attraction models and the final exclusion/attraction layers used for model calibration.

Figure 3.A2.1. **Growth rules and controlling coefficients**



Source: KRIHS and own elaboration based on University of California, Santa Barbara (2014), "Basic simulation", Project Gigalopolis, www.ncgia.ucsb.edu/projects/gig/About/bkStrSimulation.html (accessed 30 July 2014).

Figure 3.A2.2. **Input layers for the urban growth simulation of Hwaseong**



Notes: This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: KRIHS and own elaboration based on National Geographic Data and Korea Statistical Information System Data.

Table 3.A2.1. **Exclusion/attraction for business as usual and compact growth scenarios**

	Description	Business as usual	Compact growth with best protection of natural resources and environment
		Level of protection (%)	
Protected areas	Lakes and bodies of water	100	100
	Wetlands	100	100
	Riparian buffer zones	No protection(50)	100
	(300-metre buffer around wetlands, lakes, and water bodies)		
	Green belt for preservation	100	100
	Wildlife and plant conservation area	100	100
	Conservation forest with common interests	100	100
	Conservation forest with forestry goods	80	80
	Park and nature preservation areas	100	100
Other resistance/ attraction	Distance to major roads	30	30
	(500-metre buffer around the roads)		(1 500-metre buffer of 102, 102 and 108 roads)
	Distance from rail stations	30	30
		(2 000-metre buffer from rail stations)	(2 000-metre buffer from rail stations)
	Distance to Suwon	10-100	10-100
		(classified into 10 classes)	(classified into 10 classes)
	Population density by EMD	5-100	10-100
		(classified into 7 classes)	(classified into 7 classes)
	Residential development district	10	10
	Green corridors	N/A	90 (first class)
			70 (second class)

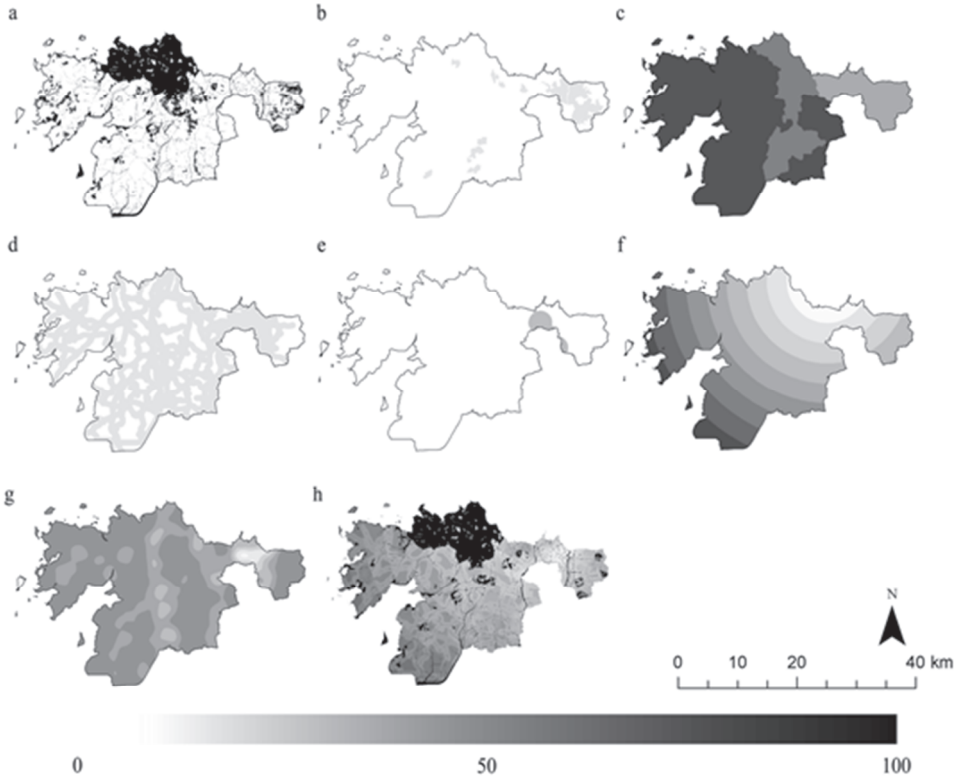
Source: KRIHS and own elaboration based on National Geographic Data and Korea Statistical Information System Data.

Based on these narratives, an exclusion/attraction map was generated for each scenario to represent the corresponding spatial changes to policies or drivers of land-use change. For the business as usual scenarios, the simulation used the same exclusion/attraction layers that were used for calibration, assuming no change in land-use policies. For the compact growth scenario, forecasts of future urbanisation were created through modification of the exclusion/attraction layers and by applying alternative future growth rates using SLEUTH's self-modification function (Table 3.A2.1).

Model calibration

Calibration is a process of testing and adjusting model parameters to find the best set of parameter values. The process involves iterative comparison of the actual map and simulated map. The purpose of calibration is to make the model produce outcomes as realistic as possible by changing parameter values. Once appropriate parameters are chosen through the calibration process, the model is run for the future.

Figure 3.A2.3. **Attraction and resistance layers used for calibration**



Notes: a) protected lands; b) residential development district; c) population density; d) distance from roads; e) distance from rail stations; f) distance from Suwon; g) road density; and h) final exclude/attraction map. This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: KRIHS and own elaboration based on National Geographic Data and Korea Statistical Information System Data.

The calibration of SLEUTH is to determine the best fit values for the five growth coefficients: dispersion, breed, spread, slope and road gravity. The SLEUTH model offers a range of measurement metrics that can be used for the determination of the best parameter set. Two measurements were used in this study to identify the best fit values for the growth parameters (Jantz et al., 2010): the population fraction difference (PFD), which measures a direct comparison between the number of urban pixels in the urban land maps and the corresponding simulated maps and the cluster fractional difference (CFD), which measures direct comparisons between the number of urban clusters in the urban land cover maps and the corresponding simulated maps. Table 3.A2.2 presents the selected parameters and the value of two measurement metrics.

Table 3.A2.2. **Best fit parameters derived from a calibration**

Diffusion	Breed	Spread	Slope	Road growth	Population fraction difference	Cluster fractional difference
1	90	100	1	20	-0.137	0.118

Source: KRIHS and own elaboration based on the SLEUTH simulation on Hwaseong.

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