Department for Transport

Impacts of integrating land-use and transport planning: a rapid evidence assessment - Annexes

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Contents

Detailed findings

In this annex detailed results are presented for each of our four domains of interest:

- Transport outcomes
- Economic outcomes;
- Environmental outcomes; and
- Social outcomes.

The summaries presented in the main body are fully consistent with these detailed findings.

The studies shortlisted for in-depth review were selected based on methodological rigour, relevance to the UK and comparable international contexts, and their ability to offer nuanced insights into the impacts of integrated planning interventions.

The final evidence base covered a breadth of geographies (see Table 1) and spanned a range of research methodologies, including multi-level modelling, regression techniques, scenario-based simulations and both longitudinal and cross-sectional designs (Table 2). As well as individual quantitative studies our review has also identified meta-analyses and theory-driven studies that synthesise findings across multiple case studies and geographic contexts. Collectively, these studies provided a robust evidence base for our REA, capturing the dynamic interplay between land use and transport planning.

Table 1: Breakdown of studies shortlisted for in-depth review, by geography and outcome category

Geography	Transport outcomes	Economic outcomes	Environmental outcomes	Social outcomes
UK	2	2	1	-

Europe	1	1	-	4
North America	1	1	4	3
Australia	-	1	4	3
Asia	4	-	4	5
South America	-	-	1	-
Africa	-	-	-	1
International comparisons / theoretical studies	2	6	1	4
Total	10	11	12	19

Table 2: Breakdown of studies shortlisted for in-depth review, by methodology and outcome category

Methodology	**Transport outcomes**	**Economic outcomes**	**Environmental outcomes**	**Social outcomes**
Regression analysis	6	4	4	9
Quantitative modelling	2	1	7	6
Literature review	2	3	1	2
Case study analysis	-	3	-	2
Total	10	11	12	19

Table 3 Results: Transport outcomes

Author(s)	Study context	Geographic area	Form of integration	Results
Agglomeration economies in Australian cities: productivity benefits of increasing urban density and accessibility, Trubka, 2011	This study tries to measure the magnitude by which employment productivity in a range of industries in Australian cities is influenced by agglomeration and offers a method for these estimations that is suitable given the types of data collected and made available nationally.	Australia	Urban agglomeration	The study shows that increasing urban density and accessibility in Australian cities (which can come about as a result of transport orientated development) can lead to significant labour productivity gains, though the magnitude of these benefits depends strongly on local conditions and the industry in question. For instance, in Melbourne, doubling employment density is linked to a 7.4% increase in average wages, while Perth experiences a more modest 3.5% rise. In knowledge-intensive sectors such as data processing and financial services, the elasticity estimates are as high as 0.29. This means that a 1% increase in urban density and accessibility translates to a 0.29% boost in productivity. Impacts are far lower for less knowledge intensive sectors such as retail. These coefficients illustrate that while urban densification can be a powerful driver of economic growth, its benefits are highly industry-specific and emphasise the critical role of local industry concentration, particularly in inner-city areas.
A statistical meta-analysis of the design components of new urbanism on housing prices, Mi et al., 2016	This study investigates whether the principles of New Urbanism (such as increased density, mixed land uses and street connectivity) can increase property values.	International comparison	Increased density, mixed land use and increased property values	This meta-analysis finds that lower density, decreased street connectivity and closer proximity to transit stops all contribute to increased housing premiums, while mixed land uses were not always shown to do so. Proximity (within a quarter-mile) to transit infrastructure is positively correlated with house prices (mean correlation coefficient of 0.03) and conversely increased distance to transit infrastructure displays a weak negative association (mean correlation coefficient of –0.04). Mixed land use exhibits varied relationships: while proximity to institutional uses is weakly associated with higher prices, larger industrial areas tend to correlate with lower values, and commercial uses present mixed effects. Although these correlations are relatively small, their statistical significance underscores that even subtle changes in urban design can influence housing values.
Compact City Policies: A Comparative Assessment, OECD Green Growth Studies, 2012	This report offers a better understanding of the compact city concept, its role in today's urban contexts, and the potential outcomes of compact city policies.	International comparison	Compact city	Compact cities which are characterised by high density and mixed land use can increase the efficiency of infrastructure investment and reduce the cost of maintenance, particularly for systems such as transport, energy and water supply, and waste disposal. They give residents easier access to a diversity of local services and jobs. Moreover, high density, combined with a diversity of urban functions, is claimed to stimulate knowledge diffusion and thus economic growth. The authors also argue that conceptually the compact city generates new "green" needs (e.g. new types of low emissions transport options which are

				required when automobile dependency is lower) that promote technological development and innovation and thus stimulate growth. The authors note that some previous studies (e.g. Morikawa, 2011) have argued that density itself generates "economies of density" which relate to stability of demand, especially for services. This can increase productivity in the service industry. Similarly, Jones et al. (2010) find that high density leads to greater concentration of demand and related spending, which could better enable social and private services to remain viable within smaller catchment areas.
Do urban social enterprises benefit from agglomeration? Evidence from four UK cities, Pinch and Sunley, 2015	This study examines the relevance of clustering theory for an understanding of the location of social enterprises (SEs), through an analysis of the extent to which managers of SEs in four major UK cities perceive themselves to benefit from agglomeration effects.	UK	Urban agglomeration	The study investigated whether urban social enterprises (SEs) in four UK cities benefit from agglomeration which can come about as a result of effective deployment of mixed land use and integrated land use and transport planning. SEs do gain significant advantages from urban clustering. Key benefits include: Inter-sectoral learning: A notable minority of SE managers actively learn from both private firms and other SEs, fostering innovation. Local demand and funding: SEs benefit from the complex, localised social needs that drive targeted funding and institutional support, particularly in cities with strong financial infrastructures. Trust and networks: Face-to-face interactions help build trust, which is critical for securing contracts and sharing knowledge. Overall, although direct clustering benefits may be modest, the "soft" infrastructure provided by local networks and institutional support is crucial for the operational success and resilience of SEs in challenging market conditions.
Housing delivery through mixed use urban regeneration schemes: a European comparison, Karadimitriou et al, 2013	This study discussed the delivery of non-market housing and other merit and public goods through market-led urban regeneration projects in Western Europe.	Amsterdam (Netherlands), Lyon (France), Manchester (UK)	Mixed use urban regeneration schemes	The study compares three European mixed-use urban regeneration schemes: Ijoever, Amsterdam (Netherlands): A redevelopment of a former port area along the river Ij, scheduled for completion by mid-2015. The project involves six separate schemes delivering 2,500 apartments (30% social housing), delivered alongside significant transport infrastructure, with a total investment of €3.6 billion. Governance was managed jointly by the Amsterdam municipality and its districts through a dedicated project office which facilitated meaningful integration of planning and delivery of transport and land use schemes. Carré de Soie, Lyon (France): This 500-hectare regeneration project transforms a derelict industrial area over a 30-year period. Key early-stage components include a shopping and leisure centre, public realm revitalisation, new transit infrastructure, and 800 housing units near transit stops. The project relied on a small coordinating structure formed by the Greater Lyon Authority and local municipalities which enabled integrated planning.

				New Islington, Manchester (UK): This related to mixed-use scheme on a 12.5-hectare site in a deprived part of Manchester's city centre. Initially planned to deliver 1,400 new homes along with commercial and community amenities. Key stakeholders included Manchester City Council, the regeneration funding agency, and developers like Urban Splash. Conclusions: The analysis highlights that the success of mixed-use regeneration schemes depends largely on how risks, uncertainties, and returns are shared among public, private, and third-sector actors. Robust institutional frameworks as seen in Amsterdam and Lyon enable better coordination and meaningful integration of transport and land use planning and delivery. These governance frameworks enable optimal risk allocation, helping to stabilise projects even during economic downturns. In contrast, the more market-reliant approach seen in New Islington shows greater vulnerability when private investment falters. Overall, while market mechanisms are crucial, effective regeneration requires a strong, flexible public sector to manage risks and secure long-term policy outcomes, particularly in delivering non-market housing and public amenities.
How could the integration of land use and transport in planning practice contribute achieving sustainable urban form – by a case study analysis of King's Cross and Olympic Legacy in London, Yeu & Shi, unpublished.	This study seeks to analyse how the integrated land use and transport planning could contribute achieving sustainable urban form, looking at London Kings' Cross and Olympic Legacy case studies.	London, UK	Urban regeneration	This study examines two London regeneration projects the King's Cross Opportunity Area (KCOA) and the London Legacy Development Corporation (LLDC) area. The authors use these areas to assess how integrated land use and transport planning can promote sustainable urban form. King's Cross Opportunity Area (KCOA): A 24-hectare transport-led brownfield redevelopment in central London that leverages major rail hubs to create a high-density, mixed-use district with commercial, residential, educational, and green spaces. London Legacy Development Corporation (LLDC) Area: A 73-hectare site, influenced by the 2012 Olympics, designed as a new urban centre with enhanced transport connectivity, diverse land uses, and vibrant socio-economic activities. Both projects focus on improving spatial accessibility through improved transport links, boosting local economic and social vitality, and encouraging sustainable travel modes (e.g. public transport, walking, cycling) while reducing car dependency. The study concludes that integrated transport and land use planning can significantly contribute to sustainable urban forms. The authors highlighted that success relies on robust, flexible institutional frameworks that effectively manage risk and coordinate public, private, and third-sector actors.
Human capital and agglomeration economies in urban development, Thisse, 2017	This paper surveys the recent contributions of urban economics, highlighting the role of external increasing returns – called agglomeration	Theory based	Urban agglomeration	The paper argues that integrating housing, transport, and labour market policies is essential to achieve sustainable urban development. Key points include:

	economies in the context of a city			Interdependencies and government role: Neglecting the links between housing, transport, and local labour markets can undermine intended policy outcomes. Spatial concentration vs. dispersion: Concentrated urban development requires large investments and in some cases migration flows to achieve efficiency. Overly dispersed development may prevent critical mass and miss out on agglomeration benefits. Poor local governance and inadequate public services can limit the benefits of agglomeration even in concentrated areas. Role of human capital and the informal sector: The benefits of agglomeration are strongly linked to the quality of human capital. In developing cities, a significant informal sector benefits from close interpersonal interactions, yet low human capital and weak infrastructure can restrict productivity gains. Cities and global trade: Urbanisation alone does not guarantee industrial or trade success. Instead, cities that develop robust global networks and invest in human capital tend to benefit more from agglomeration effects. In short, while integrated land use, transport, and labour market policies can drive economic growth through agglomeration effects, their success depends on effective institutions, high-quality public services, and sufficient human capital.
Mixed land use in the urban environment: exploring the impact of physical diversity on residential property prices in Rotterdam, van Meerkerk, 2015	This cross-sectional study explores what impact mixed land use and individual land use types have on residential property prices per square metre in a subarea within Rotterdam, the Netherlands.	Rotterdam, Netherlands	Mixed land use	This study examines how various property characteristics, locational factors, and specific land-use elements influence residential property prices in Rotterdam. Location plays a crucial role; a 10% increase in distance from the city centre (e.g., moving from 500m to 550m) is linked to a 0.6% rise in property value. Being 10% closer to a highway ramp results in an approximate 0.5% reduction. Among land-use features, proximity to an urban park within 500m yields the strongest positive effect, boosting values by about 4%, whereas a 10 percentage point increase in water bodies or parking spaces has only a minimal impact (increasing by 0.05% and decreasing by 0.06%, respectively).
Planning for mixed use: affordable for whom?, Moos et al, 2018	This study examines how housing affordability changed for different occupational groups in mixed-use zones in Toronto (Canada) from 1991 to 2006, through a spatial analysis to understands how	Toronto, Canada	Mixed-land use	This study examines housing affordability in Toronto's mixed use zones[1] between 1991 and 2006, revealing that these areas are significantly less affordable compared with other parts of the city. By 2006, about 33% of owner-occupied households in mixed-use zones spent over 30% of their income on housing compared to roughly 25%

[1] In this study, mixed-use zones refer to areas designated by the City of Toronto as Commercial Residential (CR), Mainstreet Commercial Residential (MCR), and Reinvestment Areas (RA) under the 2005 zoning bylaw. These zones allow for a mix of residential, commercial, and institutional uses, often located in the downtown core and along arterial roads to promote density, walkability, and transit access.

	affordability changes for different types of workers in mixed-use zones compared with the rest of the city and metropolitan region.			elsewhere. Likewise, nearly half (47%) of rental households in mixed-use areas exceeded the 30% threshold, versus 45% in other zones. Additionally, housing costs per room were markedly higher: ownership costs in mixed-use areas were 44% higher than in the broader metropolitan region in 1991, rising to 59% higher by 2006, and rental costs increased from 45% to 64% higher over the same period, illustrating a substantial and growing premium. Occupational differences further emphasise these trends; high-income groups, such as business workers, experienced notable improvements in affordability (with ownership costs dropping from 55% to 34% of income and rental costs from 41% to 24%), whereas lower-income groups saw stagnant or deteriorating conditions, with sales and service workers facing the most severe burdens (ownership costs reached 71% of income and rental costs 50% amongst that group by 2006). Spatially, inner city mixed-use zones became even less affordable over time, while areas along arterial roads maintained relatively better affordability. These effect sizes indicate that without targeted affordable housing policies, mixed-use zoning tends to favour higher-income households, exacerbating affordability challenges for lower-income groups by imposing significant income burdens relative to their housing costs.
Urban agglomeration and regional economic performance connectedness: thin ice in developing regions, Maket et al., 2024	This study examines how urban agglomeration changes impinge on economic performance changes.	66 developing and developed economies from Asia, Europe and Sub-Saharan Africa (SSA)	Urban agglomeration	This study, spans 66 countries in Asia, Europe, and Sub-Saharan Africa from 2000 to 2020, reveals that the impact of urban agglomeration on GDP per capita growth varies markedly by region and the scale of urban concentration. A sizeable increase in agglomeration measured by the HHI100 index[2] yields a robust, is positively associated with economic performance in European regions and the global sample, but exhibits a significant negative effect in Asia and an insignificant impact in Sub-Saharan Africa. However, a small one-unit increase in agglomeration does not lead to positive impacts. Additionally, the coefficients for urban infrastructure improvements indicate that better infrastructure significantly enhances economic performance in Europe and Sub-Saharan Africa.

[2] The HHI100 Index used in the study is a modified version of the Herfindal-Hirschman Index (HHI), adapted to measure urban agglomeration rather than market concentration. In particular, this study uses two different indexes to measure agglomeration: the HHI50 index, comprising all a country's cities that have 50,000 or more dwellers and an HHI100 index, that is, all cities of 100,000 or more residents.

Table 4 Results: Economic outcomes

Author(s)	Study context	Geographic area	Form of integration	Results
Agglomeration economies and transport investment, Joint Transport Research Centre (OECD, International Transport Forum), 2007	This paper considers the link between agglomeration and productivity for sectors of the UK economy. It develops an "effective density" measure of accessibility to economic mass for small spatial areas which incorporates an implicit transport dimension.	International comparison	Urban agglomeration	The study estimates positive agglomeration externalities for manufacturing, construction and for six service industries. A doubling of accessibility to economic mass is associated with an increase in total factor productivity of just under 20%. Results suggest that services enjoy higher returns from agglomeration than manufacturing. Calculating a weighted average elasticity over all industries implies that for every 1% increase in accessibility to economic mass productivity is expected to increase by approximately 0.12%.
Agglomeration economies in Australian cities: productivity benefits of increasing urban density and accessibility, Trubka, 2011	This study tries to measure the magnitude by which employment productivity in a range of industries in Australian cities is influenced by agglomeration and offers a method for these estimations that is suitable given the types of data collected and made available nationally.	Australia	Urban agglomeration	The study shows that increasing urban density and accessibility in Australian cities (which can come about as a result of transport orientated development) can lead to significant labour productivity gains, though the magnitude of these benefits depends strongly on local conditions and the industry in question. For instance, in Melbourne, doubling employment density is linked to a 7.4% increase in average wages, while Perth experiences a more modest 3.5% rise. In knowledge-intensive sectors such as data processing and financial services, the elasticity estimates are as high as 0.29. This means that a 1% increase in urban density and accessibility translates to a 0.29% boost in productivity. Impacts are far lower for less knowledge intensive sectors such as retail. These coefficients illustrate that while urban densification can be a powerful driver of economic growth, its benefits are highly industry-specific and emphasise the critical role of local industry concentration, particularly in inner-city areas.
A statistical meta-analysis of the design components of new urbanism on housing prices, Mi et al., 2016	This study investigates whether the principles of New Urbanism (such as increased density, mixed land uses and street connectivity) can increase property values.	International comparison	Increased density, mixed land use and increased property values	This meta-analysis finds that lower density, decreased street connectivity and closer proximity to transit stops all contribute to increased housing premiums, while mixed land uses were not always shown to do so. Proximity (within a quarter-mile) to transit infrastructure is positively correlated with house prices (mean correlation coefficient of 0.03) and conversely increased distance to transit infrastructure displays a weak negative association (mean correlation coefficient of –0.04). Mixed land use exhibits varied relationships: while proximity to institutional uses is weakly associated with higher prices, larger industrial areas tend to correlate with lower values, and commercial uses present mixed effects. Although these correlations are relatively small, their statistical significance underscores that even subtle changes in urban design can influence housing values.

Compact City Policies: A Comparative Assessment, OECD Green Growth Studies, 2012	This report offers a better understanding of the compact city concept, its role in today's urban contexts, and the potential outcomes of compact city policies.	International comparison	Compact city	Compact cities which are characterised by high density and mixed land use can increase the efficiency of infrastructure investment and reduce the cost of maintenance, particularly for systems such as transport, energy and water supply, and waste disposal. They give residents easier access to a diversity of local services and jobs. Moreover, high density, combined with a diversity of urban functions, is claimed to stimulate knowledge diffusion and thus economic growth. The authors also argue that conceptually the compact city generates new "green" needs (e.g. new types of low emissions transport options which are required when automobile dependency is lower) that promote technological development and innovation and thus stimulate growth. The authors note that some previous studies (e.g. Morikawa, 2011) have argued that density itself generates "economies of density" which relate to stability of demand, especially for services. This can increase productivity in the service industry. Similarly, Jones et al. (2010) find that high density leads to greater concentration of demand and related spending, which could better enable social and private services to remain viable within smaller catchment areas.
Do urban social enterprises benefit from agglomeration? Evidence from four UK cities, Pinch and Sunley, 2015	This study examines the relevance of clustering theory for an understanding of the location of social enterprises (SEs), through an analysis of the extent to which managers of SEs in four major UK cities perceive themselves to benefit from agglomeration effects.	UK	Urban agglomeration	The study investigated whether urban social enterprises (SEs) in four UK cities benefit from agglomeration which can come about as a result of effective deployment of mixed land use and integrated land use and transport planning. SEs do gain significant advantages from urban clustering. Key benefits include: Inter-sectoral learning: A notable minority of SE managers actively learn from both private firms and other SEs, fostering innovation. Local demand and funding: SEs benefit from the complex, localised social needs that drive targeted funding and institutional support, particularly in cities with strong financial infrastructures. Trust and networks: Face-to-face interactions help build trust, which is critical for securing contracts and sharing knowledge. Overall, although direct clustering benefits may be modest, the "soft" infrastructure provided by local networks and institutional support is crucial for the operational success and resilience of SEs in challenging market conditions.
Housing delivery through mixed use urban regeneration schemes: a European comparison, Karadimitriou et al, 2013	This study discussed the delivery of non-market housing and other merit and public goods through market-led urban regeneration projects in Western Europe.	Amsterdam (Netherlands), Lyon (France), Manchester (UK)	Mixed use urban regeneration schemes	The study compares three European mixed-use urban regeneration schemes: Ijoever, Amsterdam (Netherlands): A redevelopment of a former port area along the river Ij, scheduled for completion by mid-2015. The project involves six separate schemes delivering 2,500 apartments (30% social housing), delivered alongside significant transport infrastructure, with a total investment of €3.6 billion. Governance was managed jointly by the Amsterdam municipality and its districts through a dedicated project office

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How could the integration of land use and transport in planning practice contribute achieving sustainable urban form – by a case study analysis of King's Cross and Olympic Legacy in London, Yeu & Shi, unpublished.	This study seeks to analyse how the integrated land use and transport planning could contribute achieving sustainable urban form, looking at London Kings' Cross and Olympic Legacy case studies.	London, UK	Urban regeneration	This study examines two London regeneration projects the King's Cross Opportunity Area (KCOA) and the London Legacy Development Corporation (LLDC) area. The authors use these areas to assess how integrated land use and transport planning can promote sustainable urban form. King's Cross Opportunity Area (KCOA): A 24-hectare transport-led brownfield redevelopment in central London that leverages major rail hubs to create a high-density, mixed-use district with commercial, residential, educational, and green spaces. London Legacy Development Corporation (LLDC) Area: A 73-hectare site, influenced by the 2012 Olympics, designed as a new urban centre with enhanced transport connectivity, diverse land uses, and vibrant socio-economic activities. Both projects focus on improving spatial accessibility through improved transport links, boosting local economic and social vitality, and encouraging sustainable travel modes (e.g. public transport, walking, cycling) while reducing car dependency. The study concludes that integrated transport and land use planning can significantly contribute to sustainable urban forms.

				The authors highlighted that success relies on robust, flexible institutional frameworks that effectively manage risk and coordinate public, private, and third-sector actors.
Human capital and agglomeration economies in urban development, Thisse, 2017	This paper surveys the recent contributions of urban economics, highlighting the role of external increasing returns – called agglomeration economies in the context of a city	Theory based	Urban agglomeration	The paper argues that integrating housing, transport, and labour market policies is essential to achieve sustainable urban development. Key points include: Interdependencies and government role: Neglecting the links between housing, transport, and local labour markets can undermine intended policy outcomes. Spatial concentration vs. dispersion: Concentrated urban development requires large investments and in some cases migration flows to achieve efficiency. Overly dispersed development may prevent critical mass and miss out on agglomeration benefits. Poor local governance and inadequate public services can limit the benefits of agglomeration even in concentrated areas. Role of human capital and the informal sector: The benefits of agglomeration are strongly linked to the quality of human capital. In developing cities, a significant informal sector benefits from close interpersonal interactions, yet low human capital and weak infrastructure can restrict productivity gains. Cities and global trade: Urbanisation alone does not guarantee industrial or trade success. Instead, cities that develop robust global networks and invest in human capital tend to benefit more from agglomeration effects. In short, while integrated land use, transport, and labour market policies can drive economic growth through agglomeration effects, their success depends on effective institutions, high-quality public services, and sufficient human capital.
Mixed land use in the urban environment: exploring the impact of physical diversity on residential property prices in Rotterdam, van Meerkerk, 2015	This cross-sectional study explores what impact mixed land use and individual land use types have on residential property prices per square metre in a subarea within Rotterdam, the Netherlands.	Rotterdam, Netherlands	Mixed land use	This study examines how various property characteristics, locational factors, and specific land-use elements influence residential property prices in Rotterdam. Location plays a crucial role; a 10% increase in distance from the city centre (e.g., moving from 500m to 550m) is linked to a 0.6% rise in property value. Being 10% closer to a highway ramp results in an approximate 0.5% reduction. Among land-use features, proximity to an urban park within 500m yields the strongest positive effect, boosting values by about 4%, whereas a 10 percentage point increase in water bodies or parking spaces has only a minimal impact (increasing by 0.05% and decreasing by 0.06%, respectively).

Planning for mixed use: affordable for whom?, Moos et al, 2018	This study examines how housing affordability changed for different occupational groups in mixed-use zones in Toronto (Canada) from 1991 to 2006, through a spatial analysis to understands how affordability changes for different types of workers in mixed-use zones compared with the rest of the city and metropolitan region.	Toronto, Canada	Mixed-land use	This study examines housing affordability in Toronto's mixed use zones[3] between 1991 and 2006, revealing that these areas are significantly less affordable compared with other parts of the city. By 2006, about 33% of owner-occupied households in mixed-use zones spent over 30% of their income on housing compared to roughly 25% elsewhere. Likewise, nearly half (47%) of rental households in mixed-use areas exceeded the 30% threshold, versus 45% in other zones. Additionally, housing costs per room were markedly higher: ownership costs in mixed-use areas were 44% higher than in the broader metropolitan region in 1991, rising to 59% higher by 2006, and rental costs increased from 45% to 64% higher over the same period, illustrating a substantial and growing premium. Occupational differences further emphasise these trends; high-income groups, such as business workers, experienced notable improvements in affordability (with ownership costs dropping from 55% to 34% of income and rental costs from 41% to 24%), whereas lower-income groups saw stagnant or deteriorating conditions, with sales and service workers facing the most severe burdens (ownership costs reached 71% of income and rental costs 50% amongst that group by 2006). Spatially, inner city mixed-use zones became even less affordable over time, while areas along arterial roads maintained relatively better affordability. These effect sizes indicate that without targeted affordable housing policies, mixed-use zoning tends to favour higher-income households, exacerbating affordability challenges for lower-income groups by imposing significant income burdens relative to their housing costs.
Urban agglomeration and regional economic performance connectedness: thin ice in developing regions, Maket et al., 2024	This study examines how urban agglomeration changes impinge on economic performance changes.	66 developing and developed economies from Asia, Europe and Sub-Saharan Africa (SSA)	Urban agglomeration	This study, spans 66 countries in Asia, Europe, and Sub-Saharan Africa from 2000 to 2020, reveals that the impact of urban agglomeration on GDP per capita growth varies markedly by region and the scale of urban concentration. A sizeable increase in agglomeration measured by the HHI100 index[4] yields a robust, is positively associated with economic performance in European regions and the global sample, but exhibits a significant negative effect in Asia and an insignificant impact in Sub-Saharan Africa. However, a small one-unit increase in agglomeration does not lead to positive impacts.

[3] In this study, mixed-use zones refer to areas designated by the City of Toronto as Commercial Residential (CR), Mainstreet Commercial Residential (MCR), and Reinvestment Areas (RA) under the 2005 zoning bylaw. These zones allow for a mix of residential, commercial, and institutional uses, often located in the downtown core and along arterial roads to promote density, walkability, and transit access.

[4] The HHI100 Index used in the study is a modified version of the Herfindal-Hirschman Index (HHI), adapted to measure urban agglomeration rather than market concentration. In particular, this study uses two different indexes to measure agglomeration: the HHI50 index, comprising all a country's cities that have 50,000 or more dwellers and an HHI100 index, that is, all cities of 100,000 or more residents.

				Additionally, the coefficients for urban infrastructure improvements indicate that better infrastructure significantly enhances economic performance in Europe and Sub-Saharan Africa.

Table 5 Results: Environmental outcomes

Author(s)	Study context	Geographic area	Form of integration	Results
Can mixed land use reduce CO2 emissions? A case study of 268 cities, Li et al., 2022	This study aims to investigate the relationship between mixed land use and CO2 emissions, using 268 Chinese cities as a case study.	268 Chinese cities	Mixed land use	This study of 268 cities finds a significant U-shaped relationship between mixed land use, measured by the IELUS index,[5] and CO_2 emissions. For IELUS values below an inflection point of 0.351, each unit increase in mixed land use is associated with an approximate 5.7% reduction in emissions. However, once this threshold is surpassed, the effect reverses, with emissions rising by roughly 8.2% per unit increase. These effect sizes remain robust even when accounting for potential endogeneity and spatial spillovers, with instrumental variable estimations yielding even larger magnitudes. Mechanistically, mixed land use appears to lower emissions by enhancing total factor productivity and significantly boosting public transport use, although its impact on traffic congestion is less clear. Overall, these findings suggest that while increasing mixed land use can be beneficial for reducing CO_2 emissions up to a certain point, surpassing an optimal balance may lead to counterproductive environmental outcomes (according to this metric).
Can regional transportation and land-use planning achieve deep reductions in GHG emissions from vehicles?, Tayarani et al., 2018	This study evaluates what it would take to achieve deep GHG emission reductions from transportation without advances in vehicle energy efficiency and fuel decarbonisation beyond what is currently expected under existing regulations and market expectations, based on the Albuquerque, New Mexico, metropolitan area.	Albuquerque, New Mexico (US)	Compact urban development	This study finds that no single policy intervention can reduce future GHG emissions by the required margin (40%) on its own. For example, imposing a high vehicle miles travelled taxes (VMT) yields a reduction effect comparable to that of very compact land-use development or increasing substantially the share of journeys made by bicycle. The analysis indicates that both very compact and moderately compact development offer comparable GHG reductions. In contrast, public transport improvements in Albuquerque had minimal effect, likely due to the city's low congestion and sprawling urban form.

[5] IELUS is the Information Entropy of Land Use Structure, a widely recognised index in measuring the land use mixing degree.

Compact City Policies: A Comparative Assessment, OECD Green Growth Studies, 2012	This report offers a better understanding of the compact city concept, its role in today's urban contexts, and the potential outcomes of compact city policies.	International comparison	Compact city	Shorter intra-urban distances and less automobile dependency (both of which can come about as a result of integration of transport and land-use planning) can help reduce energy consumption and CO2 emissions. Compact cities conserve farmland and natural biodiversity around urban areas that would otherwise be lost. They create more opportunities for urban-rural linkages. Nearby farming encourages local food consumption and reduces the distance travelled by food, which helps to reduce CO2 emissions further. However, compact cities may be more vulnerable to natural disasters such as earthquakes, tsunamis, flooding and fires. Care must be taken to mitigate their vulnerability and to make cities resilient to the various risks associated with natural disasters. For example, built-up areas at high risk of flooding may not be appropriate for densification.
Densification versus urban sprawl. Modelling the impact of two urban growth scenarios on air quality, Valencia et al., 2023	The study analyses the impact of urban form of air pollution for two urban growth scenarios in 2040 for Quito, Ecuador: urban sprawl and densification.	Quito, Ecuador	Urban sprawl versus densification	This paper compares two future urban growth scenarios: (i) densification and (ii) urban sprawl; and their impacts on air quality relative to current levels. Both scenarios show aggregate improvements (driven by better technology), with overall reductions in pollutants such as CO, NO_2, NO_x, and PM2.5 typically under 4% at the metropolitan scale. However, the local effects differ substantially. Under the densification scenario, a higher concentration of residents in the city centre results in greater local exposure to pollutants like CO, O_3, and PM2.5, with a higher proportion of the population exceeding local air quality limits, especially for PM2.5. In contrast, the sprawl scenario, disperses the population more widely, thereby reducing exposure to high pollutant levels in central hotspots, though areas with heavy commuting may see localised increases in NO_2 and NO_x. These results suggest that densification may pose heightened public health risks in concentrated zones, whereas urban sprawl can lower exposure in specific areas at the expense of increased emissions from a more extensive transport network.
Dirty density: air quality and the density of American cities, Carozzi et al, 2023	This study investigates the effect of urban density on the exposure of city dwellers to air pollution using data from the United States urban system.	United States	Urban densification	This study finds that higher urban density in American cities is significantly associated with increased PM2.5 exposure. Using OLS, a 1% increase in population density is linked to about a 0.07% rise in residential PM2.5 levels, while instrumental variable (IV) estimates suggest a stronger effect. In practical terms, doubling the density is estimated to boost PM2.5 concentrations by roughly 0.73 $\mu g/m^3$ and to increase the fraction of residents exposed to levels above acceptable standards by about 1 percentage point. These coefficients translate into significant health costs. Overall, these findings suggest that while densification may offer some environmental advantages, its adverse effects on air quality and public health warrant careful consideration in urban planning policies.

Impacts of integrating land-use and transport planning

Does mixed-use development in metropolis lead to less carbon emissions?, Zagow, 2020	This study examines the relationship between mixed-use development and carbon dioxide emissions in the zip code level in the US	United States	Mixed use development	This study explores how different mixed-use development models relate to carbon emissions. Results show that the “low, dense” metropolis model—a more spatially distributed urban form with a balanced mix of businesses and residential areas—tends to have lower emissions than the “hybrid metropolis” model, which is characterised by higher density and a greater concentration of facilities such as businesses, entertainment, retail, and services. The reduction in emissions in low, dense areas may be due to better spatial distribution, improved accessibility, and fewer congestion-related emissions, rather than business density alone. The “hybrid metropolis” model (which attracts a diverse range of facilities and vehicles) shows markedly higher emissions than the low, dense model. For instance, the "mixed land use" coefficient in the hybrid model is approximately 106.5, compared to 17.1 in the low, dense model, suggesting that highly concentrated mixed-use areas generate significantly more carbon output due to increased vehicle activity and congestion. These findings highlight that while mixed-use developments can provide environmental benefits, the specific land-use mix and urban form are critical factors. More evenly distributed, low-density configurations tend to be more sustainable than hybrid models, which encourage higher vehicular traffic and facility concentration.
Evaluating the effects of compact growth on air quality in already high density cities with an integrated land use-transport emission model: a case study of Xiamen, China, Yuan et al., 2017	This study develops an integrated land use-transport-emission model focusing on the already high density city of Xiamen, and explores the effects of compact growth on traffic emissions and exposure to air pollution.	Xiamen, China	Urban density	In Xiamen, compact growth (which can come about as a result of integration of land use and transport planning) may significantly reduce regional traffic emissions and exposure to air pollution. Specifically, compact growth makes private car usage decline—evidenced by a 6% drop in car sharing rates and a 31–32% decrease in both vehicle and passenger distances. At the same time public transport use increased by 23% in terms of passenger distance. As a result, overall traffic emissions fall by nearly 17% though public transport emissions remain unchanged. Despite these gains, emissions become more concentrated in the urban centre, leading to a 1–8% increase in population- and employment-weighted exposure. These coefficients illustrate that while compact growth can effectively lower overall traffic emissions through a shift to public transport and reduced car dependency, planners must also address the potential for heightened exposure in dense urban cores to ensure balanced public health benefits.
High carbon expansion or low carbon intensive and mixed land use? Recent observations from megacities in developing countries: A	This study tries to answer the following research question: with the implementation of land conversation and intensive use policy, will the expansion of built-up area and	Shanghai, China	Mixed land use	Between 2010 and 2020, Shanghai's land use policies led to marked changes: industrial land decreased from 11% to 8%, while woodland approximately doubled from 7% to 13%. In built-up areas, industrial land shifted toward hybrid residential and balanced types. Central urban zones exhibited more mixed use.

case study of Shanghai, China, Wang et al., 2023	the increasing carbon emissions continue to represent the typical urban land use changes and related environmental impacts in China or not? Is the influence of land-use mixture on carbon emissions in megacities positive or suppressive?			Despite increased carbon sequestration from afforestation, overall land-use carbon emissions edged up slightly—from 54.50 to 55.90 million tons—largely because the carbon emission density of remaining industrial land surged by about 27.85%, even though converting industrial land reduced emissions by 10.59 million tons and hotspot areas dropped by roughly 24%. Notably, mixed industrial land grids achieved a 33–39% reduction in carbon emission density compared to single-use industrial land, while hybrid grids for residential, cultivated, and woodland uses showed higher emission densities. These coefficients suggest that although Shanghai's strategies have successfully curtailed high-carbon industrial areas and boosted green space, the overall carbon deficit remains significant, underscoring that mixed land use can mitigate emissions in industrial clusters but its benefits vary by land type. Future strategies must therefore better integrate ecological space with urban functions and reform industrial and energy structures to move toward carbon neutrality.
Land use, transport and vehicle technology futures: an air pollution assessment of policy combinations for the Cambridge Sub-Region of the UK, Namdeo et al., 2019	This study reports on an investigation of the impact on air-quality of combinations of urban form development scenarios and vehicle fleet technology changes. The scenarios combine policies affecting urban land use plans within the Cambridge Sub-Region of the UK, alongside technological changes within the projected vehicle fleet.	Cambridge, UK	Urban compaction vs market-led development scenarios.	Compared to a 2001 baseline, the study projects an 11.5% increase in total vehicle kilometres in the Cambridge Sub-Region in 2021. However, improved vehicle technology leads to substantial emission reductions—CO_2 falls by 16%, PM_{10} by 37%, and NOx/HC by over 80%. Urban form changes (modelled as alternate scenarios based on allocation of households and employment principles of "Compaction", "Planned expansion" and "Market led dispersal" in combination with transport technology advancement) alone yield relatively modest emission variations (ranging from a 12.7% decrease to a 7.1% increase, depending on the scenario adopted). Results across different scenarios suggest that changes in vehicle technologies have a larger impact on emissions than the changes in urban form alone. Compact development cuts NOx by up to 40% in suburban areas but can worsen air quality in central Cambridge, with increases of up to 50%., The authors highlight the "paradox of intensification" where reduced per capita car use is offset by increased congestion and localised pollution. In contrast, the Market-led dispersal scenario (the historic pattern towards dieselification of the private fleet is continued, and compounded by a further trend towards larger-engine) tend to raise emissions, whereas Planned Expansion (increased demand for bus/park-and-ride facilities and expansion of existing guided bus routes) results in only minor changes.
Mixed land use and its relationship with CO2 emissions: a comparative analysis based on several typical development zones in Shanghai, Shi et al., 2023	This study investigates how mixed land use interacts with CO2 emissions in urban development zones. It does this by using a detailed 50-meter grid to measure various	Shanghai, China	Mixed land use	This study explores development zones in Shanghai and finds that most zones exhibit higher industrial output efficiency (relative to the Shanghai average) and tend to have lower CO_2 emissions per unit area. However, exceptions exist, particularly in petrochemical-heavy zones where emissions remain high despite industrial activity.

	dimensions of land use and assess both the efficiency and intensity of CO2 emissions.			Importantly, the authors find a strong coupling coordination between land use mixing and CO_2 emissions, with coupling degrees mostly exceeding 0.7, indicating a robust interaction. Coupling coordination refers to the extent to which these two factors develop in a mutually beneficial manner—meaning that as land use mixing improves, CO_2 emissions efficiency tends to increase. A high coupling coordination degree (closer to 1) suggests that urban planning and land use integration contribute positively to emission reduction, whereas a low coordination score indicates a misalignment between land development and environmental sustainability. The study finds that economic/tech development zones tend to have stronger coordination, while industrial zones—especially those with energy-intensive industries—exhibit weaker coupling. The results of this study show that there is a significant interaction between land use mixing degree and carbon dioxide emissions in most development zones of Shanghai, that is, increasing land use mixing degree can help reduce the total amount and intensity of carbon dioxide emissions. Of course, the relationship between land use mixing degree and carbon dioxide emissions is not fixed, it is not only related to the leading industrial characteristics of the development zones, but also closely related to the development stage of the development zones. In other words, the relationship between the two may be diverse and complex, and does not simply lead to a unified conclusion.
The impact of mixed use development, small businesses, and walkability on carbon emissions in cool climate cities, Zagow, 2022	This study examines the relationship between land use, walkability, socioeconomics variables and carbon dioxide emissions at the zip code level, by comparing the carbon footprint of four metro regions in cool climatic zone 5[6] with a model of all US zip code, to generate a benchmarking predictive model for climate change across all US zip codes.	US cities in cool climatic zone 5	Mixed use development	The study finds that in US cities within a certain climatic zone urban areas with higher public transportation usage and dense residential zones tend to have lower carbon emissions. Across econometric models, a 1 percentage point increase in public transportation usage is linked to a reduction in logged CO2 emissions. The effect sizes range from -0.027 in the full US sample to -0.117 in Zone 5, with Chicago's metro area exhibiting a -0.985 effect. Although the overall US data shows a modest positive effects of local business density (around 0.002 per additional business), city level analyses reveal that compact, mixed-use environments with higher residential occupancy (up to 20.37 in city models) can actually foster lower emissions when paired with effective transit options.
Understanding the potential loss and inequities of green space distribution with urban densification, Lin et al., 2015	This study investigates the spatial distribution of green infrastructure within Sydney to determine how patterns of green infrastructure vary according to land use,	Sydney, Australia	Urban densification	In urban Sydney, residential areas have an average Foliage Projection Cover (FPC) of 43%, while parklands boast a higher FPC of 53%. The authors' regression analysis reveals that higher residential dwelling density is significantly associated with lower green space. Their analysis implies that, all else equal, a 1% increase in residential tree cover is

[6] The US DOE's "Climate Zone 5" covers parts of the Northeast and Midwest, further divided into 5A (cold) and 5B (mixed-humid).

	residential density and socio-economic variation.			associated with an approximate 2.55% decrease in residential density on a log scale. Also each additional percentage point of parkland is linked to a 0.01% decrease in residential density on a log scale—an effect that, while statistically significant, explains a much smaller portion of the variation. Overall, these coefficients indicate that as urban densification increases, both private green space (reflected in residential tree cover) and public green space (parkland) decline, with potential inequities emerging as more affluent areas tend to have higher private tree cover while disadvantaged communities depend on limited public green space.

Table 6 Results: Social outcomes

Author(s)	Study context	Geographic area	Form of integration	Results
A systematic review of the scientifically demonstrated effects of densification, Berghauser Pont et al., 2020	This study aims to provide a systematic review of international research on urban density and its potential benefits and drawbacks for sustainable urban development.	Systematic review of literature, unrestricted geographic focus	Urban densification	The review synthesises evidence from 179 studies, grouping outcomes into nine categories. Overall, about half of the studies report a positive relationship between densification and sustainable urban development, one third report negative effects, and 12% report no significant relationship. Over 70% of North American research reporting positive transport outcomes, such as increased shifts toward sustainable public and active transport, reduced car use, and lower transport-related emissions. In the economic domain, approximately 52% of studies emphasise agglomeration benefits like higher labour productivity and improved public finances. In contrast, outcomes related to ecology, social impact, and human health tend to be negative; for instance, studies focusing on ecological conditions, social equity, and physical health often report adverse effects of higher density. The review also highlights that these trends are relatively robust across different density measures and units of analysis. In summary, densification is strongly linked with beneficial transport and economic outcomes. However, it can simultaneously pose challenges for ecological sustainability, social interaction, and health.
Compact City Policies: A Comparative Assessment, OECD Green Growth Studies, 2012	This report offers a better understanding of the compact city concept, its role in today's urban contexts, and the potential outcomes of compact city policies.	International comparison	Compact city	Compact city policies are reported to have positive effects on individuals' health. Potential health gains due to a shift from private motorised transport to walking, cycling and rapid transit/public transport include reduced cardiovascular and respiratory disease from air pollution, less traffic injury and less noise-related stress. Promoting the mix of jobs and homes in various urban areas may shorten travel distance to jobs, reduce travel costs and increase job opportunities. However, the potential social benefits for local residents are not clear and

				need to be assessed carefully. It can lead to gentrification and push out lower income populations.
Compact city, urban sprawl, and subjective well-being, Mouratidis, 2019.	This paper investigates how social well-being is shaped by compact versus low-density sprawled urban form, using survey data collected in the Oslo metropolitan area.	Oslo, Norway	Compact city	The study uses regression modelling to quantify how both urban form and common urban issues influence subjective well-being (SWB) and its determinants. In terms of urban form, compactness itself exhibits modest but significant effects. Without controlling for common urban problems, a one standard deviation increase in compactness is associated with a 0.09 standard deviation increase in personal relationships satisfaction and a similar positive effect on perceived health (around 0.08). However, an increase in compactness also leads to a negative emotional response (–0.10) that may contribute to higher anxiety. When the models account for urban issues (for example safety, noise, and cleanliness) the positive impacts of compactness become more pronounced. For instance, the coefficient for compactness on personal relationships satisfaction rises to approximately 0.15, and its previously negative effect on emotional response reverses, contributing to a significant positive association with overall life satisfaction. These effect sizes suggest that, although the direct influence of compact urban form on overall SWB is modest, its robust positive effects on social relationships and health can foster higher subjective well-being.
Impact of mixed land use on housing prices, spatial differentiation and implications: empirical analysis based on Qingdao, Gao & Feng, 2023	This study investigates the impact of mixed land use on housing prices in Qingdao, China	Qingdao, China	Mixed land use	The study examined how mixed land use affects housing transaction prices in high-density areas using several regression modelling applied to data from Qingdao. The authors' analysis shows that properties in a "commercial-service-dominated" (Bdominate) mix[7] experience about a 4.3% price reduction, while those in a "public-commercial-balanced" (ABdominate) mix[8] see about a 9.2% reduction, compared to other types. These results are consistent across models with fixed effects at the district and commercial circle levels. However, when spatial autocorrelation is accounted for the overall effect of the aggregated mix index turns negative. The analysis further reveals marked spatial heterogeneity: in Qingdao's core, older areas, a high degree of mixed land use tends to depress housing prices, whereas in the city centre and newer town areas, the impacts differ by dominant type. In conclusion, the paper establishes that mixed land use significantly influences housing values, but its effects are complex and spatially variable. While a higher overall mix can be beneficial, certain dominant configurations may have adverse impacts.

[7] Areas with absolute dominance of land for commercial service facilities.
[8] Areas with a similar number of public service and commercial facilities.

Improvement in the quality of living environment with mixed land use of rural settlements: a case study of 18 villages in Hebei, China, Zhang et al., 2023	This study investigates the influence of mixed land use in rural settlements on the quality of the living environment.	Hebei Province, China	Mixed land use	This study of 18 rural villages in Xing'an town, Hebei province, China, over the period 2010–2020 revealed that improvements in mixed land use are strongly associated with enhanced quality of the living environment. Villages classified as having high levels of mixed land use consistently outperformed their counterparts in terms of quality of living environment. High mixed land use was linked to improvements in foundational infrastructure Statistical analyses (Spearman correlations and Mann-Whitney U tests) confirmed that both the levels and growth rates of mixed land use are significantly and positively correlated with improvements in the living environment.
Influence of mixed land use on realising the social capital, Nabil & Eldayem, 2015	This study investigates the influence of mixed land-use on realising the social capital via studding the mutual relationship between the two variables in more than one zone in the Greater Cairo Region.	Cairo, Egypt	Mixed land use	The study found that increased mixed land uses directly enhance social capital in Cairo. Specifically, the number of land uses exhibits a robust positive relationship with social capital (coefficient = 0.73). Every one-unit increase in the number of land uses[9] is associated with a 0.73 units increase in social capital10. This suggests that diversified functions promote stronger informal interactions and community bonds. The actual mix of uses (square metres of commercial, industrial and public land uses in the neighbourhood divided by the number of housing units) is also highly relevant. A one-unit increase in the quality or degree of actual land use integration corresponds to a 0.92 unit rise in social capital. The building mix (number of building types) shows only a weak positive correlation (coefficient = 0.30) with social capital. Additionally, the study finds that shorter walking distances to commercial services facilitate social interactions. However, a longer road network (coefficient = 0.81) is associated with lower social due to higher vehicular dependency and diminished interpersonal contact.
Land use mix and physical activity in middle-aged and older adults: a longitudinal study examining changes in	This study investigates the effect of land use mix on cycling/walking in two Dutch aging cohorts using data with 10 years follow-up.	Amsterdam, Netherlands	Mixed land use	This longitudinal study of two Dutch cohorts of middle-aged and older adults (mean ages 53 and 69 years) examined how changes in residential land use mix (LUM) relate to cycling and walking.

[9] Measure of land use mix: (m2) of commercial, industrial, and public land uses in the neighbourhood divided by the number of housing units; the higher the ratio, the greater the land use mix.

[10] Social capital is measured through an index that considers the following parameters: i) availability of informal and formal existing social networks; ii) the number of civil society organisations operating in the zone; iii) the number of members of civil society organisations operating in the zone; iv) ability to collective action; v) the existence of a strong information network of the district or zone; vi) the existence of representatives from the local bodies in the zone; vii) the extent of trust available among the populations (community cohesion); viii) the extent of trust available among the populations and the government; ix) the existence of groups that operate for a common goal of the zone; x) the availability of laws monitoring the government performance; xi) the extent of security and good monitoring available in the zone; xii) the number of religious institutions in the zone.

land use mix in two Dutch cohorts, Noordzij et al., 2021				the authors found that higher overall LUM is positively associated with walking. A 10% increase in LUM in a 1000-m buffer corresponded to an additional 11.10 minutes of walking per week. However, sensitivity analyses using different buffer sizes produced mixed findings: in 1600-m buffers, within-individual increases in LUM were associated with a decrease in cycling time (a 10% increase in LUM led to 7.49 fewer minutes of cycling per week). In 500-m buffers, a 10% increase in LUM was linked to a decrease in walking time. These divergent results suggest that while individuals in neighbourhoods with a higher overall land use mix tend to walk more, changes in LUM over time might actually reduce their cycling and walking activity. The authors concluded that combining between- and within-individual analyses is crucial for understanding how evolving urban environments impact physical activity and call for further longitudinal research to clarify these complex associations.
Land use, transport, and population health: estimating the health benefits of compact cities, Stevenson et al., 2016	This study investigates the estimated population health effects arising from alternative land-use and transport policy initiatives in six cities.	Melbourne, Australia; London, UK; Copenhagen, Denmark; Sao Paulo, Brazil; Delhi, India.	Compact city	The authors developed a compact cities model that quantified the health benefits of integrated land use and transport planning by simulating realistic interventions. In the model, urban design is modified by increasing residential density, enhancing land-use diversity, and reducing the average distance to public transport by 30%. These land use policies are integrated with a transport policy that shifts 10% of vehicle kilometres from private motor vehicles to active modes. The model predicts marked improvements in population health through two main pathways. First, there are substantial gains in transport-related physical activity—for example, the model estimates a 72.1% increase in physical activity in Melbourne, 55.7% in Boston, 39.1% in London, 28.9% in Copenhagen, 24.1% in São Paulo, and 18.5% in Delhi. Second, these interventions lead to notable reductions in transport-related particulate emissions: estimated decreases are approximately 12.4% in Melbourne, 11.8% in Boston, 10.1% in London, and 10.9% in Copenhagen, with smaller reductions of 4.9% in São Paulo and 3.2% in Delhi. These improvements are linked to reductions in the burden of chronic diseases (cardiovascular disease, type 2 diabetes, and respiratory disease) quantified in disability-adjusted life-years (DALYs). For instance, under the compact cities scenario, the model estimated reductions of 622 DALYs per 100,000 population for cardiovascular disease in Melbourne, with similar magnitude reductions in other cities. However, the shift toward active transport also carries a trade-off: in cities such as Melbourne, Boston, and London, increased walking and cycling are projected to raise road trauma (road deaths and serious injuries) DALYs.

				The model suggests that to offset this, these cities would need to invest in separated cycling and pedestrian infrastructure. Overall, the findings indicate that integrated urban design and transport policies can yield significant health benefits by increasing physical activity and reducing emissions. However, careful attention to road safety measures is crucial to fully realise these benefits.
Mixed land use and neighbourhood crime, Wo, 2019	This study investigates how mixed land use influences crime, net of specific land use and sociodemographic characteristics.	Los Angeles, USA	Mixed land use	The study found that higher levels of mixed land use are associated with increases in neighbourhood crime over time. Specifically, a block group that is one standard deviation above the mean for mixed land use in 2008 experienced a 4.5% higher robbery rate and a 5% higher aggravated assault rate four years later. Select land uses also contribute significantly, as retail land use raises crime rates by roughly 2.9-5.3%, whereas both local and spatially lagged vacant land use appear to reduce crime rates by 2.4-9%. In socioeconomically advantaged neighbourhoods, the crime-producing effect of mixed land use is most pronounced. This moderation effect suggests that while mixed land use disrupts social control mechanisms (diminishing residents' ability to monitor and deter criminal activity) it has a smaller impact in already disadvantaged neighbourhoods.
Mixed land use has opposite associations with subjective well-being through social capital: spatial heterogeneity in residential and workplace neighbourhoods, Yin, 2024	This study investigates the associations among mixed land use, social capital and subjective well-being in residential and workplace neighbourhoods	Shanghai, China	Mixed land use	This study examines how mixed land use (MLU) influences residents' subjective well-being (SWB) through its impact on social capital. In residential areas: A one standard deviation increase in MLU (reflecting a shift towards a more mixed environment with retail, office, and other non-residential uses) is associated with a substantial decrease (about 0.85 standard deviations) in social capital. This reduction translates into an indirect negative effect on SWB of approximately 0.25 standard deviations. In workplace areas: Here, a one standard deviation increase in MLU leads to an increase of about 0.72 standard deviations in social capital. Overall interpretation: These findings suggest that mixed land use can have contrasting effects depending on the context. In residential neighbourhoods, higher MLU may erode social fabric, reducing residents' well-being. Meanwhile, in workplace areas, a greater mix of land uses supports social connectivity and improves quality of life.
Mixed land use: implications for violence and property crime, Zahnow, 2018	This study investigates the effect of mixed land use on violence and property crime in neighbourhood block groups	Brisbane, Australia	Mixed land use	This study examined how mixed land use influences violent and property crime within Brisbane neighbourhoods. Violent crime:

	while simultaneously considering the presence of criminogenic facilities and sociodemographic conditions.			Mixed land use (measured through the Blau index, which ranges between zero and 1, with lower values representing homogeneity and higher values indicating heterogeneity) within a neighbourhood group showed no significant impact on violence. However, a one-unit increase in mixed land use in adjacent areas was linked to a notable rise in violent crime ($\beta \approx 0.98$, $p < 0.01$). This suggests that external neighbourhood dynamics are influential. The presence of nearby transport stops reduced crime rates, implying they might draw offenders away from the focal area. Property crime: Higher mixed land use within a neighbourhood corresponded with a substantial reduction in property crime ($\beta \approx -1.23$, $p < 0.01$), likely due to increased street activity and informal surveillance. In contrast, mixed land use in nearby areas raised property crime ($\beta \approx 1.87$, $p < 0.01$), indicating spillover effects. Implications: The effect sizes suggest that while mixed land use can deter property crime locally, its benefits may be undermined by spillover effects from adjacent areas and the presence of high-risk facilities like bars.
Neighbourhood effects on crime in San Francisco: an examination of residential, non-residential and mixed land uses, Wo et al., 2020	This study examines the neighbourhood effects of several land use measures on crime counts using negative binomial regression, drawing on a sample of San Francisco census blocks	San Francisco, USA	Mixed land use	The authors' modelled how land use effects neighbourhood crime in San Francisco. Greater level of residential land use is associated with 27–30% fewer robberies, assaults, larcenies, and other crimes. In contrast, a greater proportion of retail land use is linked to roughly 18–26% more robberies, assaults, and larcenies. The effects of mixed-use depends on the specific combination observed. Commercial mixed-use[11] increases crime by 7–7.4%, while residential mixed-use[12] reduces crime by 9–14%. Greater land use heterogeneity is associated with a higher crime rate (up to 134% more robberies, 127% more assaults, 39% more burglaries, and 121% more larcenies) compared to those with low heterogeneity. The findings suggest that the impact of mixed land use is nuanced and context-dependent, emphasising the need for targeted policing strategies that account for overall land use diversity.
Planning for mixed use: affordable for whom?, Moos et al, 2018	This study examines how housing affordability changed for different occupational groups in mixed-use zones in	Toronto, Canada	Mixed-land use	This study examined housing affordability in Toronto's mixed-use zones between 1991 and 2006. The analysis revealed that mixed-use areas are significantly less affordable compared with other parts of the city.

[11] Defined as buildings that combine distinct land uses in the absence of residential land use.
[12] Defined as buildings that combine residential land use with any type of non-residential land use.

	Toronto (Canada) from 1991 to 2006, through a spatial analysis to understands how affordability changes for different types of workers in mixed-use zones compared with the rest of the city and metropolitan region.			By 2006, about 33% of owner households in mixed-use zones spent over 30% of their income on housing - compared to roughly 25% elsewhere. Additionally, housing costs per room were markedly higher: ownership costs in mixed-use areas were 44% higher than in the broader metropolitan region in 1991, rising to 59% higher by 2006, and rental costs increased from 45% to 64% higher over the same period, illustrating a substantial and growing premium. Occupational differences further emphasise these trends; high-income groups, such as business workers, experienced notable improvements in affordability. Whereas lower-income groups saw stagnant or deteriorating conditions, with sales and service workers facing the most severe burdens. Spatially, downtown mixed-use zones became even less affordable over time, while areas along arterial roads maintained relatively better affordability. These effect sizes indicate that without targeted affordable housing policies, mixed-use zoning tends to favour higher-income households, exacerbating affordability challenges for lower-income groups.
Simulating the dynamic effect of land use and transport policies on the health of populations, McClure, 2015	This study aims to identify the features of a land use and transportation system that optimises the health and well-being of the population	Various global cities, including European and UK examples	Integrated land use and transport policies	The study uses dynamic modelling to assess the health impacts of land use and transport policies across six cities. The 10-year simulation shows that coordinated land use and transport policies can markedly reduce transport crash deaths and health burdens (measured in all-cause disability adjusted life years, or DALYs). In London, a no-policy-change scenario increases deaths by 15%, but combining road safety measures with a shift from private cars to active transport cuts deaths by 25% and reduces DALYs by 6%. Similar patterns are seen in Copenhagen. In Beijing, without intervention, deaths rise by 126%, but coordinated land use and transport policies reduce deaths by 92% and DALYs by 23%. Delhi and New York show comparable improvements. Overall, the greatest health benefits are achieved by integrating road safety interventions, modal shifts, and protective infrastructure, underscoring the need for holistic policies to enhance traffic safety and public health.
Stakeholder views about land use and transport integration in a rapidly-growing megacity: social outcomes and integrated planning issues in Seoul, Lee et al., 2021	This study examines if and how land use and transport integration policy can bring positive social outcomes, including accessibility and quality of life, in rapidly growing megacities.	Seoul, South Korea	Generic	The authors carried out site visits, focus groups with local residents and planners, and spatial analysis to explore how land use and transport integration policies and mega urban transport projects (MUTPs) in Seoul affect social outcomes. Key findings reveal that the expansion of the urban subway network has improved macro-scale accessibility. However, local stakeholders reported that rapid high-density commercial and office development around transport nodes has led to several negative outcomes. These outcomes included: diminished access to basic public facilities, increased congestion, reduced

				local mobility, and lower quality of daily life. These adverse effects are most pronounced in the central business district (CBD). The authors identified several barriers which can limit the positive impacts of transport-oriented development. These barriers included a top-down planning approach that limits local authorities' ability to tailor policies to their specific needs, insufficient incentives for developers to contribute to local quality improvements, and inflexible metropolitan policies that do not account for diverse local contexts. In contrast, opportunities at the local level include the potential for decentralised decision-making, enhanced collaboration between metropolitan and local planners, and the strategic use of incentives to improve public spaces and pedestrian infrastructure near nodes. In conclusion, the research argues that while land use and transport integration and MUTP policies are necessary for urban growth, they are not sufficient on their own to ensure positive social outcomes. To achieve enhanced accessibility, social equity, and overall quality of life, integrated spatial planning must adopt a context-specific, multi-level governance approach that balances development with the preservation of liveable environments.
The health dilemma of urban densification: a study on the health effects of urban densification in three Swedish cities, Runenberg, 2023	This study investigates whether health aspects are safeguarded in urban densification processes and how they are safeguarded in three Swedish municipalities, Gothenburg, Malmo and Jonkoping	Gothenburg, Malmo, Jonkoping, Sweden	Urban densification	This study examined how urban densification in three Swedish cities (Gothenburg, Malmö, and Jönköping) affects public health. The authors analysed municipal planning documents and conducted interviews with urban planners. Densification and health: Densification can promote benefits such as improved walkability and reduced car dependence. However, it also raises significant health concerns. Planners noted that increased density often leads to the loss of green spaces, reduced daylight, higher noise and air pollution levels, and the potential disappearance of vital community spaces. These trade-offs can negatively affect both physical and mental health. Actions and strategies: Municipalities have attempted to implement strict guideline values for noise pollution, air quality, and daylight. However, the authors found that these measures are not always enforced in the detailed planning stage. Organisational challenges, such as poor communication between departments and limited local authority power, further complicate the effective integration of health considerations into densification processes.
The relationship between urban greenery, mixed land use and life satisfaction: an examination using remote sensing data and deep learning, Bahr, 2024	This study employs a deep learning approach in conjunction with high-resolution satellite imagery and land use data to obtain the distribution of different green space types in the residents' neighbourhood and	Switzerland	Urban greenery and mixed land use	The study employed deep learning and remote sensing to dissect how specific types of urban green spaces and the degree of mixed land use in walkable neighbourhoods relate to residents' life satisfaction. The authors focused specifically on age differences. Key findings include: Urban greenery effects: For residents over 65, a one standard deviation increase in trees and grass located in parks and gardens is linked to a significant boost in life satisfaction (with trees contributing an increase of about 0.137 standard deviations, and

	examine their effect on life satisfaction.			grass even higher at approximately 0.240 standard deviations for the oldest age group). Conversely, certain green space types matter differently: unspecified green areas are negatively associated with life satisfaction amongst younger adults. Mixed land use effects: Using a continuous age variable (centred at 25), the study finds that for a 25-year-old resident, a one standard deviation increase in mixed land use is associated with a 0.079 standard deviation increase in life satisfaction. However, there is a negative interaction between mixed land use and age—indicating that the positive effect observed for younger residents diminishes as age increases. Overall, the findings underscore that urban green space benefits are highly age-specific. Older residents derive more life satisfaction from well-maintained green spaces like parks and gardens, whereas younger individuals tend to benefit more from a balanced, uniform mix of land uses in their immediate neighbourhoods. These nuanced insights provide valuable guidance for land-use and transport policymakers aiming to tailor green and mixed-use environments to the specific needs of different age groups.
Urban densification and 12-year changes in cardiovascular risk, Chandrabrose et al., 2019	This longitudinal study examines the potential impact of population-density increases in urban areas (urban densification) on cardiovascular risk makers among Australian adults	Australia	Urban densification	This 12 year longitudinal study of Australian adults examined how urban densification affects cardiovascular risk markers. Key findings include: Obesity-related measures: A 1% annual relative increase in population density was significantly associated with smaller annual increases in waist circumference (WC) and weight. For example, each 1% annual increase in density was linked to a 0.043 cm smaller increase in WC per year. These findings suggest that densification may help protect against abdominal obesity—a key marker of cardiometabolic risk—likely through improved access to walkable destinations and increased physical activity. Blood pressure (BP) and lipids: The associations with BP were less consistent. Relative densification showed only a borderline positive association with diastolic BP (an increase of about 0.032 mm Hg/year per 1% density increase). In terms of lipid profiles, both relative and absolute densification were associated with small adverse effects on cholesterol (a 1% density increase was linked to a 0.035 mg/dL smaller increase in HDL-C per year in fully adjusted models).
Urban greenness, mixed land-use and life satisfaction: evidence from residential locations and workplace settings in Beijing, Wu et al., 2022	This study investigates the effect of urban greenness and mixed land-use, two key dimensions defining urban liveability, on residents' life satisfaction at both residence	Beijing, China	Mixed land use	The study used geo-coded survey data, a machine learning algorithm to classify street-level greenness, and fine-grained land-use metrics. The authors conclude that that both urban greenness and mixed land use significantly influence life satisfaction—but in contrasting ways across residential and workplace settings. At residential locations, a one-unit increase in street-level greenness raises the probability of a one-unit increase in life satisfaction by 4.65 times.

	and workplace stings in Beijing.			Conversely, at workplaces, increased greenness unexpectedly reduces life satisfaction, potentially because workers have limited engagement with these green spaces, or because such greenness is often found in peripheral areas lacking other desirable amenities. Mixed land use, however, shows a consistent positive association with life satisfaction in both settings: a one-unit increase in mixed land use elevates satisfaction probabilities by 1.44 times at residences and 2.77 times at workplaces. At residential locations, the combined effect of high greenness and diverse land use amplifies life satisfaction, while at workplaces, a robust mix of land uses can not only counteract but even reverse the negative effects of greenness. These findings underscore the necessity for urban planners to adopt a nuanced approach: fostering integrated, mixed-use environments alongside quality green infrastructure to optimise life satisfaction across both residential and work contexts.

The summaries presented in the main body are fully consistent with the detailed findings presented above.

Full REA Protocol

The REA protocol also set out the inclusion and exclusion criteria that guides the scope of the review, the strategy for the search, refinement and extraction of evidence, and the subsequent synthesis of that evidence The criteria to determine which studies are eligible for inclusion are shown in Table 7. In a small number of cases an evidence source was included in our detailed review even if it did not meet the inclusion criteria (e.g. it fell outside the time period window set out below). This flexibility ensured that the final evidence base would be as useful as possible in answering DfT's research questions.

Table 7: Inclusion and exclusion criteria to determine scope of REA

Topic	Inclusion criteria	Exclusion criteria
Type of literature	Academic literature such as theoretical / conceptual and applied studies (e.g. evaluation evidence) Grey literature including evaluation reports and analysis documents by think tanks, government agencies and consultancies Review studies, synthesis reports or meta-studies which distil findings from multiple other relevant studies	Blogposts Webpages Newspaper articles
Type of publication	Peer-reviewed published literature in journals Non-peer-reviewed literature including working papers that are published by credible sources Policy and evaluation reports	Books Videos Audio outputs
Relevance to research questions	Document contains information which is relevant to in-scope definitions (e.g. land-use planning, integration of land-use and transport). Document contains information on relevant economic, social or environmental outcomes (see below for further details) which are attributed to, or associated with, integration of land-use and transport planning or delivery. Document contains information on relevant economic, social or environmental outcomes (see below for further details) which are attributed to, or associated with, diversity of land-use mix.	Document contains no information relevant to research questions of interest
Time-period	Studies published since 2014	Studies published pre-2014 (unless judged to be highly relevant and not adequately covered by post-2014 literature)
Transport mode	Rail / light rail Bus Active travel	Aviation Maritime

	Car	
Geography	UK Comparable European countries Non-European OECD countries such as Singapore / Canada / USA Wider evidence from non-European countries which filled important gaps in the evidence base	Wider evidence from non-European countries which related to topics already covered by European / UK evidence.
Language	English language	Evidence published in other languages

In line with Cabinet Office best practice[13] we analysed the quality of qualitative evidence by considering the following principles:

1. contributory in advancing wider knowledge or understanding;

2. defensible in design by providing a research strategy which can address the evaluation questions posed;

3. rigorous in conduct through the systematic and transparent collection, analysis and interpretation of qualitative data;

4. credible in claim through offering well-founded and plausible arguments about the significance of the data generated.

Search strategy

Creation of longlist

We employed an iterative process drawing on existing knowledge, searches of key databases and refinement/snowballing of the search based on the results generated. The results of these searches were then used to create a longlist of papers for inclusion in the REA.

To avoid duplication we started with a list of known sources from previous work conducted on this topic by DfT. We scanned these sources to help us define a set of keywords. We also conducted a snowballing exercise to mine references of papers reviewed to identify further literature.

Our final list of search terms is as follows:

- “Integrated land use and transport” AND “reduced commute”;
- “Integrated land use and transport” AND “economic growth”;
- “Integrated land use and transport” AND “urban regeneration”;
- “Integrated land use and transport” AND “reduced greenhouse gas emissions”;

[13] See here for further details

- “Integrated land use and transport” AND “air quality”;
- “Integrated land use and transport” AND “quality of life”;
- “Integrated land use and transport” AND “health benefits”;
- “Integrated land use and transport” AND “deprivation”;
- “Integrated land use and transport” AND “reduced commute”;
- “Mixed land use” AND “quality of life”;
- “Mixed land use” AND “greenhouse gas emissions”;
- “Mixed land use” AND “housing prices”;
- “Mixed land use” AND “health benefits”;
- “Mixed land use” AND “economic growth”;
- “Mixed land use” AND “urban regeneration”;
- “Mixed land use” AND “air quality”;
- “Mixed land use” AND “reduced commute”;
- “Urban densification” AND “benefits”;
- “Urban densification” AND “air quality”;
- “Urban densification” AND “health benefits”;
- “Urban densification” AND “car dependency”;
- “Agglomeration” AND “benefits”;

The development of keywords was an iterative process based on the evidence that we identified during initial searches. To keep the approach agile, we did not set limits on the number of iterations in advance. Our searches ended when no further relevant studies are identified through additional searches.

The evidence was searched through Google Scholar, a commonly used web-based academic search engine, catalogues between 2 and 100 million records of both academic and grey literature (articles not formally published by commercial academic publishers). We also conducted targeted Google searches to identify grey literature, and the websites of relevant bodies such as the What Works Centre for Local Economic Growth, Department for Transport, National Infrastructure Commission, Centre for Cities, the World Bank, the International Transport Forum, OECD, European Commission, Australasian Transport Research Forum, and others.

Filtering

Once the individual searches were completed, we combined the results to give us a full longlist of the evidence found, removing any duplicates. We then filtered these sources using three complementary methods.

Firstly, we skimmed through the title of the articles to identify any literature that was picked up by the search strategy that were obviously not relevant to the study based on the research questions and scope of review.

The next step was to screen the remaining sources to check whether they meet the inclusion and exclusion criteria. This was intended to remove articles captured by the search strings that are not relevant to the study based on the agreed research questions and scope of the review. We examined the abstract, introduction, and conclusions based on a speed-reading of the articles. Anything that again did not meet the scope of the study based on the inclusion and exclusion criteria but have passed through the first stage screening was be excluded.

Finally we excluded papers which did not meet a minimum quality standard (see Table 2 above). This assessment of minimum quality allowed us to distinguish between findings in which there is a greater or lower level of confidence. We have placed more weight on sources of evidence which perform better according to the quality areas set out above. We did include some less robust studies which filled an important evidence gap (e.g. they related to the UK specifically). We have transparently noted where this applies in the remainder of this report.

This process yielded a shortlist of relevant papers that could be reviewed in full. This final list contained 52 evidence sources.

The full longlist and final shortlist have been separately shared with DfT in the interests of full transparency.

Following the filtering of the papers described above we carried out an initial review. This led to our articulation of the workable set of relevant definitions (see out in Section 4) which were then shared with DfT and guided the remainder of our work.

Review and synthesis of evidence

For the review stage we focused on the shortlisted papers that meet the inclusion criteria and minimum quality standards.

We used an Evidence Collation Template in Excel to structure the evidence review. This structured the information that we collected from each source into categories including: Title, Abstract, Database, Search query used, Research questions met, Key relevant findings, Year of publication, Journal, Authors and affiliations, Geographical context, Time period of evaluation, Type of intervention studied, Transport mode covered, Counterfactual identification methodology, Types of outcomes measured, Key findings, Internal validity and External validity of findings.

When the detailed review of shortlisted papers was complete, we began the synthesis stage. This involved:

- Describing the overall characteristics of the evidence base, including the types of evidence available, research designs used, jurisdictions studied, interventions studied, and outcomes measured. We also identified material gaps in the available evidence.

- Summarising what the evidence base suggests, including regarding the consistency and convergence of the findings.

- Developing the implications of the findings, and how far they address the research questions. We also noted where further research may be considered, e.g. where there are significant gaps in the evidence base.

The synthesis of findings was structured thematically according to the outcome categories and the research questions, presenting a narrative synthesis of evidence relating to each question in turn. In line with DfT's final research question we have also transparently highlighted any emerging gaps in the current evidence base and proposed future pieces of research which would help to fill these gaps.