2. The state of the built environment and how it impacts well-being and sustainability

The built environment has multiple impacts on people's well-being and sustainability: from the satisfaction of basic human needs to the provision of space for various activities. The built environment can also undermine people's current and future well-being by generating significant costs or creating pressures on the environment and ecosystems. A poor-quality built environment (i.e. housing, transport, infrastructure, urban design/land use) may also aggravate the ingrained inequalities between population groups in the society. This chapter presents the main inter-relationships between the built environment, well-being and sustainability and provides an overview of its current state in OECD countries, drawing from available internationally comparable data.

2.1. Using a well-being lens to examine the built environment

The built environment impacts well-being in several ways. It satisfies basic human needs (e.g. providing shelter), while giving access to amenities and services that support several dimensions of people's well-being (e.g. health, education, culture and nature). It provides space for various activities such as working, studying and caring. When carefully planned, it can help people access opportunities for life-enhancing activities such as socialising and education. On the other hand, the built environment can undermine people's current and future well-being by generating significant costs or creating pressures on the environment and ecosystems (OECD, 2019[1]). When the overall built environment is degraded or has poor functional or aesthetic quality, it can significantly compromise people's quality of life, particularly through its impact on safety, as well as on physical and mental health. The built environment may also aggravate the ingrained inequalities between population groups in a society. For example, workers without the means to commute longer distances will have fewer employment opportunities (Seltzer and Wadsworth, 2023[2]). Furthermore, the built environment affects well-being through numerous unexpected channels. A study in the US showed that congested highways influenced people to make less healthy food store choices due to time lost (Bencsik, Lusher and Taylor, 2023[3]). Hence, analysing the built environment through a well-being lens leads to a multi-dimensional perspective that can consider both the benefits and the challenges of the built environment that bear on people's well-being, which can assist policy makers to be more cognizant of its mixed impact on people's lives when making decisions about the built environment and evaluating its performance.

This chapter explores the inter-relationships between the built environment, well-being and sustainability. The analysis is conducted in terms of three broad factors of current well-being (i.e. material conditions, quality of life factors, community relations) as well as four types of capital (i.e. economic, human, natural and social capital) that are related to sustainability. Material conditions are grouped with economic capital; quality of life factors are examined with human and natural capital; and community relations are explored along with social capital. The built environment and its components are examined with a well-being lens in terms of quantity and quality, based on both a review of existing literature and an analysis of internationally comparable data (available as of March 2023). Before going further, a snapshot of the current state of the overall built environment in OECD countries (Table 2.1) is presented below, with more detailed illustrations provided later in the chapter. Definitions and sources for each indicator are available in Annex 2.A.

Table 2.1. At a glance: The built environment in OECD countries

Selected indicators to assess the quantity and quality of the built environment

Component	Quantity/ Quality	Indicator and unit of measurement	OECD average levels and country range
Overall built environment	*Quantity*	**Built environment (buildings and civil engineering works) stock** USD per capita at 2015 PPPs	USD 111 273 (Range: USD 154 317)
		Investment in the built environment (buildings and civil engineering works) *% growth rate or percentage of GDP	11.5% over 2011-2021 (12.3% of GDP in 2021) (Range: 13 pp over 2011-2021)
Housing	*Quantity*	**Housing (residential buildings) stock** USD per capita at 2015 PPPs	USD 53 816 (Range: USD 76 991)
		Investment in housing (residential buildings) *% growth rate	24.4% over 2011-2021 (Range: 267 pp over 2011-2021)
	Quality	**Housing affordability (current expenditures)** **% of available household disposable income after deducting housing current expenditures*	79.7% (Range: 14 pp)
		Housing cost (rent and mortgage) overburden	18.4%

Component	Quantity/ Quality	Indicator and unit of measurement	OECD average levels and country range
		% of households in the bottom 40% of the income distribution spending more than 40% of their disposable income on housing cost	(Range: 39 pp)
		Overcrowding rate *% of households living in overcrowded conditions*	11.2% (Range: 34 pp)
		Poor households lacking access to basic sanitary facilities (toilets) *% of households below 50% of median equivalised disposable household income without indoor flushing toilet*	5.3% (Range: 53 pp)
		Housing distress *% of respondents somewhat or very concerned by not being able to find/maintain adequate housing*	44% (short-term)/ 51% (long-term) (Range: 45 pp (short-term) / 48 pp (long-term))
Infrastructure	*Quantity*	**Infrastructure (civil engineering works) stock** USD per capita at 2015 PPPs	USD 23 229 (Range: USD 61 000)
Transport	*Quality*	**Convenient access to public transport** *% of population in large metro areas with convenient access to public transport*	83% (Range: 71 pp)
		Access to various public transport modes *% of population in large urban areas with a public transport option in 10 mins*	84% (bus); 33% (metro or tram) (Range: 73 pp (bus); 80 pp (metro or tram))
		Transport effectiveness in providing access to destinations *ratio (above 1: transport is effective, below 1: transport has poor performance)	0.9 (Range: 2)
Technical Infrastructure	*Quality*	**Access to improved drinking water sources** *% of population with access to improved drinking water*	95% (Range: 57 pp)
		Access to public sewerage (primary, secondary, tertiary or other treatment) *% of population connected to public sewerage*	90% (Range: 74 pp)
		Access to electricity *% of population with access to electricity*	100% (Range: 1 pp)
		Ability to keep the dwelling warm *% of households who cannot afford to keep their home adequately warm (energy poverty)*	12.5% (Range: 38 pp)
Urban design/land use	*Quantity*	**Artificial surfaces** *% of total land*	1% (Range: 11 pp)
		Change in artificial surfaces (to and from) *% of land change compared to 2004*	27.4% change to artificial surfaces (2004-2019) (Range: 115 pp)
		Urban built-up areas *sqm per capita	292 sqm (Range: 601 sqm)
		Average urban building height *metres	7 metres (Range: 9 metres)
		Urban green areas *% of functional urban areas covered by vegetation*	46% (Range: 55 pp)
		Open space for public use *% of built-up area of cities which is open for public use*	65% (Range: 85 pp)
	Quality	**Access to recreational green space in urban areas** *% of urban population with access within 10 mins walking distance from home*	69% (Range: 85 pp)
		Proximity to services *of services within 15 minutes walking distance (10 km) in European capital cities*	57 restaurants, 28 food shops, 13 schools, 5 recreation destinations, less than one hospital or one urban green space

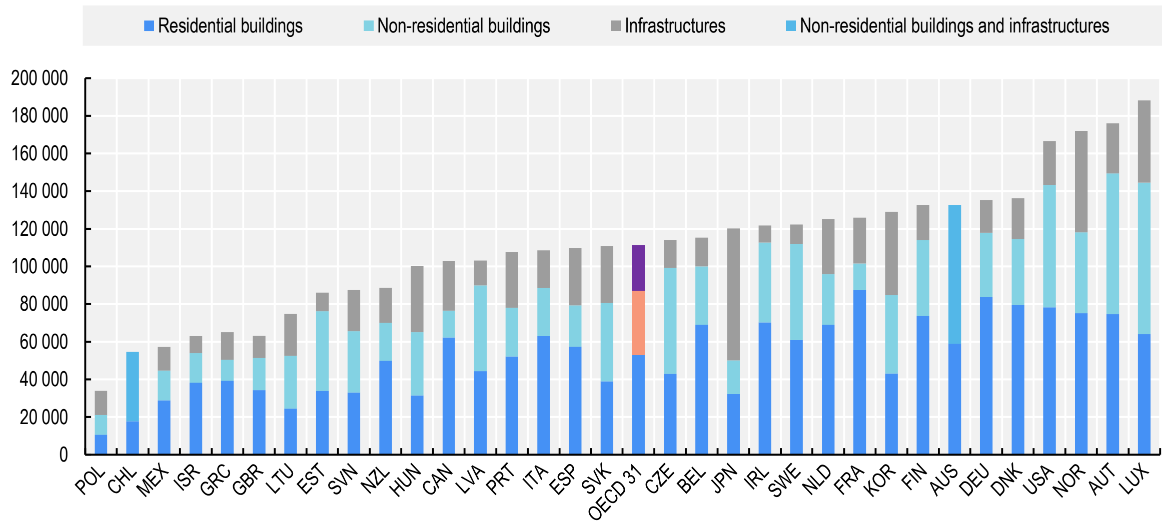
Note: Country range is a descriptive measure of variability across OECD countries. It is calculated as the difference between the highest and lowest available country value in the OECD. A detailed description for each indicator is presented in Annex 2.A. “pp” stands for percentage points.

The most comprehensive, internationally comparable, monetary market estimation of the built environment can be sourced from the National Accounts. The National Accounts are an internationally coherent, consistent and integrated set of macroeconomic accounts and balance sheets that measure economic activity. In the National Accounts, data are available for dwellings (residential buildings), non-residential buildings and civil engineering works (infrastructure).[1] There exists no single value that summarises the quantity (and the quality) of the overall built environment, however. Despite being the most comprehensive internationally comparable measure of the built environment, the National Accounts' estimation is limited to its monetary market value. It does not account for some quality features of the built environment (e.g. its accessibility). It also does not fully capture the value for well-being or the hidden costs (e.g. pressures on the environment) associated with construction and maintenance of the built environment. Nevertheless, quantifying components of the built environment in monetary market value can help picture its overall state across OECD countries in terms of both stock and investment, laying the ground for further analysis on its inter-relationships, as well as the tensions and trade-offs, with different dimensions of well-being and sustainability.

The stock value of the built environment in terms of USD per capita ranges widely among OECD countries: from almost USD 34 000 per capita in Poland to over USD 188 000 per capita in Luxembourg (Figure 2.1). Most countries, however, are clustered around the OECD average value of about USD 111 000 per capita. On average, the monetary market stock value of residential buildings generally constitutes most of the built environment stock in OECD countries (almost 50%), followed by non-residential buildings and infrastructure. Together, residential and non-residential buildings account for 80% of the stock value of the built environment in OECD countries, on average. Japan is the only country where infrastructure composes more than 50% of the total stock of the built environment, whereas in France the stock value of residential buildings amounts to almost 70% of the total monetary market stock value of the built environment, the highest in OECD countries. Here, it is again important to note that a larger stock or share of a certain component of the built environment may not necessarily be linked to a higher level of people's well-being or society's sustainability. Indicators related to the stock (monetary) value of the built environment can be used as a reference, to compare relative sizes/shares between OECD countries and change over time.

Figure 2.1. The monetary market average stock value of the built environment in OECD countries ranges from USD 34 000 to USD 188 000 per capita

USD per capita at 2015 PPPs, 2021 or latest available year



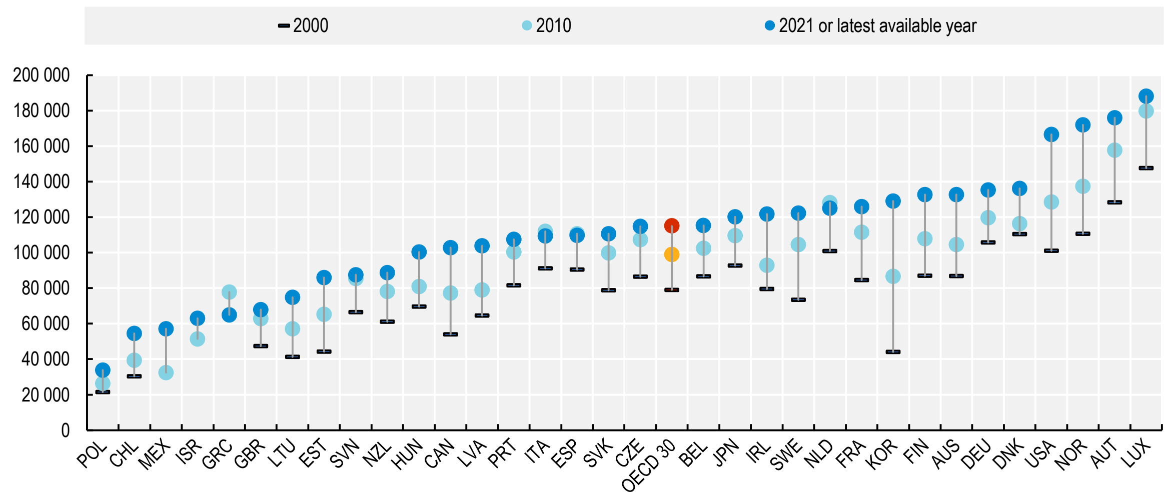
Note: Data refer to 2021 for Australia, Belgium, Chile, the Czech Republic, Denmark, France, Finland, Korea and the United States. Data refer to 2019 for Estonia, Greece, Latvia, Lithuania, Norway, Poland and Sweden. Data refer to 2017 for New Zealand. Data refer to 2020 for all the other countries. The OECD average excludes Australia, Chile, Colombia, Costa Rica, Iceland, Switzerland, Türkiye, due to lack of data. Data for non-residential buildings and infrastructures are available only at aggregate level for Australia and Chile.
Source: OECD Calculations based on the OECD *National Accounts Statistics* (database): 9B. Balance sheets for non-financial assets, http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE9B.

StatLink https://stat.link/qkgbl9

The monetary market value of the built environment stock has evolved to differing degrees across OECD countries in the last two decades (Figure 2.2). On average, the real stock value of the built environment stood above USD 111 000 per capita in 2021 for OECD countries, up from about USD 80 000 per capita in 2000 and around USD 100 000 in 2010. With the exception of Greece, where the real stock value of the built environment decreased from 2010 to 2021, most countries have experienced real growth in the total monetary market value of the built environment over the last two decades. Korea marked the largest leap, from around USD 44 000 per capita in 2000 to almost USD 130 000 in 2021. Luxembourg, Austria, Norway and the United States showed the highest levels for the built environment in 2021 or the latest available year, with the stock amounting to over USD 160 000 per capita. Changes in the monetary market stock value of the built environment were mainly driven by changes in the values of residential buildings. However, a comprehensive repository of internationally granular comparable data on the number, dimension and value of buildings and infrastructure is not available, therefore it is not possible to assess whether the growth has been driven by the increasing number of assets or by their increasing value, or by both. Detailed statistics on the value of residential buildings and land could help identify the driving elements that cause macroeconomic imbalances related to households and help understanding the causes of households' vulnerability in times of financial instability (OECD, 2015[4]).

Figure 2.2. The monetary market stock value of the built environment has evolved to differing degrees across OECD countries in the last 20 years

USD per capita at 2015 PPPs



Note: The OECD average excludes Colombia, Costa Rica, Greece, Iceland, Israel, Mexico, Switzerland and Türkiye, due to lack of data or breaks in the series.

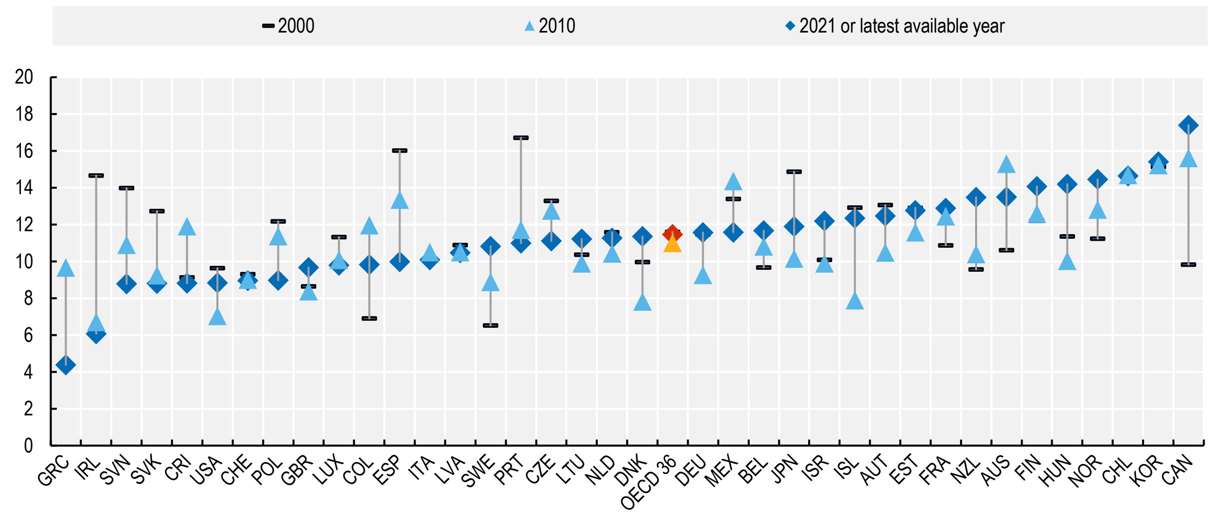
Source: OECD Calculations based on the OECD *National Accounts Statistics* (database): 9B. Balance sheets for non-financial assets, http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE9B.

StatLink https://stat.link/zqs7bo

As a share of Gross Domestic Product (GDP), total (public and private) annual investment in the built environment stands at 12% on average in the OECD. It ranges from below 7% of the GDP in Greece and Ireland to above 15% of the GDP in Korea and Canada. In the last 20 years, investment in the built environment as a share of GDP has fallen the most in Ireland (more than 8 percentage points), Spain and Portugal (6 percentage points), and increased the most in Canada (almost 8 percentage points) and New Zealand (almost 4 percentage points). Comparable data before 2010 are not available for Greece, but since 2010, its investment as a share of GDP has dropped by more than 5 percentage points, the highest drop across OECD countries in the last 10 years (Figure 2.3). In absolute terms, in the OECD, on average, investment in the built environment cumulatively grew by 12% in the last ten-year period, compared to a cumulative drop of 9% over the 2000-10 period. Investment made in the built environment during the 2011-21 period was notably high in Iceland, with a cumulative growth above 120%. Investment in the built environment is crucial in maintaining its current state and in improving its quality; for example, increasing the housing supply may support affordability objectives.

Figure 2.3. Annual investment in the built environment ranges from below 7% to above 15% of GDP in OECD countries, and has cumulatively grown over the last 10 years

Annual investment in the built environment as a percentage of GDP



Note: The OECD average excludes Greece and Türkiye, due to lack of data or breaks in the series.
Source: OECD Calculations based on the OECD *National Accounts Statistics* (database): 1. Gross domestic product, http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE1.

StatLink https://stat.link/die9nf

Both the monetary stock value and the size of investment in the overall built environment are shown to have grown in most OECD countries over the last ten years. The following sections will examine the inter-relationship between key components of the built environment and well-being, while also presenting some findings on the state of the quality of the built environment.

2.2. Well-being and the built environment: Housing

2.2.1. The inter-relationship between well-being and housing

Material conditions and economic capital

Wealth and consumption

Housing is important for the financial security of households. Housing is the most widely owned asset in households' wealth (OECD, 2021[5]), while property debt is the largest liability in households' portfolios (Causa, Woloszko and Leite, 2019[6]). Housing costs typically take up a significant portion of household expenditure, particularly for low-income households. Average current housing expenditure for rent (actual and imputed, in the case of homeowners) and maintenance accounts for around 20% of household disposable income in OECD countries. It is the single-largest household expenditure item, accounting for around 22% of final household consumption expenditure, followed by food and non-alcoholic beverages (around 14%) and expenditure on transport (around 13%) (OECD, 2021[7]). On the other hand, job losses and reduced earnings and working hours threatened people's ability to meet housing costs during the pandemic, exacerbating existing socio-economic divides and longstanding housing challenges (OECD, 2021[8]). Inequalities in housing affordability were particularly pronounced in urban areas and among low-income households, renters in the private market and youth. In some countries, youth are increasingly living with their parents, while seeking their way in a challenging labour market. Many OECD countries introduced emergency support to avoid some of the worst effects of the crisis on housing, with mortgage forbearance and eviction bans among the most common measures (OECD, 2021[9]).

Housing is the main source of wealth for low-income households. The relative importance of the main residence varies across the wealth distribution, being more important for lower-wealth households. Accounting for an average 51% of households' gross assets (i.e. not deducting liabilities), the main residence is the physical asset that, on average, constitutes the core of their wealth (OECD, 2021[5]). The main residence accounts for 61% of gross assets for the bottom 40% of households, while this share is only 34% for the top 10%. Lower-wealth households own a smaller share of financial wealth, compared to wealthier households, making them more vulnerable to financial shocks, as financial assets are more easily liquidated than real estate and can be a source of resilience in the short term. Also, inequality in net wealth is higher than in net housing wealth, with the highest gap at the top of the wealth distribution, reflecting a higher share of non-housing sources of wealth, such as business and financial wealth, at the top of the distribution. Countries with low homeownership exhibit greater wealth inequality, even when income inequality is low (Causa, Woloszko and Leite, 2019[6]).

Property debt is the largest liability in households' portfolios, in particular for homeowners at the bottom of the wealth distribution and young homeowners. The average share of liabilities in households' gross wealth is 12%, 10% of which is property debt and 2% consumer debt. In terms of the distribution, low-wealth households have much higher *relative* debt and property debt than wealthier households: liabilities account for 56% (40% is property debt and 16% consumer debt) of gross wealth among the bottom 40% of households but only 6% (5% is property debt and 1% consumer debt) among the top 10% (OECD, 2021[5]).

There is great variation in the mix of housing tenures across OECD countries, with different implications for financial security of homeowners and tenants. Housing tenure mix is defined in terms of homeownership rates and the relative proportion of outright owners and owners with mortgages. With an OECD average at around 60%, homeownership rates vary from around 80% in the Slovak Republic, Hungary and Spain to around 40% in Germany, Denmark and Austria. Cross-country differences partly reflect historical legacies (e.g. high homeownership rates in Eastern European countries, as a consequence of mass privatisation at submarket prices to sitting tenants) and differences in policies and institutions that affect housing demand and supply (such as regulations of mortgage markets and rental markets, the provision of social housing, taxation and land-use policies). Differences in households' socio-demographic characteristics also contribute to the variation in the housing tenure mix, notably the structure of households in terms of age and size. For example, retirement age household members and larger households are more likely to be owners, whereas younger household members and single person households are more likely to be renters (Causa, Woloszko and Leite, 2019[6]). While no universal *appropriate* housing tenure mix exists, the implications of policies to foster well-being may differ for homeowners and tenants (e.g. rental market restrictions, landlord-tenant regulations) (OECD, 2021[10]).

Work and job quality

Housing's role as a crucial determinant of people's well-being was highlighted during the COVID-19 pandemic. With the enforcement of lockdowns and physical distance measures, work and school activities moved online whenever possible, forcing people to reorganise their housing space and activities. The availability of the option to work from home, however, differed for different population groups and places. For example, in OECD countries, it became mainstream for many high-skilled workers, but remained marginal in many low-skilled occupations (OECD, 2021[8]). The actual uptake of remote work also varied widely across European regions, the share of remote workers increased by 70% in rural areas but it almost tripled in cities between 2019 and 2020 (OECD, 2022[11]).

Economic capital

At aggregate level, housing represents a long-term resource for the sustainability of well-being. The monetary value of housing accounts for almost 50% of the value of the overall built environment. Not only is housing an important part of household wealth, but it also plays a crucial role in countries' economic capital. For instance, taking a mortgage provides an opportunity for households to accumulate wealth and for the country to boost the economy in the short term. However, when too high and widespread, it can also expose the most vulnerable households and become a risk for the whole economy. While indebtedness does not necessarily imply financial distress, household debt ratios and mortgage cycles are closely linked to house prices, impacting on economic resilience (OECD, 2017[12]). OECD countries that have seen the steepest rise in house prices since the 2007 financial crisis were those with the strongest increase in household debt (OECD, 2017[12]).

Quality of life, human capital and natural capital

Physical and mental health

Poor housing conditions are associated with poor physical health conditions. There is evidence that indoor damp, mould, cold and household crowding are strongly associated with adverse health outcomes (World Health Organization (WHO), 2018[13]; OECD, 2021[14]), even after controlling for other confounding factors, like income (Riggs et al., 2021[15]). Living in a cold, damp home is likely to exacerbate or induce respiratory and cardiovascular conditions (Centre for Aging Better, 2020[16]). Overcrowding is linked to risks of respiratory (and other) infections in children (Krieger and Higgins, 2002[17]). Households living in overcrowded conditions, unhealthy house conditions (cold, damp house), or lacking or with poor basic sanitation were also more at risk to contract COVID-19 (OECD, 2021[14]). Young people and low-income households are the most at risk, as they are more likely to live in poor-quality dwellings, be overburdened by housing costs or face problems with housing affordability (OECD, 2021[14]). The relationship between housing and health has been internationally recognised, and the WHO *Housing and health guidelines* (World Health Organization (WHO), 2018[13]) provide practical recommendations to reduce the health burden due to unsafe and substandard housing. Based on systematic reviews, the guidelines provide recommendations relevant to inadequate living space (crowding), low and high indoor temperatures, injury hazards in the home, and the accessibility of housing for people with functional impairments.

As for mental health, there is a two-way relationship with housing. Housing costs and unstable housing tenure can undermine mental health, whereas satisfaction with housing conditions and home ownership usually contribute to higher well-being. Housing unaffordability, debt, foreclosure and instability are related to levels of stress and the incidence of mental health conditions (Taylor, Pevalin and Todd, 2007[18]; Robinson and Adams, 2008[19]; Alley et al., 2011[20]; McLaughlin et al., 2011[21]). The stress of homelessness can worsen mental health outcomes, and mental health conditions can increase the likelihood of becoming homeless (Nilsson, Nordentoft and Hjorthøj, 2019[22]; Moschion and van Ours, 2022[23]; Liu et al., 2021[24]; OECD, 2015[25]; Hammen et al., 2009[26]; Zhang et al., 2015[27]; OECD, 2023[28]). Housing conditions such as overcrowding and poor housing quality are also significant drivers of severe mental health conditions (Keller et al., 2022[29]; Morganti et al., 2022[30]; OECD, 2023[28]). Poor quality housing (in terms of structural condition, maintenance, damp, rot, mould) is related to poor psychological well-being (stress, anxiety and low life satisfaction) (Evans, Wells and Moch, 2003[31]; Fujiwara, n.d.[32]). On the other hand, better quality housing can improve mental health outcomes and life satisfaction (Cattaneo et al., 2009[33]; Boarini et al., 2012[34]). Dwelling characteristics, such as the dwelling's plan, design, size, the adequacy of interior space, construction quality, amenities and price, are all linked to housing satisfaction (Wang and Wang, 2019[35]; Nguyen et al., 2017[36]; Aigbavboa and Thwala, 2016[37]). Housing satisfaction is positively associated with life satisfaction, happiness and eudaimonia (Mouratidis, 2020[38]; Clapham, Foye and Christian, 2017[39]; Foye, 2016[40]; Tsai, Mares and Rosenheck, 2011[41]). Home ownership is also associated with higher life satisfaction, higher levels of resilience to financial shocks and social prestige (Ruprah, 2010[42]; Mason et al., 2013[43]; Zumbro, 2013[44]). The quality and aesthetics of housing and the local neighbourhood also promotes positive mental health (Bond et al., 2012[45]).

Environmental quality and natural capital

Indoor air pollution is hazardous for human health and exacerbates outdoor air pollution. Indoor air pollution in the house can occur due to heating, cooking, smoking, cleaning and even to furnishings or building materials, which are important indoor sources of gaseous pollutants and particles (He et al., 2004[46]; Isaxon et al., 2015[47]). Pollution levels are measured in terms of the concentrations of particulate matter (PM10 or PM2.5) in houses, which are dangerous for human health (OECD, 2019[1]). They are also directly correlated with carbon emissions, through the residential combustion of wood and the impact on air quality at the local and regional levels, especially during the winter (heating) period (Guerreiro et al., 2016[48]).

The housing sector accounted for 23% of total CO_2 emissions in the OECD in 2020 (Hoeller et al., 2023[49]). The residential sector's emissions emanated from space and water heating, cooling, ventilation, lighting and the use of electrical appliances. The construction of residential buildings contributed an additional 6% to total CO_2 emissions, largely reflecting the heavy use of concrete and steel in current building technologies. Carbon emissions are also correlated with the residential combustion of wood and have an impact on air quality at the local and regional scales, especially during the winter (heating) period (Guerreiro et al., 2016[48]). Since 2000, the OECD-wide total CO_2 emissions of the residential sector have fallen by 17%, despite an increase in the population and number of dwellings. This reduction is being driven by improvements in the energy efficiency of homes and appliances and the reduction of the carbon content of the energy supply in many countries. The OECD average, however, hides a stark variation across countries: emissions have fallen by more than 50% in Denmark, Estonia, Lithuania and Sweden, while they have risen by more than 50% in Chile, Colombia and Türkiye (Hoeller et al., 2023[49]).

Greenhouse gas (GHG) emissions directly generated by buildings and dwellings are relatively well understood, but data are often not sufficiently granular. GHG emissions comprise both direct emissions (i.e. burning gas/oil for heating) and indirect emissions (i.e. from electricity consumption). However, one challenge is the limited granularity of the available information: data on GHG emissions are typically available only at the national scale, using simple averages, hence, there is limited understanding of GHG emissions from the residential sector at the neighbourhood and city levels, or across territories.[2] Additionally, even where available, such data are not always disaggregated according to households' characteristics, such as household type, housing tenure and dwelling type (OECD, 2019[1]), although (Hargreaves et al., 2013[50]) found that household characteristics such as the number of bedrooms, the number of occupants and the property type were relevant for determining energy use in the home. Securing sufficiently granular data may help to design a more effective roadmap for reducing GHG emissions in the housing sector.

2.2.2. The state of housing in OECD countries

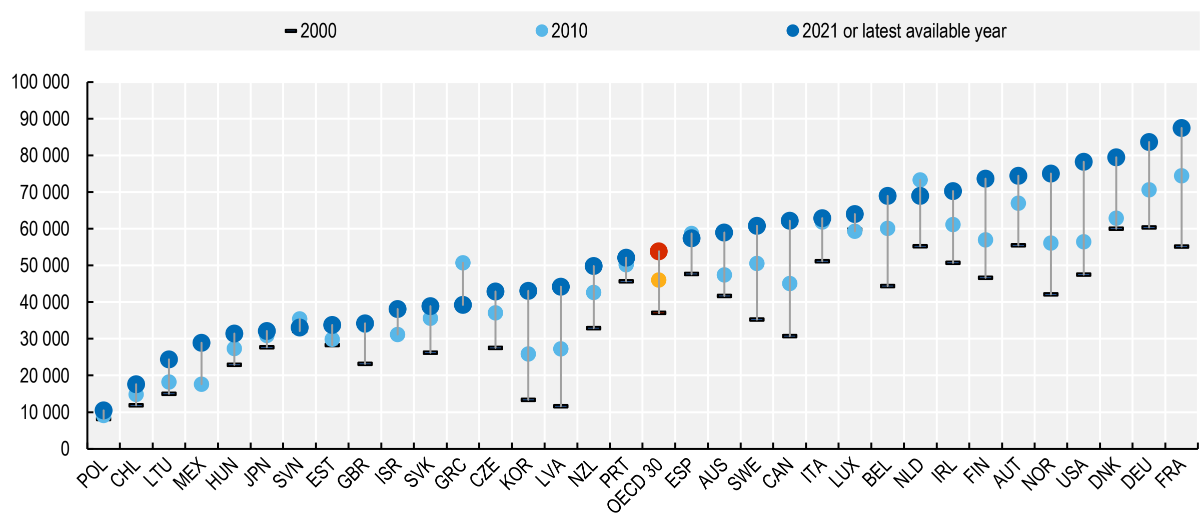
Housing quantity

In 2021, the OECD average real monetary market stock value of residential buildings per person was close to USD 54 000 (Figure 2.4). The real monetary market stock value of residential buildings per capita is the highest (over USD 80 000) in Germany and France, and the lowest (below USD 20 000) in Poland and Chile. Between 2000 and 2021, the OECD average real monetary market value of residential buildings cumulatively increased by nearly 45%, with a 17% cumulative increase between 2010 and 2021 (up from around USD 37 000 per capita in 2000 and from USD 46 000 per capita in 2010). The largest increases occurred in Latvia and Korea, where the cumulative real increase since 2000 was more than

200%, and more than 60% since 2010, with the largest drop examined in Greece (-23% since 2010). Again, the monetary stock value of housing should be interpreted with caution; for example, high values could signal an increase in housing prices or an increase in housing supply, or both.

Figure 2.4. The real monetary market stock value of residential buildings has cumulatively increased by nearly 45% since 2000 in OECD countries, on average

USD per capita at 2015 PPPs



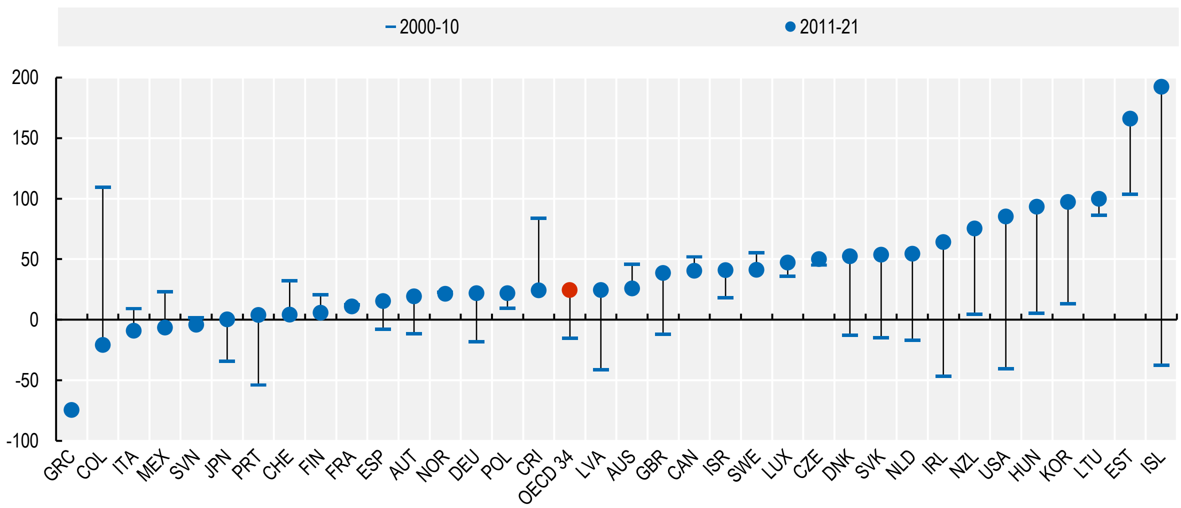
Note: The latest available year is 2021 for Australia, Belgium, Canada, Chile, the Czech Republic, Denmark, France, Finland, Korea and the United States; 2019 for Estonia, Greece, Latvia, Lithuania, Norway, Poland and Sweden; 2017 for New Zealand, and 2020 for all the other countries. The OECD average excludes Colombia, Costa Rica, Greece, Iceland, Israel, Mexico, Switzerland and Türkiye, due to lack of data or breaks in the series.
Source: OECD Calculations based on the OECD *National Accounts Statistics* (database): 9B. Balance sheets for non-financial assets, http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE9B.

StatLink https://stat.link/gz09la

In terms of total public and private investment in residential buildings in the OECD area, on average, this cumulatively grew by 24.4% over the last decade (2011-21) (Figure 2.5). It is up from -15.4% in the previous decade (2000-10), a reduction that was an outcome of the global financial crisis, which itself originated in the housing sector. The size of investment in residential buildings varies more widely than for the overall built environment across OECD countries, from a cumulative negative investment in Greece and Colombia to a cumulative increase of 100% or more in Lithuania, Estonia and Iceland over the 2011-21 period.

Figure 2.5. OECD average investment in residential buildings cumulatively grew by 24.4% over the last decade (2011-21), up from -15.4% in the previous decade (2000-10)

Cumulative growth, percentage



Note: The latest available year is 2021, except for Colombia, Japan and New Zealand (2020). The OECD average excludes Belgium, Chile, Greece and Türkiye, due to lack of data or breaks in the series. Cumulative growth is calculated on investment in constant prices and constant PPPs.
Source: OECD Calculations based on the OECD *National Accounts Statistics* (database): 1. Gross domestic product, http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE1.

StatLink https://stat.link/hyflm9

Housing quality

Housing quality is a multidimensional concept, profoundly impacting people's lives and well-being. This section explores some of the main quality features of housing, such as affordability, the availability of indoor space and the presence of basic facilities, as well as people's concern for finding and maintaining adequate housing. *(For a detailed description of the indicators included, please refer to Annex 2.A.)*

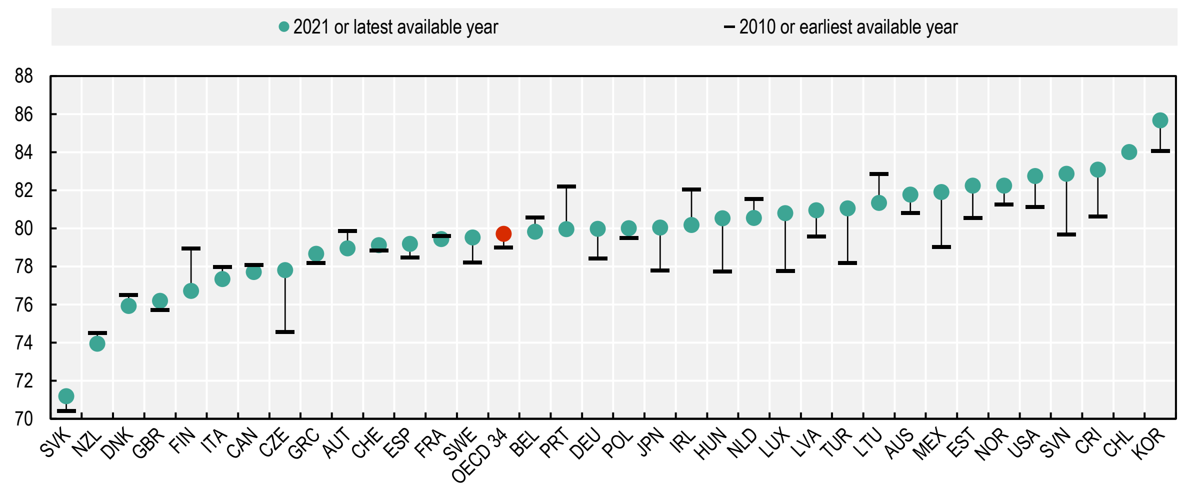
Housing affordability

Ensuring housing affordability is closely intertwined with securing an adequate stock of housing. Affordability is a relative concept, as it depends on the amount of economic resources one has and also on how much housing costs weigh on them. When a high share of disposable income is spent on housing costs, this reduces what households can afford to consume and save to support other aspects of their well-being (OECD, 2020[51]). The housing affordability indicator presented below accounts for housing current expenditures, which include rent (also imputed rentals for housing held by owner-occupiers) and maintenance (expenditure on the repair of the dwelling, including miscellaneous services, water supply, electricity, gas and other fuels, as well as expenditure on furniture, furnishings, household equipment and goods and services for routine home maintenance), but does not include mortgage payments or upfront costs such as a deposit. It should be noted that some concerns have been raised about how well this indicator captures different country contexts. For instance, this indicator does not directly capture the upfront costs (e.g. deposit) or mortgage serviceability costs of housing. In Australia, the time required to save for a 20% deposit worsened since the start of the pandemic (Commonwealth of Australia, 2022[52]).

In 2021 or the latest available year, households in 34 OECD countries had, on average, 80% of their disposable income available after accounting for their housing current expenditures, slightly more than in 2010 (Figure 2.6). This share is the lowest in New Zealand and the Slovak Republic, where it fell below 75%, and the highest in Costa Rica, Chile and Korea, where it exceeded 83%. The average small improvement in the OECD masks diverging trends across member countries: since 2010, the Czech Republic, Luxembourg and Slovenia gained 3 percentage points or more, while Finland and Portugal lost more than 2 percentage points.

Figure 2.6. The average OECD household has 80% of disposable income left after housing costs

Percentage of household gross adjusted disposable income remaining after deductions for housing rent and maintenance



Note: The latest available year is 2020 for Chile, Costa Rica, Japan, Mexico, New Zealand, Switzerland, and 2017 for Türkiye. The OECD average excludes Chile, Colombia, Iceland and Israel due to a lack of data.
Source: OECD calculations based on "5. Final consumption expenditure of households" and "14A. Non-financial accounts by sectors", OECD *National Accounts Statistics* (database), http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE5 , http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE14A, as available from the *OECD How's Life? Well-being* (database), https://stats.oecd.org/Index.aspx?DataSetCode=HSL.

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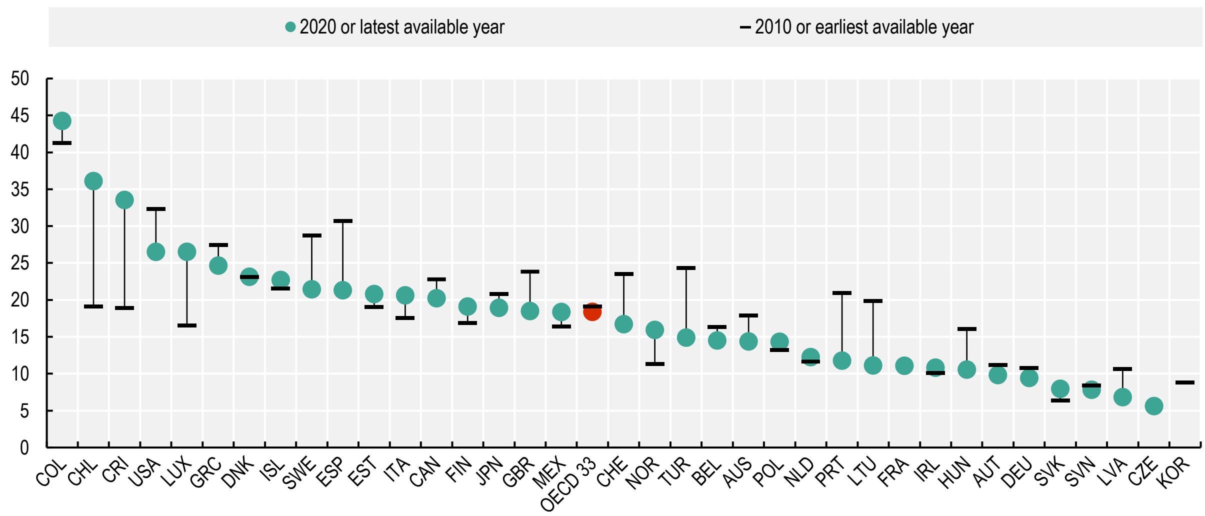
When taking into account rent and mortgage costs, lower income households bear the larger burden of housing costs: 18.4% of the households in the bottom 40% of the income distribution spent more than 40% of their disposable income on rent and mortgage costs in 2020 or the latest available year (Figure 2.7). Overburden rates are highest (above 30%) in Colombia, Chile and Costa Rica and lowest in the Czech Republic, Latvia, Slovenia and the Slovak Republic (below 9%).

Figure 2.7. Almost 20% of lower income households in OECD countries spend more than 40% of their income on housing (i.e. rent and mortgage costs)

Percentage of households in the bottom 40% of the income distribution spending more than 40% of their disposable income on total housing costs



Note: The latest available year is 2019 for Germany and Italy, 2018 for Canada and Iceland, and 2017 for Chile. The earliest available year is 2011 for Chile and Costa Rica, 2012 for Belgium, Colombia, Hungary and Korea. The OECD average excludes the Czech Republic, France, Israel, Korea and New Zealand, due to lack of data.
Source: OECD Affordable Housing Database, http://www.oecd.org/social/affordable-housing-database.htm.

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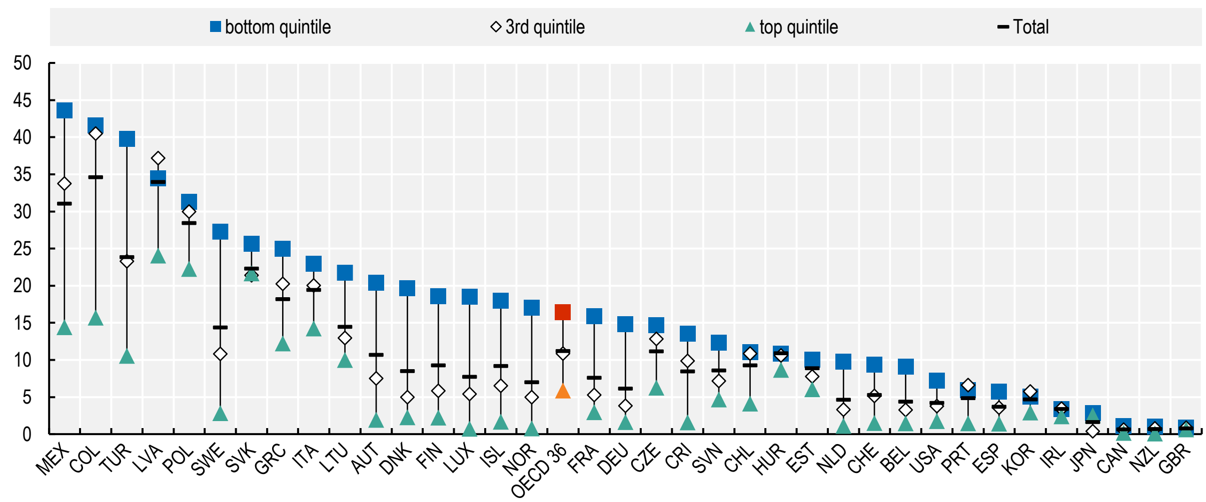
Housing space

The availability of adequate space for each dweller is fundamental in ensuring privacy, personal space, and physical and mental health. While there is no globally agreed standard to define an adequate housing space, the European Union (EU) has set some criteria to measure overcrowding. The EU-agreed definition accounts for different needs for living space according to the age and gender composition of the household (Eurostat, 2023[53]). It defines housing as overcrowded if less than one room is available in each household: for each couple in the household; for each single person aged 18 or more; for each pair of people of the same gender between 12 and 17; for each single person between 12 and 17 not included in the previous category; and for each pair of children under age 12. This report will use this overcrowding measure, included in the OECD Affordable Housing database and in the OECD Well-being Framework.

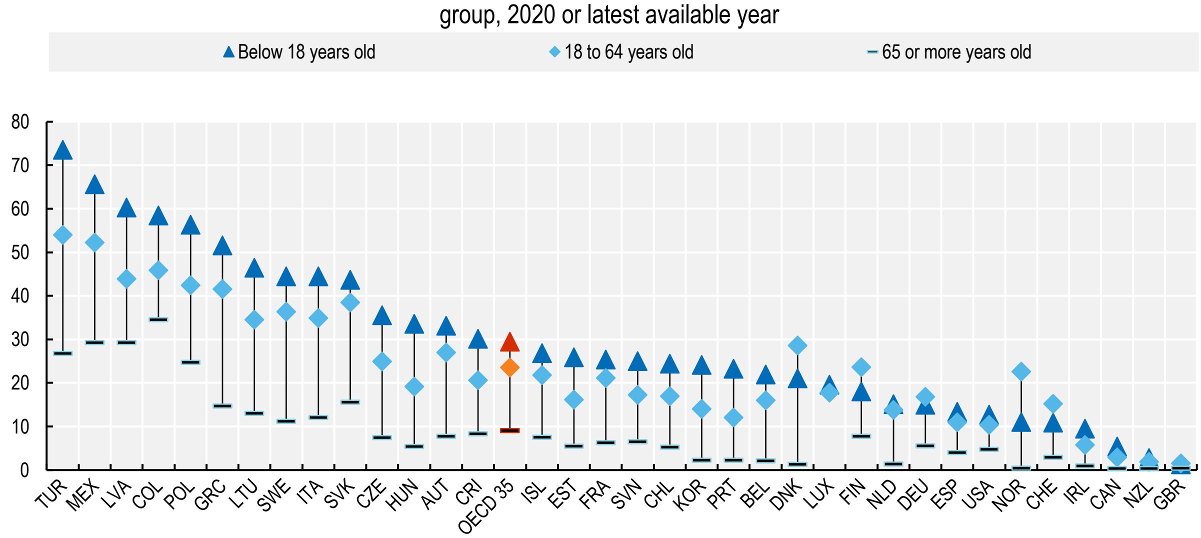
There are large differences across OECD countries in terms of overcrowding rates. The issue of overcrowding was highlighted during the COVID-19 pandemic, associated with people's physical and mental health. In 2020, on average, the overcrowding rate stood at just above 10% in the OECD countries (OECD, n.d.[54]), but was 16% among households in the lowest income quintile (Figure 2.8, Panel A). Age is an important factor that affects people's exposure to housing overcrowding: nearly 30% of children in the poorest households live in overcrowded conditions, more than the working age (24%) and older age populations (9%) (Figure 2.8, Panel B).

Figure 2.8. Overcrowding stands just above 10% on average in the OECD, but is 16% among households in the lowest income quintile, 30% of whom are children

Panel A. Percentage of overcrowded households, by quintiles of the income distribution, 2020 or latest available year



Panel B. Percentage of the population in the bottom quintile of the income distribution living in overcrowded dwellings, by age group, 2020 or latest available year



Note: Low-income households are households in the bottom quintile of the (net) income distribution. Gross income is considered for Chile, Colombia, Mexico, Korea, Türkiye and the United States, due to data limitations. In the United Kingdom, net income is not adjusted for local council taxes and housing benefits, due to data limitations. Data for Canada are adjusted by Statistics Canada based on the assumption of the presence of a kitchen in dwellings where it is expected, and income quintiles are based on adjusted after-tax household income. In Panel A, data refer to the population rather than households for Japan, as data are available only at respondent level. The OECD average excludes Australia, Israel and Japan (Panel B only), due to lack of data.

Source: *OECD Affordable Housing Database*, http://www.oecd.org/social/affordable-housing-database.htm.

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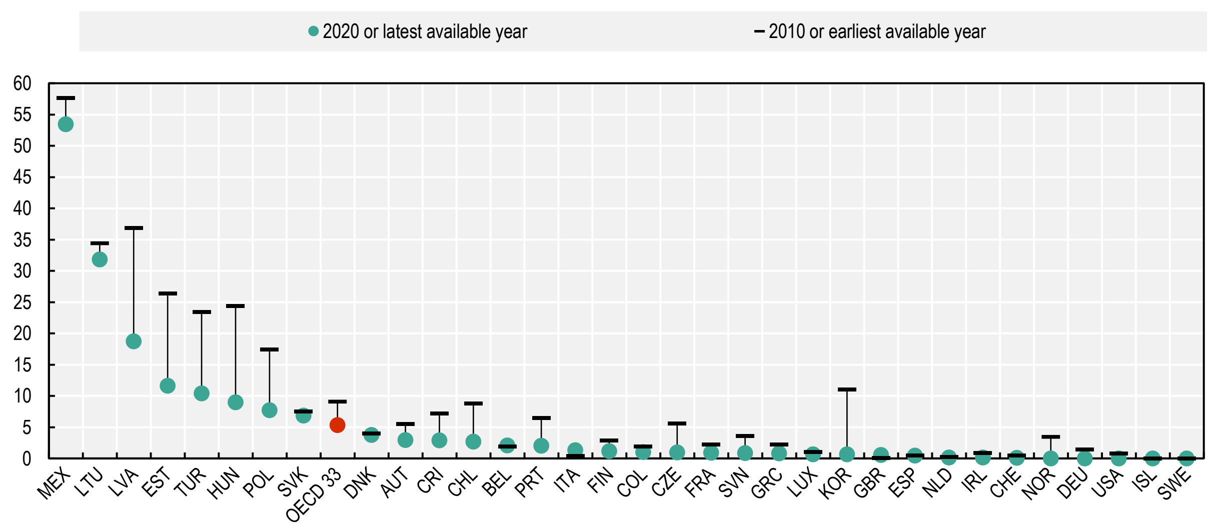
Housing basic facilities

Certain facilities, such as a toilet, bath or shower, are essential in housing to ensure people's basic needs are met. Although there is almost no lack of housing basic facilities[3] on average across OECD countries, the evidence suggests that more could be done for the poorest households, those with below 50% of median equivalised disposable household income. There is a high correlation between the availability of a toilet and that of a bath or shower, so the evidence on the former was studied. To ensure that not only the availability, but also the quality of the toilet is taken into consideration, data are presented for indoor flushing toilets for the sole use of the household.[4] **The percentage of poor households without an indoor flushing toilet differs widely across OECD countries** (Figure 2.9). The situation improved in the last decade on average, with the percentage of households lacking basic sanitation falling from 9% in 2010 to around 5% in 2020. However, the persistent gap lingers between OECD countries, with 20% or more poor households lacking basic sanitation in countries like Mexico, Lithuania and Latvia, while that percentage stands at 1% or less for half of OECD countries.

Figure 2.9. The percentage of poor households lacking basic sanitation in OECD countries ranges from less than 1% to more than 50%

Percentage of households below 50% of median equivalised disposable household income without indoor flushing toilet



Note: The latest available year is 2019 for Germany and Italy, and 2018 for Iceland. The earliest available year is 2011 for Chile and 2012 for Colombia. The OECD average excludes Australia, Canada, Israel, Japan and New Zealand, due to lack of data.
Source: *OECD Affordable Housing Database*, http://www.oecd.org/social/affordable-housing-database.htm.

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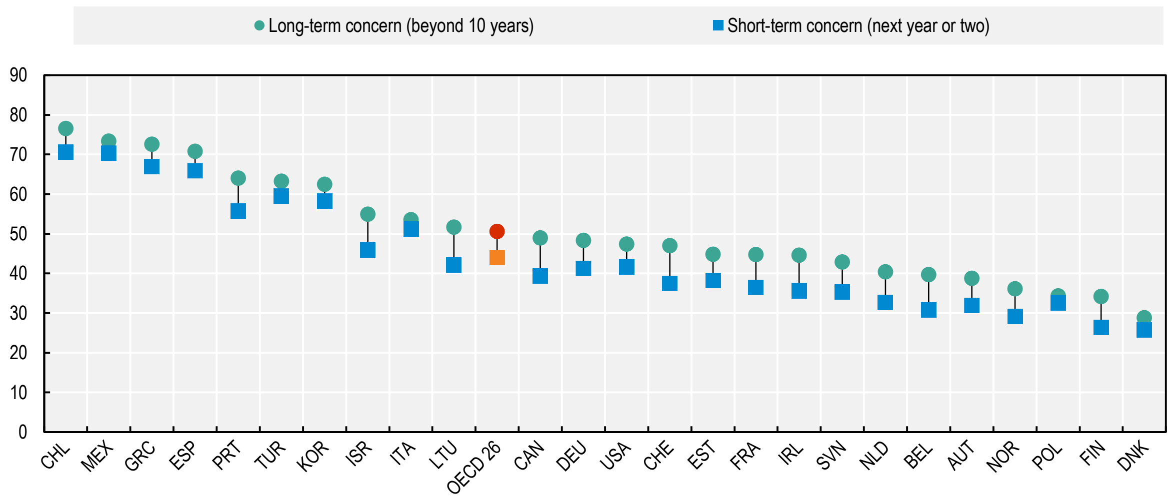
Housing distress

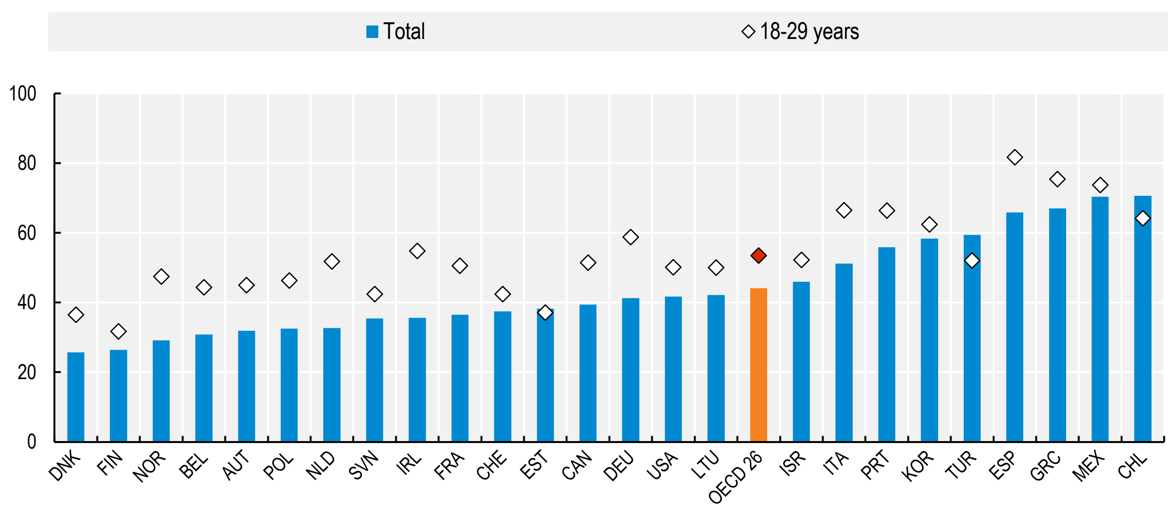
Housing is a major concern for many people in OECD countries. Finding and maintaining adequate housing is both a short and long-term concern, although people are more concerned about housing in the long term than in the short term. According to the *OECD Risks that Matter* survey, more than half of the respondents were somewhat concerned or very concerned for the next 10 years with regards to the availability of adequate housing (Figure 2.10, Panel A). Young people (18-29 years) were more concerned than the older generations about housing, except in Chile, Türkiye and Estonia (Figure 2.10, Panel B).

Figure 2.10. Finding and maintaining adequate housing is a concern in the short and long term, especially among young people

Panel A. Percentage of respondents reporting being either "somewhat concerned" or "very concerned" by not being able to find or maintain adequate housing in the short and long-term, 2020



Panel B. Percentage of respondents reporting being either "somewhat concerned" or "very concerned" by not being able to find/maintain adequate housing in the next year or two, by age group, 2020



Note: The OECD average excludes Australia, Colombia, Costa Rica, the Czech Republic, Hungary, Iceland, Japan, Latvia, Luxembourg, the Slovak Republic, Sweden, Türkiye and the United Kingdom, due to lack of data.
Source: OECD Secretariat estimates based on OECD *Risks That Matter* 2020 survey, http://oe.cd/rtm, as reported in the OECD *Affordable Housing* database, http://www.oecd.org/social/affordable-housing-database.htm.

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2.3. Well-being and the built environment: Transport

2.3.1. The inter-relationship between well-being and transport

Transport enables human activity by connecting people and places. Given this important role, its characteristics and performance can profoundly influence people's well-being and access to opportunities. Transport can also negatively impact well-being: threatening users' safety through traffic accidents and people's health through air pollution; or increasing economic and social inequalities as well as the social exclusion of vulnerable population groups, when planned without accounting for the needs of all population groups. Moreover, transport contributes to climate change, being a significant emitter of global greenhouse gases (GHG) and can cause habitat loss and degradation (OECD, 2019[1]).

Material conditions and economic capital

Consumption

No internationally agreed methodology on transport affordability exists yet. The United Nations, in the *UN SDG Indicator 11.2.1. methodology* on transport accessibility, suggests that it is measured as "the percentage of household income spent on transport of the poorest quintile of the population", indicating that the percentage spent on transport should not exceed 5% of the average net income of households in the poorest quintile (UN, 2021[55]). The European Commission measures transport affordability as the "share of the poorest quartile of the population's household budget required to hold public transport passes (unlimited monthly travel or equivalent) in the urban area of residence" (European Commission, 2021[56]).

Rising fossil fuel prices impact the transport sector in a multidimensional way. As most transport modes rely on the use of petroleum products, a rise in fossil fuel prices impacts several dimensions of the transport system. Possible structural impacts include, for instance, changes in usage levels – users limiting or rationalising their usage, for example by abandoning, postponing or combining their trips. Operators might also reduce service frequency. Modal shifts can occur – part of the traffic can shift to a more energy-efficient mode that suffers less from higher petrol fuel prices, for instance, from road freight transport to rail or inland waterways (Bassot, 2023[57]). While initially passengers (or companies) could simply absorb the higher costs by reducing usage, trimming their profits or cutting their spending in other areas, in a subsequent phase, there could be changes in commuting patterns (like ridesharing or carpooling), attempts to use public transport, rapid adoption of vehicles with high fuel efficiency, and a search for other transport alternatives (Bassot, 2023[57]). Higher transport prices could become an additional burden for households and possibly lead to transport poverty (Kiss, 2022[58]), unless this is compensated at regional or national level. Low-income households that own a car, and rural households spending a higher share of their income on transport fuels, are particularly impacted (Ari et al., 2022[59]).

Work and job quality

Transport broadens people's work opportunities. With the possibility to commute, workers are no longer constrained to work locally and can seek out better employment opportunities further from home. Both the accessibility and affordability of public transport are particularly important for the inclusion of low-income people. Evidence suggests that low-income people suffer more from restricted transport options, have lower quality transport services available to them and travel under worse conditions (safety, security, reliability, comfort). Broad evidence also suggests that the lack of, or poor access to, transport options limits access to jobs, education, health facilities, social networks, etc., which in turn generates a "poverty trap" (ITF-OECD, 2017[60]). People in disadvantaged communities often have less well-maintained infrastructure – notably roads and more limited access to reliable public transport services (OECD, 2018[61]). Lack of public transport connections between minority neighbourhoods and employment centres hinders job opportunities. For example, in a neighbourhood with 1 percentage point higher share of white residents in US cities, a resident could reach 18 more jobs within a 30-minute commute on public transit (OECD, 2018[62]).

There is also a clear link between commuting time, commuting mode and job satisfaction. Findings from the *Commuting & Wellbeing Study* (Chatterjee et al., 2017[63]) indicate that longer commutes lead to decreased job satisfaction (especially for women), reduce leisure time satisfaction (with the impact growing over time), increase strain and reduce mental health. Working from home, walking to work and shorter commute times promote job satisfaction and job retention. Walking and cycling to work increase leisure time satisfaction and walking to work decreases strain. Cycling to work is associated with better self-reported health. Bus commuters feel the negative impacts of longer commute journeys more strongly than users of other transport modes.

The COVID-19 pandemic has changed commuting practices in the short and potentially long term. Prior to the pandemic, commuting to work was a necessary, almost daily activity for most workers. With the pandemic and the necessity, where possible, to work from home, employees and their employers discovered that many work tasks could be performed remotely. High-skilled workers, in particular, benefited more from teleworking opportunities than those in low-skilled occupations. The impacts of the pandemic are further changing work practices in ways that are still unfolding. This has implications for transport: potential benefits, such as reduced traffic congestion, but also challenges for public transport management and maintenance, such as those related to large drops in public transit ridership (Vielkind, 2023[64]).

Economic capital

Transport enables economic development by connecting people, goods and services. Together with housing and other real estate properties, transport equipment, such as vehicles, is an element enhancing both personal economic wealth and countries' economic capital. Moreover, transport infrastructure, such as roads, railways, and airports, is an enabler of economic development. It connects people and places and provides people with access to jobs, other activities and services, firms with access to stakeholders and markets, and cities and regions with access to other cities, to other regions and to the global economy. Building and maintaining transport infrastructure has always been a necessary condition for economic development and remains especially important for economically weaker regions (OECD, 2020[65]).

Quality of life, human capital and natural capital

Environmental quality and natural capital

Road traffic is responsible for air pollution, which is one of the greatest environmental risks to health (WHO, 2022[66]). It is responsible for an average of 25% of ambient (outdoor) PM2.5 in urban areas worldwide. Fine particulate matter (PM2.5) is an air pollutant that can be inhaled and cause serious health problems, including both respiratory and cardiovascular diseases. 62% of people across the OECD are exposed to more than 10 micrograms/m^3 of PM2.5, above the WHO threshold level (OECD, 2023[67]), and more than 373 000 people across the OECD prematurely died of causes related to ambient PM pollution in 2019 (OECD, 2023[68]).

Emissions of particulate matter (PM) from motor vehicles originate from two main sources: exhaust and non-exhaust. One source of transport air pollution is the combustion of fossil fuel, which is emitted via tailpipe exhaust. The other source is non-exhaust processes, including the degradation of vehicle parts and road surfaces and the resuspension of road dust. While PM emissions from exhaust sources are still prevalent, but falling, PM emissions from non-exhaust sources are rising. With stringent controls on tailpipe emissions and increased take-up of electric vehicles, the amount of particulate matter from exhaust sources is continuing to fall, while non-exhaust emissions are expected to comprise the vast majority of particulate matter pollution from road transport as early as 2035 (OECD, 2020[69]). Also, although electric vehicles are estimated to emit slightly less PM10 from non-exhaust sources than conventional vehicles, heavier-weight electric vehicles are estimated to emit more PM2.5 than conventional vehicles (OECD, 2020[69]). Underground railway activity also emits PM from non-exhaust sources and in France, airborne particle concentrations (PM10, PM2.5 in $\mu g/m^3$) underground were on average three times higher than in urban outdoor air (ANSES, 2022[70]).

Greenhouse gas (GHG) emissions from transport accounted for around 23% of OECD energy-related emissions in 2020. GHG emissions from passenger transport are correlated with household characteristics and location. Hargreaves et al. (2013[50]) have investigated the differences in emissions from passenger transport (private cars, public transport and international aviation) and have found that passenger transport-related emissions are highly dependent on variables such as income, location and the number of workers in the household. Differentiating policy stringency according to household characteristics with distributional relevance, such as income, geographic location and accessibility, can improve the equity of policy outcomes (Lindsey, Tikoudis and Hassett, 2023[71]).

Finally, transport can damage habitats in three main ways: habitat loss, fragmentation and degradation. The European Commission's *Handbook on the external costs of transport* (European Commission, 2020[72]) identifies three main ways habitats are damaged: habitat loss (i.e. ecosystem loss, which can result from additional land being dedicated to transport, with important impacts on biodiversity); habitat fragmentation (i.e. division of ecosystems due to transport projects, e.g. motorways or railways); and habitat degradation (i.e. negative impacts on ecosystems owing to the release of air pollutants and other toxic substances, e.g. heavy metals). While the document also acknowledges other possible negative impacts (e.g. visual intrusions, light emissions from vehicles), it focuses on the aforementioned three impacts, and estimates the total cost of habitat loss and fragmentation for the EU28 in 2016 at EUR 39.1 billion.

Safety

In 2021, road deaths across the OECD were nearly 5 per 100 000 population (OECD, n.d.[54]). The number of road deaths and casualties is often used as a key indicator of road safety. The latest report by the International Traffic Safety Data and Analysis Group (IRTAD)[5] provides comparable indicators at the national level that reflect the current state and evolution of road safety for different user and age groups, road types and severity of injuries, as well as deaths. In 2021, road deaths were below the long-term trend, with a significant fall in road-crash deaths in most countries and for all users, except for users of powered two-wheelers. The number of pedestrian fatalities also fell in most countries, except the United States and the United Kingdom (ITF, 2022[73]). In particular, pedestrians, cyclists and motorcyclists make up 80% of fatalities in dense urban areas, which is why cities are encouraged to focus on protecting vulnerable road users (ITF, 2018[74]). Transport safety is also a major concern for women. Safety concerns shape the transport behaviour of women more than men across all transport modes, making it their top priority for using public transport. Although women are generally more dependent on public transport than men, surveys show that a large majority of women worldwide feel unsafe in public transport and that many have been victims of physical or verbal harassment when using it or moving in public spaces. Therefore, when possible, women often prefer driving over walking, cycling or public transport due to safety reasons. When driving, women are three times less likely to die in road traffic than men (ITF, 2023[75]).

Improved road safety can unlock a transport modal shift and indirectly support public health and climate change mitigation. The indirect benefits of road safety go beyond the prevention of crashes and the energy and material implications of repairing or scrapping vehicles (OECD, 2019[1]). Safer streets increase confidence to walk, cycle or use public transport (which generally implies longer walking segments on journeys) (Mueller et al., 2018[76]). This improves the health of the population, which is more physically active, and can also reduce the amount of private motor-vehicle traffic and the related GHG emissions and local pollution. Thus, safer roads can support climate change mitigation strategies that focus on a modal shift towards more walking and cycling. Conversely, low levels of road safety may hamper the effectiveness of these strategies, as discouraging people from shifting towards non-motorised modes. Road safety is then a necessary condition for broader policy objectives related to public health, inclusiveness and climate change mitigation (OECD, 2019[1]).

Physical and mental health

Active transport modes (walking and cycling) bring benefits from physical exercise. Physical activity is an important determinant of health. Physiologists distinguish between moderate-intensity physical activity, which includes activities such as gardening, dancing, walking, and higher-intensity activities, such as fast swimming or running. A vast body of epidemiologic literature has associated moderate-intensity physical activity, such as walking, with reducing the risk of a large number of health outcomes, including all-cause mortality, cardiovascular disease, several types of cancer, type 2 diabetes, dementia, depression, excessive weight gain, feelings of anxiety and depression, and sleep difficulties (2018 Physical Activity Guidelines Advisory Committee, 2018[77]). Physical activity has been linked to bone strength, improved cognitive and physical function, and reduced risk of injury associated with falls among the elderly (WHO, 2022[78]), and for school-age academic achievement (Barbosa et al., 2020[79]). Research related to commuters also suggests that active commuting has a positive effect on work performance and reduces sick leave (Ma and Ye, 2019[80]; Hendriksen et al., 2010[81]; Mytton, Panter and Ogilvie, 2016[82]).

Noise from transport is an external cost that causes harm to health. Most community noise in cities comes from road traffic. In addition to annoyance, environmental noise negatively impacts physical and mental health. It increases the risk for ischemic heart disease (IHD) and hypertension, sleep disturbance, hearing impairment tinnitus and cognitive impairment, and there is growing evidence of other health impacts, such as adverse birth outcomes and mental health problems (WHO, 2022[83]; 2018[84]). While improvements in vehicles and roads are expected to reduce noise from transport, growing urbanisation (which increases exposure) and rising traffic volumes are expected to increase the overall negative impacts (European Commission, 2020[72]). The European Environment Agency (EEA) estimates that 1 out of 4 Europeans (i.e. 125 million people) suffer negative impacts from road traffic owing to noise exceeding a 55 decibels (dB) Lden[6] annual average, which is above the threshold for considering noise a nuisance, a level that could also be set at 50 dB Lden (OECD, 2019[1]). According to the European Commission's Handbook on External Costs of Transport, the total cost[7] of noise generated by transport in the EU 28 for 2016 is estimated at EUR 63.6 billion, with 67% of this stemming from passenger transport and 23% from freight road transport (European Commission, 2020[72]).Noise from air transport (airplanes and airports) is increasing and also causing harm. The average noise exposure around major EU 27 and EFTA airports significantly increased during the five years preceding the COVID-19 outbreak with the population exposed to 55 dB Lden and 50 dB Lnight[8] respectively 30% and 50% larger in 2019 than in 2005 (EASA, 2022[85]).

2.3.2. The state of transport in OECD countries

Infrastructure stock

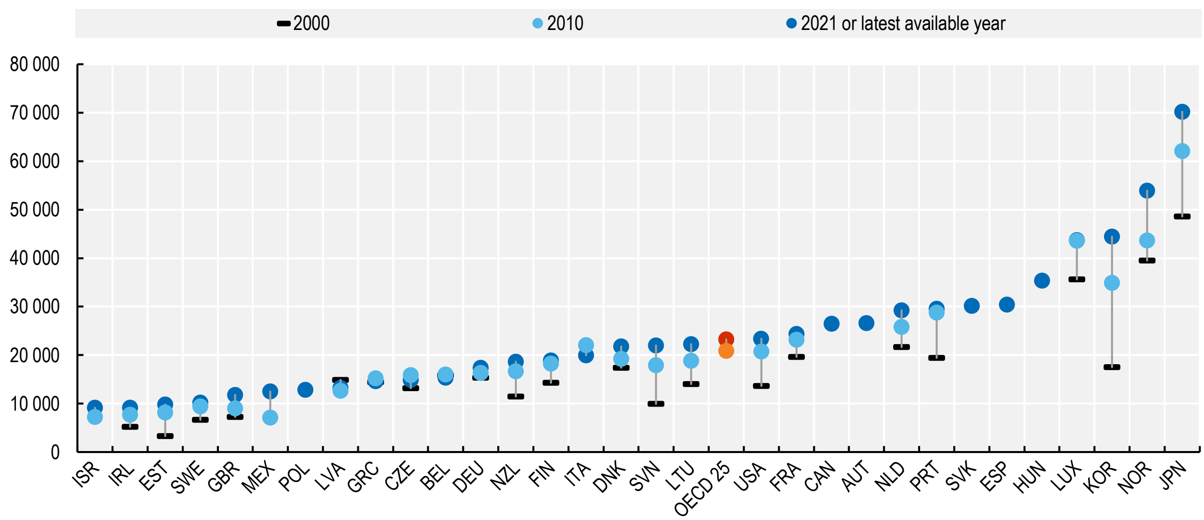
As previously mentioned, it is not possible to disaggregate the information on the monetary market stock value of the different types of infrastructure, as only an aggregate stock measure of the overall infrastructure/civil engineering works that involves the transport sector is available. This section first presents the monetary market stock value of the overall infrastructure and how it has evolved over time, and then it explores the quality of public transport, as available from internationally comparable data. (*For detailed descriptions of the indicators included, please refer to Annex 2.A)*

In 2021, the OECD average real monetary market stock value of infrastructure per person was close to USD 23 000 (Figure 2.11). It is the highest (over USD 50 000) in Japan and Norway, and the lowest (below USD 10 000) in Israel, Ireland and Estonia. As 2000 data are available only for a limited number of countries, the evolution of the real monetary market value of infrastructure is assessed over the period

2010-21. Between 2010 and 2021, the OECD average real monetary market value of infrastructure cumulatively increased by 12%, up from around USD 21 000 per capita in 2010. The largest increases occurred in Mexico, the United Kingdom, Israel and Korea, with a cumulative increase of more than 25% since 2010, and the largest falls occurred in Italy and the Czech Republic (-9% and -6%, respectively).

Figure 2.11. The market value of infrastructure cumulatively increased by 12% on average, between 2010 and 2021 in OECD countries

USD per capita at 2015 PPPs



Note: The latest available year is 2021 for Belgium, the Czech Republic, Denmark, France, Finland, Korea and the United States; 2019 for Estonia, Greece, Latvia, Lithuania, Norway, Poland and Sweden; 2017 for New Zealand; and 2020 for all the other countries. The OECD average excludes Australia, Austria, Canada, Chile, Colombia, Costa Rica, Hungary, Iceland, Poland, the Slovak Republic, Spain, Switzerland and Türkiye, due to lack of data or breaks in the series.
Source: OECD Calculations based on the OECD *National Accounts Statistics* (database): 9B. Balance sheets for non-financial assets, http://stats.oecd.org/Index.aspx?DataSetCode=SNA_TABLE9B.

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Transport quality

Internationally comparable data on transport quality shed some light on the accessibility and effectiveness of transport, despite some of these data being limited to larger metropolitan areas. Worldwide data on accessibility to public transport are calculated to track progress on SDG indicator 11.2.1 under the coordination of the United Nations Human Settlements Programme (UN-Habitat), using a variety of sources (city administration, transport service providers or, when these are not available, geospatial data such as those from open data sources, such as OpenStreetMap, Google and the General Transit Feed Specification - GTFS feeds), combined with local knowledge (UN, 2021[55]). More granular data on access to and the effectiveness of public transport modes are calculated by the OECD for large metropolitan areas. Internationally comparable data for other transport quality features, such as affordability, comfort, safety, sustainability and inclusiveness, are still lacking or limited to a restricted number of countries.[9] The use of advanced information and communications technology to improve transport users' convenience in their trips, or "smart mobility", can enhance people's well-being and help to close this information gap (Box 2.1).

Box 2.1. Smart Mobility and Well-being: Leveraging advanced traffic information and communications technology to improve people's lives

- ***"Mobility as a service (MaaS)*"** is a type of service that, through a joint digital channel, enables users to plan, book and pay for multiple types of mobility services (Mladenović, 2021[86]). MaaS enables travellers to choose mobility solutions based on their travel needs. The movement towards MaaS is being fuelled by a myriad of innovative new mobility service providers, such as carpool and ridesharing companies, bicycle-sharing systems programmes, scooter-sharing systems and carsharing services as well as on-demand "pop-up" bus services. On the other hand, the trend is motivated by the anticipation of self-driving cars, which puts into question the economic benefit of owning a personal car over using on-demand car services, which are widely expected to become significantly more affordable when cars can drive autonomously.
- This shift is being further bolstered by improvements in the integration of multiple modes of transport into seamless trip chains, with bookings and payments managed collectively for all legs of the trip (Kamargianni et al., 2015[87]). Between the multiple modes, trips and payments, data is gathered and used to help people's journeys become more efficient. For governments, the same data informs decision-making when making improvements in regional transit systems, provided that the protection of personal data is ensured. The use of advanced information and communications technology to make transport users' trips more convenient, or ***"smart mobility"***, has the potential to enhance people's well-being. Developing indicators and collecting data on smart mobility can help countries better monitor the safety, sustainability and inclusiveness of these new types of mobility services.

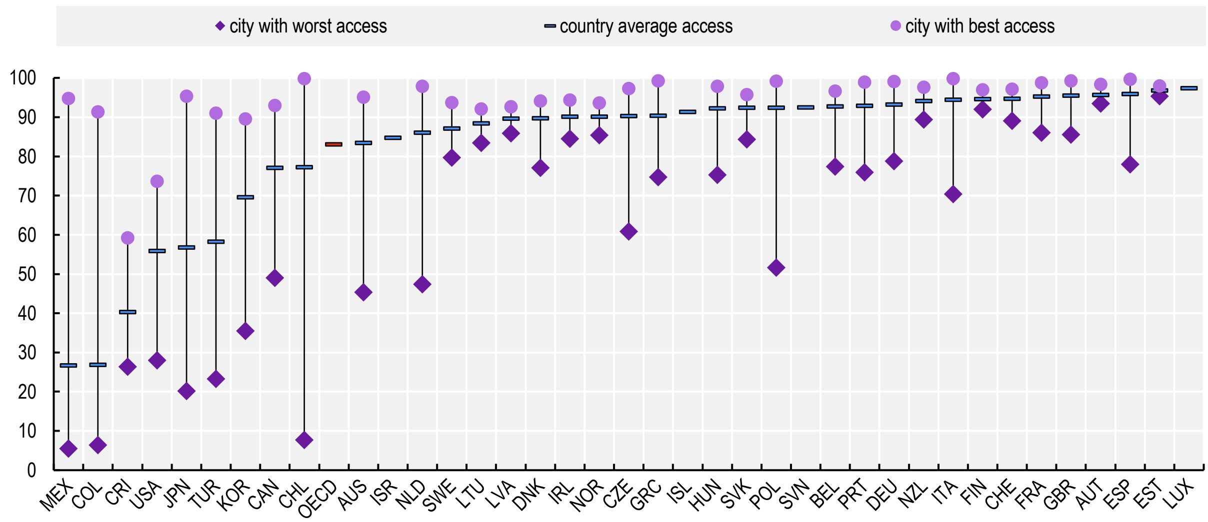
Accessibility of public transport

Accessibility to public transport is a crucial determinant of its usage. SDG indicator 11.2.1 measures the convenience of access to public transport. Access to public transport is considered convenient when a stop is accessible within a walking distance along the street network of 500 m from a reference point such as a home, school, workplace, market, etc., to a low-capacity public transport system (e.g. bus, Bus Rapid Transit) and/or 1 km to a high-capacity system (e.g. rail, metro, ferry). Additional criteria for defining public transport convenience include: 1) public transport that is accessible to all special-needs customers, including those who are physically, visually, and/or hearing-impaired, as well as those with temporary disabilities, the elderly, children and other people in vulnerable situations; 2) public transport with frequent service during peak travel times, and 3) stops present a safe and comfortable station environment (UN, 2021[55]). While the SDG indicator highlights the importance of inclusivity, internationally comparable granular data are available at subnational level for cities (such as in the OECD Programme on a Territorial Approach to the SDGs (OECD, n.d.[88])), but not by people's socio-economic characteristics.

Serious inequalities exist in convenient access to public transport across OECD cities with available data. More than 80% of the population had easy access to public transport in 2020 or the latest available year (Figure 2.12). However, there is a large gap between the cities with the best and the worst access in many countries, most starkly in Mexico, Colombia and Chile, where the gap is above 80 percentage points. Available data cover only the largest metropolitan areas, as defined by the *Degree of Urbanisation* (DEGURBA) (UN Statistical Commission, 2020[89]), but convenient access to public transport is more likely to be lower in smaller urban areas and rural areas, where public transport infrastructure is less developed.

Figure 2.12. More than 80% of the population in OECD large metropolitan areas have convenient access to public transport, but gaps exist between the cities with best and worst access

Percentage of the population that has convenient access to public transport in largest metropolitan areas, maximum, minimum and average country access, 2020 or latest available year



Note: The latest available year for Canada is 2016. The data and information on types of public transport available in each urban area, as well as the location of public transport stops, are obtained from city administration or transport service providers or, when these are not available, from geospatial data such as those from open data sources (e.g. OpenStreetMap, Google and the General Transit Feed Specification - GTFS feeds). The walking distance is calculated on the basis of the street network (as available from city authorities or from open sources such as OpenStreetMap). Data providers, on the basis of their local knowledge, exclude streets that are not walkable. Finally, the Network Analyst tool (in GIS) is used to identify service areas (i.e. regions that encompass all accessible areas via the streets network within a specified impedance/distance) around any location on a network. All individual service areas are merged to create a continuous service area polygon. The estimation of the population within the walkable distance to public transport is performed on the basis of individual dwellings or block level total populations, which is collected by National Statistical Offices through censuses and other surveys (UN, 2021[55]).
Source: *UN Global SDG Indicator Database*, indicator 11.2.1, https://unstats.un.org/sdgs/dataportal.

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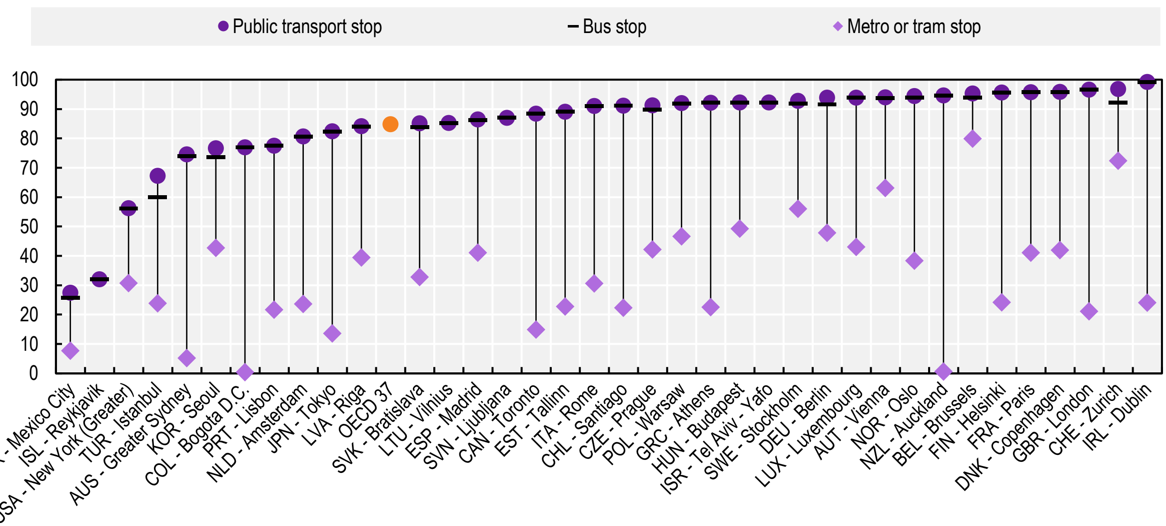
Buses are more accessible than the metro or tram in OECD large functional urban areas (Figure 2.13). The OECD, in cooperation with the European Union, has developed a harmonised definition of functional urban areas (FUAs) for metropolitan areas. FUAs are composed of a city and its commuting zone and encompass the economic and functional extent of cities based on people's daily movements (OECD, 2012[90]). The definition of an FUA aims at providing a functional/economic definition of cities and their area of influence, by maximising international comparability and overcoming the limitation of using purely administrative approaches. At the same time, the concept of an FUA, unlike other approaches, ensures a minimum link to the government level of the city or metropolitan area. Granular data on accessibility to different public transport modes is calculated using geospatial data and is limited to the largest OECD functional urban areas, due to the poor reliability of Open Street Map (OSM)[10] in identifying public transport stops in smaller cities or rural areas. 84% of the population have access to buses within a 10-minute walk, while only 33% to a metro or tram on average in OECD's FUAs with available data. The bus is also more widespread as a public transport mode than the metro or tram.

Figure 2.13. Accessibility to a bus is higher than to a metro or tram, in OECD's largest functional urban areas

Percentage of the population having access to a public transport stop within a 10-minute walk, by mode of transport, 2022



Note: The OECD average excludes Costa Rica, due to lack of data. Public transport accessibility is measured using Open Street Map (OSM) to get public transport stops. Data are limited to large OECD functional urban areas (i.e. above 250 000 inhabitants), due to the poor reliability of Open Street Map (OSM) in identifying public transport stops in smaller cities. The 2022 Mapbox isochrone API is then enabled to compute isochrones from the identified public transport stops to get to all the areas located within 10-minute walking distance. Finally, the Global Human Settlement Population layer 2015 is enabled to get the share of the population in each functional urban area (FUA) who have access to public transport in less than a 10-minute walk (OECD, 2022[11]).
Source: OECD *Regions and Cities, City statistics* (database), https://stats.oecd.org/Index.aspx?datasetcode=FUA_CITY.

StatLink https://stat.link/rh54cf

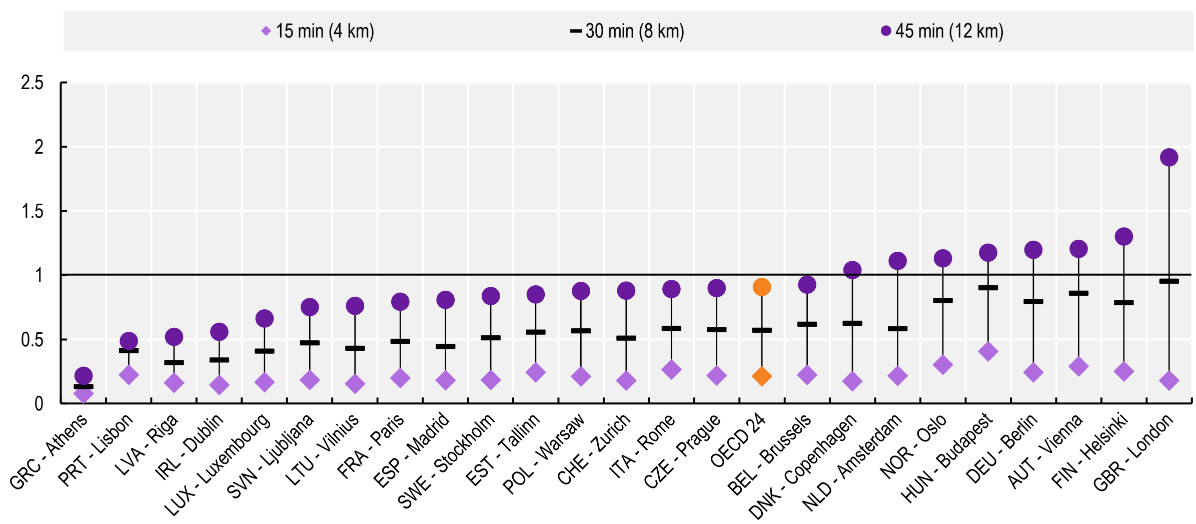
Effectiveness of public transport

Another important quality characteristic of public transport is its effectiveness. Combining geospatial data and modelling, the EC-ITF-OECD Urban access framework[11] (ITF, 2019[91]; OECD, 2020[65]) defines absolute accessibility and proximity, which are then used to compute transport effectiveness. Absolute accessibility is the total number of destinations that can be reached by a transport mode. It captures all the opportunities that are available to a resident, which are determined by the size and density of the city and the neighbourhood where someone lives, as well as by the transport network that connects the area to the rest of the city. Proximity captures the spatial concentration of trip origins and potential destinations. It is defined as the total number of services within a given distance, according to a model that assigns fixed average straight-line speeds to each mode based on typical average speeds in European cities (16 km/h for cars, public transport and cycling, 4 km/h for walking). It measures the number of destinations in "close" proximity to the origin, regardless of the effective travel time required to access them.

There is much room for improvement in public transport effectiveness in European capital cities. Transport effectiveness is computed as the ratio between the absolute accessibility for a given transport mode and proximity to potential destinations. A ratio of one or more means the transport mode performs well, as the number of accessible destinations through the transport mode is higher than those in proximity. A ratio close to zero means that the mode performs poorly, even in providing access to nearby destinations. In the case of public transport, the indicator captures the frequency of services, the in-vehicle speed, the number of transfers and the distance to the nearest bus stop or station, with as its effective performance is compared to a theoretical reference. Transport effectiveness is evaluated over three thresholds and an associated distance: 15 min (4 km), 30 min (8 km), 45 min (12 km) (ITF, 2019[91]). Public transport is effective (i.e. the indicator is higher than one) at a time threshold of 45 mins (12 km) and only in a limited number of European capital cities such as Oslo (Norway), Budapest (Hungary), Berlin (Germany), Vienna (Austria), Helsinki (Finland) and London (the United Kingdom) (Figure 2.14 Although the data presented here refer to the entire metropolitan area (and the effectiveness of the public transport of the respective city's urban centre may be better or worse than the results shown), it shows that overall even for longer time thresholds of 30 and 45 minutes, there is much room for improvement in terms of public transport effectiveness.

Figure 2.14. There is much room for improvement in terms of public transport effectiveness in European capital cities

Average public transport effectiveness in functional urban areas, by time thresholds and associated distance, 2018



Note: OECD 24 is the simple average of the 24 European capital cities included in the chart.
Source: OECD ITF Urban access framework, https://stats.oecd.org/Index.aspx?DataSetCode=ITF_ACCESS.

StatLink https://stat.link/9cuef2

2.4. Well-being and the built environment: Technical infrastructure

2.4.1. The inter-relationship between well-being and technical infrastructure

Infrastructure provides services essential to human life and health, such as drinkable water, power supplies or sewerage networks. Infrastructure should not be considered as a collection of individual assets, but rather as a system of assets that collectively has the potential to foster people's well-being and economic, social, human and environmental sustainability. This potential can be created throughout the entire life cycle of the infrastructure: it generates employment during its conception, construction and maintenance and, once built, it can spur economic activity connecting people to places and giving the possibility to perform human activities before sunrise or after sunset (through lighting) or in difficult weather conditions (through heating or cooling). Infrastructure can also play a key role in conserving natural resources and reducing the impact of climate change. Clean energy generation plants, for example, are critical in reducing dependence on fossil fuels. When it is designed to account for critical consideration of needs (i.e. who needs and gets what from infrastructure), infrastructure can contribute to equity. Finally, as infrastructure should itself be resilient to shocks, it helps to ensure the sustainability and resilience of human activities, as the services infrastructure provides are less vulnerable to extreme events and disruptions.

Water and sanitation

Access to safe water and sanitation is essential to human life and well-being. Water is a natural asset necessary to human life. Its access is a prerequisite to health, which is fundamental to the regular performance of human activities. Its importance has been recognised in Sustainable Development Goal 6, "Ensure access to water and sanitation for all". **Water is also a precious natural asset, increasingly under stress**. 60% of the global population could face water issues by 2050, with low-income families bearing the brunt of the water crisis (Romano, Lassman and Tardieu, 2022[92]). The UN defines *water stress* as the situation where the ratio of freshwater withdrawn to total renewable freshwater resources is above the 25% threshold (UN, 2022[93]). Annual water use represents more than 20% of internal water resources in close to one-third of OECD countries and some OECD countries, such as Israel, Korea, Spain and Türkiye also experience water stress (OECD, n.d.[94]). On the other hand, establishing protected marine areas can be helpful in preserving water and its biodiversity. In the OECD, the total marine protected areas, as a share of each country's exclusive economic zone, was almost 22% in 2022, ranging between below 1% in Israel, Iceland and Norway to above 40% in Australia, Chile, Germany and the United Kingdom (OECD, n.d.[95]). Not only the extension, but also the location of the protected areas is critical to the conservation of nature. One example are the marine key biodiversity areas (KBAs), of which more than half (55%), on average, is still not safeguarded (UN, 2022[93]).

Material conditions and economic capital

Measuring the affordability of water and sanitation is challenging. A common view is that tariffs are affordable if they ensure poor households' ability to afford access to adequate supplies of clean water (Leflaive and Hjort, 2020[96]). However, the amount of *adequate* clean water can vary across demographic characteristics and countries (Howard et al., 2020[97]). Expenditure for investment in infrastructure, such as upfront costs, also needs to be considered. Keeping tariffs artificially low for all customers, including those who can afford the full price of the service, can lead to a vicious cycle of decaying infrastructure and deteriorating services (Leflaive and Hjort, 2020[96]). This in turn hurts the poor the most, because, even where connected to a public service, poor households will need to procure water from private vendors (e.g. bottled water), often at greater cost (OECD, 2010[98]; OECD, 2013[99]).

While the majority of the urban population in OECD countries enjoy good water and sanitation services, further investment is necessary in water infrastructure due to urbanisation, climate change and water pollution. Economic growth and urbanisation are drivers for further investment in water supply systems, especially when these systems have already reached full capacity (e.g. Dublin in Ireland) (Leflaive and Hjort, 2020[96]). Another driver is climate change, as it causes uncertainty about future water demand and availability. Risks of prolonged droughts and heavier rains will translate into new infrastructure needs to store water or manage storm water (OECD, 2020[100]). Contaminants of emerging concern – such as pharmaceutical residues and microplastics – will also drive investment up, in order to adjust treatment capacities. Sludge management potentially adds another layer of costs (OECD, 2020[100]). Any past investment backlog will lead to infrastructure decay (e.g. non-revenue water) and degraded service quality, requiring further investment (Leflaive and Hjort, 2020[96]).

Quality of life, human capital and natural capital

Not only is access to water essential, but also its quality and safety. Safe drinking water is necessary for everyday domestic purposes, including drinking, food preparation and personal hygiene. Drinking unsafe water impairs health through illnesses such as diarrhoea, and untreated excreta contaminate groundwaters and surface waters used for drinking water, irrigation, bathing and household purposes.

Infants and young children, people who are debilitated and the elderly, especially when living in unsanitary conditions, are at greatest risk of waterborne disease. The WHO has defined Guidelines for drinking-water quality (WHO, 2022[101]), which cover a broad range of chemicals that can affect drinking-water quality. Drinking water is safe when it “does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages”.

Microplastics and pharmaceutical residues are increasingly raising concern for water quality, potentially affecting human health and ecosystems. Up to 3 million metric tons (Mt) of microplastics enter the environment every year (OECD, 2021[102]) and over 17 Mt of plastic entered the ocean in 2021 (UN, 2022[93]). Microplastics are one of the most pervasive emerging environmental issues, as tiny plastic fragments, particles and fibres now widely contaminate oceans, freshwaters, soils and air. Humans and aquatic species, from plankton to large mammals, are commonly exposed to microplastics via ingestion and inhalation. Although data gaps hinder reliable risk assessments, concerns are mainly driven by the presence in plastics of toxic chemicals and known or suspected endocrine-disrupting additives, as well as by the potential for microplastics to absorb persisting organic pollutants from the environment (OECD, 2021[102]). Pharmaceutical residues also pose grave concern. Residues of pharmaceuticals, such as hormones, antidepressants and antibiotics, have been detected in surface water and groundwater across the globe (OECD, 2019[103]).

Water should also be available in sufficient quantity. The daily consumption of sufficient safe water is required to replenish body fluids and facilitate physiological processes (Howard et al., 2020[97]). Water is also essential for personal and domestic hygiene and for productive and some recreational activities. The WHO recommended minimum daily quantity of water for drinking is 5.3 litres (L)/person. This is the volume of water that should be accessible to ensure that lactating women engaged in moderate activity at moderately high temperatures – the population group with the highest physiological needs – remain hydrated. People living a sedentary lifestyle in temperate climates may require less, whereas those living in hot climates or engaging in strenuous work may require more.[12]

Undervaluing water is one of the fundamental causes of its mismanagement (Farnault and Leflaive, 2022[104]). The value of water is multifaceted, with sociocultural, economic and religious associations, as established by the Valuing Water Initiative[13] (initiated by the government of the Netherlands). While there is no clear relationship between water’s price/cost and its value, the price or cost recorded in economic transactions tend to be confused with its value. Water is priced to recover some of the costs of service provision from consumers, but the price does not cover the full value of water. Almost absent from international conferences a few years ago, the valuing and financing water have begun to appear more recently on the international water agenda (e.g. the annual Stockholm World Water week, the Global Commission on the Economics of Water, UN Water Conference in March 2023, the OECD Roundtable on Financing water, the Valuing Water Initiative).

Energy Infrastructure

Energy is critical for basic services, human activities and development. Electricity is a versatile form of energy that has multiple impacts on human well-being and sustainability. Electricity is used to light and heat buildings, which increases the comfort, health and safety of residents. It supports a broad range of basic services, as well as economic infrastructure and activities. However, electricity generation is a major contributor to global greenhouse gas (GHG) emissions and climate change through the combustion of fossil fuels. Depending on how electricity is generated, it can have negative impacts on current and future well-being, including health, marine and terrestrial biodiversity and, more generally, sustainable development (Pachauri et al., 2014[105]).

Material conditions and economic capital

Access to energy is important but so is its affordability. Even if households have physical access, some may be excluded from electricity consumption because of fuel poverty, which may force households to reduce space heating or cooling to levels that reduce comfort and therefore well-being (OECD, 2019[1]). Looking at the electricity price alone is not sufficient to assess affordability properly, as it is not correlated with some indicators of energy affordability over the long term (Flues and van Dender, 2017[106]). On average in 2021, energy expenditure comprised 14% of households' current expenditures on housing across the OECD (OECD, n.d.[107]).

The affordability of electricity and energy poverty are multidimensional concepts. Focusing on electricity expenditure alone would result in a biased picture, in which households with electrical heating appliances appear to have higher electricity bills, although they may have lower energy bills. The European Union Energy Poverty Observatory has selected primary and secondary indicators to track energy poverty (European Commission, n.d.[108]). In addition to "inability to keep home adequately warm", the other primary indicator is "arrears on utility bills" (i.e. percentage of the population declaring to be unable to pay on time due to financial difficulties for utility bills (heating, electricity, gas, water, etc.) for the main dwelling. The two secondary indicators are "hidden energy poverty" (i.e. percentage of the population whose absolute energy expenditure is below half the national median) and "high share of energy expenditure in income" (i.e. percentage of the population whose share of energy expenditure in income is more than twice the national median share), both based on expenditure values from the Household Budget Surveys. Indicators used to monitor energy poverty and evaluate the impact of specific climate policies and energy-tax reforms on affordability ex ante have been proved to be positively correlated with the subjective indicator "inability to keep the home warm" (Flues and van Dender, 2017[106]).

During the recent global energy crisis, higher gas and coal prices accounted for 90% of the upward pressure on electricity costs around the world (IEA, 2022[109]). In 2022, Russia's cut in its natural gas supply to Europe and European sanctions on imports of oil and coal from Russia severed one of the main arteries of the global energy trade. Price and economic pressures are increasing the number of people without access to modern energy for the first time in a decade. Globally, around 75 million people who recently gained access to electricity are likely to encounter affordability challenges, and 100 million people may revert to the use of traditional biomass for cooking. High energy prices have prompted behavioural and technological changes in some countries to reduce energy use (IEA, 2022[109]).

Renewables have implications for employment opportunities, job quality and local communities. The transition to renewables is likely to create new jobs and initiate changes in job quality. For example, the number of mine workers may decrease as employment in renewables increases. This may create difficulties for some regions and communities, especially for those that rely on coal extraction (OECD, 2017[110]). However, it is difficult to define and therefore quantify the impact on overall employment, as not all jobs can be attributed clearly - in particular, indirect jobs, which refer to work for suppliers who provide services and intermediate goods for the energy sector (Advisory Council on the Environment, 2017[111]). Monitoring indirect job numbers in renewables is particularly challenging, as renewable energy suppliers consist of a relatively large variety of firms, most of which also offer other services besides renewables. Distinguishing between direct jobs (working for the mining or power company) and indirect jobs (suppliers) for fossil-fuel companies is, however, easier (OECD, 2019[1]).

Quality of life, human capital and natural capital

Electricity generation, and generation based on fossil fuel in particular, is associated with air, water and soil pollution. Fossil-fuel power plants – especially coal plants – are major contributors to GHG emissions and climate change. In 2021, the electricity sector emitted 13 gigatonnes of carbon dioxide (Gt CO_2), accounting for over one-third of global energy-related CO_2 emissions (IEA, 2022[112]). Coal accounted for 74% of the total CO_2 emissions from electricity generation. In advanced economies, electricity sector emissions have been declining since 2007, with a temporary rise in 2021 due to the recovery from COVID-19 (IEA, 2022[112]). Despite important progress in reducing air pollution from the power sector in recent years, air pollution remains a serious problem: fossil fuel air pollution is responsible for one in five deaths worldwide (Vohra et al., 2021[113]). Coal power plants are also a major source of mercury emissions (UN Environment Programme, 2023[114]). When airborne mercury enters the water cycle, it interacts with bacteria that convert it into its highly toxic form, methylmercury, which negatively affects aquatic ecosystems and animals, threatening fish-eating birds and mammals, as well as their predators (EPA, 1997[115]). Thermal power plants are also a major source of toxic waste, which can negatively affect the local environment if it is not properly stored (National Research Council, 2010[116]).

Renewable and decentralised solutions are on the way, but these are also bringing some negative impacts on public health, safety and ecosystems. In 2021, across OECD countries, nearly 12% of the total primary energy supply came from renewable sources, up from nearly 8% in 2010 (OECD, n.d.[117]). The share is higher when looking at electricity supply: 30% of the electricity generated in 2021 across the OECD was renewable, up from 18% in 2010 (OECD, n.d.[117]). With distributed energy resources (from small generation units (small hydro, rooftop solar), energy storage, demand response and electric vehicles), consumers can play a more active role self-producing electricity and transforming the traditional power system from a unidirectional, centralised system towards a bidirectional, decentralised system (OECD, 2019[1]). Distributed energy resources coupled with improvements in energy efficiency can lower the energy bill and have positive impacts on ecosystems and finite natural resources (land, materials) (IEA, 2018[118]) Nuclear and renewable energies, however, can also have negative impacts on public health and safety, ecosystems and biodiversity. Unless the negative impacts are addressed by appropriate policy design, low-carbon generation may come at the expense of other well-being goals (Gasparatos et al., 2017[119]). Nuclear energy may generate issues related to safety, health and ecosystems (Pachauri et al., 2014[105]; OECD, 2019[1]; Steinhauser, Brandl and Johnson, 2014[120]), which is affecting public acceptability in some countries. Renewable energies, including solar, hydro, wind and tidal, can have negative impacts on ecosystems and biodiversity through the loss or fragmentation of habitats. Large hydro dams often require displacing communities and interfere with the surrounding ecosystems, causing deforestation and landscape degradation (Winemiller et al., 2016[121]). Furthermore, large-scale bioenergy can put significant pressure not only on ecosystems and biodiversity, but also on available land and food production (OECD, 2019[1]).

2.4.2. The state of technical infrastructure in OECD countries

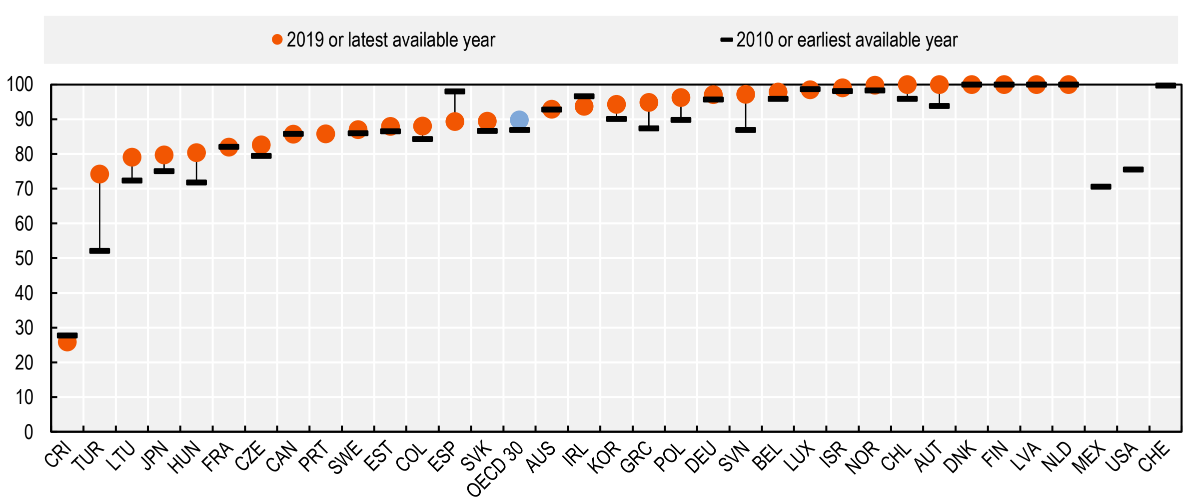
Access to essential services (drinkable water, electricity and public sewerage)

In terms of providing essential services to people, such as drinkable water, electricity and public sewerage, the stock of technical infrastructure in most OECD countries has reached a somewhat sufficient level. Nevertheless, there continues to be inequality between and within countries in terms of the provision of key technical infrastructure, which calls for continued attention from policy makers.

Access to drinkable water and to public sewerage are almost complete. While more than 90% of the population had access to drinkable water on average in the OECD in 2020, access was still below 90% in some OECD Latin American countries: 81% in Costa Rica, 73% in Colombia and 43% in Mexico. Data by urban/rural areas are scattered (i.e. available for only seven OECD countries) and show a slightly lower access to drinkable water in rural areas (between zero and five percentage points lower). The only exception is Colombia, which shows the highest urban-rural gap: only 40% of the rural population had access to drinkable water, compared to 80% in urban areas. Access to electricity is also complete or almost complete in urban and rural areas across OECD countries. Access is complete in all OECD countries, except in Mexico (98%) and in rural areas of other OECD Latin American countries (Chile, Colombia and Costa Rica), where access is almost complete, as 89% of the population or more have access to electricity. In terms of access to public sewerage, in 2019, 90% of the OECD population were connected to public sewerage (Figure 2.15). The percentage of the population connected to public sewerage varies from 26% in Costa Rica and just above 70% in Türkiye to complete coverage in Austria, Chile, Denmark, Finland, Latvia, the Netherlands and Norway.

Figure 2.15. Access to public sewerage in OECD countries varies from 26% and just above 70% to complete coverage

Percentage of the population connected to public sewerage



Note: Percentage of the national resident population connected to an urban wastewater collecting system. "Connected" means physically connected to a wastewater treatment plant through a public sewerage network (incl. primary, secondary, tertiary or other treatment). Individual private treatment facilities such as septic tanks are not covered. The latest available year is 2018 for the Slovak Republic, Spain and Türkiye; 2017 for Canada, Chile, Colombia, Costa Rica, Estonia, France, Germany, Greece, Ireland, Portugal and Sweden; and 2016 for Luxembourg. The OECD average excludes Iceland, Italy, Mexico, New Zealand, Portugal, Switzerland, the United Kingdom and the United States, due to lack of or outdated data.

Source: OECD *Green Growth indicators* (database), https://stats.oecd.org/Index.aspx?DataSetCode=GREEN_GROWTH.

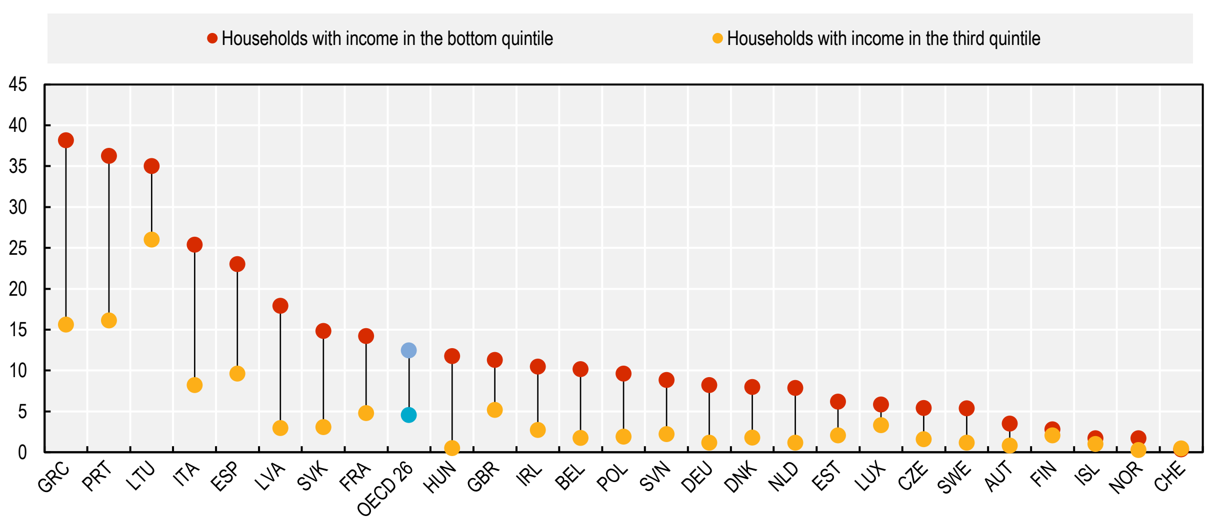
StatLink https://stat.link/9ea5hi

The quality of electricity access and service still matters. The quality of electricity access includes the quality and duration of the supply over the course of the day and the legality and safety of the connection. Hazardous connections in homes, notably in rural areas and slums, can cause major health issues, injuries and deaths (Bhatia and Angelou, 2015[122]). A large set of indicators inform policy makers and regulators about the electricity system's current performance (disruptions of electricity supply, supply shortage to satisfy demand).

While access to electricity is almost complete, one in eight low-income households in Europe cannot afford to keep their dwelling adequately warm (Figure 2.16). This share is almost three times that of those in the third income quintile. The percentage of those that cannot afford to keep the dwelling adequately warm in the bottom quintile ranges from below 2% in Iceland, Norway and Switzerland to above 30% in Greece, Lithuania and Portugal. This indicator is one of the primary indicators identified by the EU Energy Poverty Observatory to measure energy poverty (Thema and Vondung, 2020[123]). There are limitations to this indicator, however. It depicts an outcome of being in energy poverty, but it does not provide information about the reasons behind this inability to keep the home adequately warm, which could be economic (price of energy, lack of resources, etc.), issues with the building (energy efficiency of the home, lack of equipment) or others. Given that it is subjective, the social and cultural characteristics of households strongly influence the declaration of an inability to heat one's home adequately, and the level of adequate temperature can vary from country to country. Finally, there is the "denial of reality bias": energy-poor people might deny seeing themselves as being in an uncomfortable situation and, therefore, do not declare it. To better understand and monitor the drivers of energy poverty, a set of indicators, rather than a single indicator, may need to be considered (EU DG for Energy, 2023[124]).

Figure 2.16. One in eight low-income households cannot afford to keep their dwelling adequately warm

Percentage of households that cannot afford to keep their dwelling adequately warm, bottom and third quintiles of the disposable income distribution, 2020 or latest year available



Note: Data refer to 2019 for Germany and Italy; and 2018 for Iceland and the United Kingdom. The OECD average excludes Australia, Canada, Chile, Colombia, Costa Rica, Israel, Japan, Korea, Mexico, New Zealand, Türkiye and the United States due to lack of data.
Source: OECD calculations based on European Survey on Income and Living Conditions (EU-SILC), as available from the OECD *Affordable Housing* Database, http://www.oecd.org/social/affordable-housing-database.htm.

StatLink https://stat.link/noe3qu

2.5. Well-being and the built environment: Urban design/land use

2.5.1. The inter-relationship between well-being and urban design/land use

Urban design and land use determine access to opportunities (e.g. employment, health and education), neighbourhood characteristics (e.g. the quality of services, public space and infrastructure), and the transport connections between a given dwelling and different areas of a city. All these have impacts on health, safety, the environment, equity and overall well-being. For example, planning housing development as part of more compact and mixed land-use development, integrated with high-quality public and non-motorised transport facilities, can avoid urban sprawl and car dependence, reduce air pollution and GHG emissions, and improve the quality of life (OECD, 2019[1]). Inclusiveness can also be promoted by urban design. Low-income areas are often associated with lower-quality education, less access to good-quality green space, and a lower quality of the dwelling itself (Clarke and Wentworth, 2016[125]). To foster inclusivity, some cities like Vienna (City of Vienna, n.d.[126]) and Barcelona (City of Barcelona, n.d.[127]) have applied a gendered lens to urban planning to account for gender differences in needs and experiences of the city. Some of the urban planning models fostering well-being and sustainability (such as compact cities and superblocks) are further introduced in Box 2.2.

Box 2.2. New urban planning models fostering well-being and sustainability: Compact cities, Superblocks, the 15-minute city

In recent years, new urban planning models such as compact cities, superblocks, the 15-minute city, no-car city and a combination of these have emerged to foster well-being and sustainability.

- **Compact cities** are characterised by a higher residential density, shorter distances and a more diversified land use. One of the key elements is the shift from private motor vehicles towards pedestrians, bicycles and low-emission public transport. Compact cities bring health benefits to citizens, such as reducing diabetes, cardiovascular disease and respiratory disease, when planned to favour green spaces and avoid heat island effects. (Stevenson et al., 2016[128]).
- Another model is **the superblocks model**, planned by the city of Barcelona. With the creation of over 500 so-called "superblocks", the city aims to reduce motor vehicle traffic on some streets and to provide more space for people and green areas. An analysis of the impact of the superblocks implemented in the neighbourhoods of Poblenou, Sant Antoni and Horta by the Barcelona Public Health Agency (ASPB) (Ajuntament de Barcelona, n.d.[129]) concluded that they are generally perceived as better for well-being, tranquillity, sound quality, noise reduction, pollution reduction and social interactions and mobility. These effects, in turn, can help to prevent chronic health problems, such as cardio-vascular or respiratory diseases, diabetes, obesity, cancer, depression and anxiety.
- Finally, **the 15-minute city model** builds on the idea that the city should be a place where work, school, entertainment and other activities can be reached within a quarter of an hour's walk from home. The city of Paris is pursuing this model, which was first conceptualised by the urban planner Carlos Moreno. Moreno's vision is that of a polycentric city, where the population density is made pleasant, where the inhabitants can satisfy six categories of social functions: to live, to work, to supply themselves, to take care of themselves, to learn and to have fun. The model is based on three main ideas: ecology (for a green and sustainable city), proximity (living at a small distance from other activities) and solidarity (to create links between people).

Material conditions and economic capital

Income, consumption and housing

Housing and transportation costs, combined, should be considered in urban planning. Failure to account for the higher transportation costs in remote neighbourhoods could lead to policies, plans and regulations that exacerbate sprawl and locate households far from civic, social and economic amenities and opportunities (Guerra and Kirschen, 2016[130]). Various measures are necessary to bring opportunities to people living in low-income neighbourhoods by favouring mixed land-use to increase the proximity of people and opportunities. Investment to improve the efficiency of the transport system may increase accessibility in a neighbourhood but, without additional measures, may not necessarily translate into greater accessibility for low-income residents. House prices and rents in the less affluent neighbourhoods targeted by investment will rise alongside improvements in accessibility. Complementary policies (such as expanding the housing supply through densification around transport links or dedicated affordable housing) can alleviate these cost pressures (OECD, 2020[65]). In this context, the Center for Neighborhood Technology (CNT) in the United States has developed a methodology incorporating transportation costs into measures of neighbourhood affordability (Guerra and Kirschen, 2016[131]). The resulting *Housing and Transport (H+T©) Affordability Index* was used to develop a national framework that calculates neighbourhood affordability within and across cities in the United States. The CNT defines transport and housing as affordable when their expenditures stand below 15% and below 30% of household income, respectively (OECD, 2019[1]).

In particular, the location of housing matters. Broadening the spatial scale from an individual house to the area where the house is located allows room for examining their interdependencies. It is possible to leverage interdependencies to better consider synergies and trade-offs (OECD, 2019[1]; Turcu, 2010[132]; 2012[133]; Suescún et al., 2005[134]). For example, densifying areas without sufficient levels of transport accessibility can increase congestion (especially in adjacent neighbourhoods), fuel GHG emissions and pollution and reduce the quality of life. Likewise, not ensuring minimum green space in urban areas can undermine the physical and mental health of inhabitants (Clarke and Wentworth, 2016[125]; Power et al., 2009[135]) and miss opportunities for contributing to climate change mitigation and resilience, by reducing urban heat islands through nature-based negative-emission approaches (OECD, 2019[1]). Housing is not an isolated entity, but it is part of a neighbourhood (meso scale), a city (macro scale), a region (regional scale) and finally the wider ecosystems in which urban agglomerations are embedded (OECD, 2019[1]).

This broad approach is consistent with the WHO definition of healthy housing and the UN Habitat New Urban Agenda (NUA) adopted in 2016. The WHO's definition of healthy housing includes both "the presence of a community, and the quality of the neighbourhood and its relation to social interaction, sense of trust and collective efficacy", and "the nature of the immediate housing environment, such as the quality of urban design, including green spaces, services and public transport choices" (WHO, 2018[136]). It is consistent with that of the NUA, which states that adequate housing should be "i) ensuring adequate social functions and standard of living that ensure access to basic services such as drinkable water, public goods, and quality services for food and security; ii) fostering inclusiveness and gender equality; iii) promoting civic engagement; iv) leveraging urbanisation to support the transition to a sustainable and formal economy; v) fostering territorial integration and development; vi) enhancing efficient and sustainable urban mobility, as well as improving accessibility; and (vii) protecting ecosystems and natural habitat, and promoting sustainable consumption and production" (UN Habitat, 2017[137]).

Quality of life, human capital and natural capital

Safety

Urban design and land use drive neighbourhood safety. Land and urban design can influence the speed of travellers and the complexity (e.g. number of road intersections, intersection design, bus stop design) they are exposed to, potentially creating circumstances that increase or reduce the frequency and severity of traffic crash risks (Saha, Dumbaugh and Merlin, 2020[138]). Road characteristics such as the length of roadway segments, the number of lanes, or roads' location in an urbanised area are positively associated with the higher risk of a crash (Chen and Lym, 2021[139]). Greater numbers of parcel deliveries and transit stops are associated with higher risk of crashes involving pedestrians, bicycles and vehicles (Kim, Pant and Yamashita, 2010[140]; Yu and Woo, 2022[141]; Osama and Sayed, 2017[142]). Conversely, single and multi-family residential areas are associated with fewer crashes (Yu and Woo, 2022[141]; Kim, Pant and Yamashita, 2010[140]).

An unkept and blighted built environment can increase the perception that it is unsafe. Empirical studies on the "Broken Windows Theory" (Wilson and Kelling, 1982[143]) suggest that physical environmental disorder increases criminal behaviour and perceived and actual social disorder (Hinkle and Yang, 2014[144]), therefore contributing to lower perceived safety. The presence of trash in the street, vandalised buildings, blighted lots, insufficient nighttime street lighting, low network connections and unkept and insufficiently lit green spaces can increase the perception of crime (Velasquez et al., 2021[145]; Pearson et al., 2021[146]; Kaplan and Chalfin, 2021[147]; Hardley and Richardson, 2021[148]). People with a lower economic status are more likely to live in degraded neighbourhoods and are disproportionately affected by violence (CDC, 2021[149]). For adults with functional limitations, sidewalk quality matters for safety (Velasquez et al., 2021[145]). In 2022, 73% of people declared they felt safe walking alone at night in their neighbourhood in the OECD, up from 65% in 2006. In particular, women feel significantly less safe than men: over the period 2017-22, 80% of men declared feeling safe compared to 65% of women (OECD, n.d.[54]).

Physical and mental health

The built environment can shape people's physical activity behaviours, especially in terms of active transport (e.g. biking, walking) (OECD/WHO, 2023[150]; Cervero et al., 2009[151])**.** People living in more "walkable", safe and attractive environments are more likely to use active transport and have higher levels of physical activity (Mackett and Brown, 2011[152]; Handy et al., 2002[153]). Urban design and the efficiency of municipal transport networks are crucial factors in favouring or hampering active transport, and consequently physical activity. A compact urbanisation that prioritises the needs of pedestrians instead of motor vehicles promotes physical activity (OECD/WHO, 2023[150]).

Safer, less polluted and greener neighbourhoods are associated with improved mental health. Living in unsafe areas with high levels of violent crime and/or vandalism is associated with higher levels of mental ill-health and lower levels of life satisfaction (Guite, Clark and Ackrill, 2006[154]; Fujiwara and HACT, 2013[155]; OECD, 2023[28]). Exposure to air pollution, especially at a young age, can lead to future problems with physical and mental health (OECD, 2023[28]). Air pollution is often worse in lower socio-economic neighbourhoods where residents are more likely to also have worse employment outcomes and housing conditions (Brunekreef, 2021[156]; Kerr, Goldberg and Anenberg, 2021[157]), which contribute to poor mental health. Air pollution can also affect health-related behaviours: people who live in heavily polluted areas are less likely to spend time outside or to engage in physical activity (Bos et al., 2014[158]). Conversely, improved mental health outcomes are associated with greater access to clean air and more time spent in nature (Bratman et al., 2019[159]). Living in neighbourhoods with ample access to green spaces like gardens and parks is associated with better mental health (Guite, Clark and Ackrill, 2006[154]). More exposure to green areas and increasing the number of leisure facilities in the built environment also provide opportunities and venues for physical activity and social interaction for the elderly, thereby promoting their physical and mental health (Yan, Shi and Wang, 2022[160]). As for housing, the quality and aesthetic of a neighbourhood are associated with greater momentary happiness (Seresinhe et al., 2019[161]) and influence positive mental health as a status symbol (Bond et al., 2012[45]). Contemporary architecture – characterised by asymmetry, lack of ornamentation, and industrial appearance – has been found to score lower in environmental perception than traditional architecture (Mouratidis and Hassan, 2020[162]) and could thereby trigger negative emotional responses, since environmental perception may contribute to affective appraisal (Zhang and Lin, 2011[163]).

Environmental quality and natural capital

The nexus between the built environment and the natural environment and capital is complex and intertwined. Buildings and the construction sector are major sources of CO_2 emissions, the consumption of natural resources, waste and pollution, all of which aggravates climate change and threatens biodiversity. However, green urban areas may mitigate some of these negative impacts on the natural environment and provide additional well-being benefits.

Looking at land use and the way it is changing leads to a more comprehensive picture of its impact on the natural environment and its resources. Across the OECD, 75% of land in 2019 was covered by natural or semi-natural vegetation. This share ranges from below 30% in Israel, Denmark and Hungary to above 87% in Norway, Ireland and Australia (OECD, n.d.[164]). Between 2004 and 2019, the total land covered by natural and semi-natural vegetation in OECD countries remained stable. However, it is important to separate losses and gains in natural and semi-natural vegetation, as losses can involve damage to habitats rich in biodiversity (e.g. loss of primary or old-growth forest) that may not be compensated by gains in semi-natural areas that are poor in biodiversity. Land change also matters for economic and environmental efficiency. There are powerful economic incentives to redevelop urban land, such as brownfields, for industrial, residential and commercial uses, leading to additional carbon emissions. Most brownfield sites have some form of "greenish space" in the form of derelict, empty or vacant land, which is being taken over by natural space. These green areas are often suppressed, because bringing nature back to contaminated sites is believed to be relatively expensive. Nonetheless, brownfield sites can provide opportunities to develop green and blue spaces, and their development should be monitored in tandem with the evolution of green and blue spaces (OECD, 2019[1])

Urban green areas mitigate exposure to air pollution, excessive heat and noise and foster pro-environmental behaviours (WHO Regional Office for Europe, 2016[165]; Engemann et al., 2019[166]). A recent study published in the *Lancet* (Iungman et al., 2023[167]) found that of the 6 700 premature deaths linked to higher temperatures in 93 European cities during 2015, one-third could have been prevented by increasing urban tree cover by at least 30% per neighbourhood. High temperatures in urban environments are associated with negative health outcomes, such as cardiorespiratory failure, hospital admission and premature death (Iungman et al., 2023[167]). Strategically integrating green infrastructure into urban planning can promote more sustainable, resilient and healthy urban environments.

Green areas can support climate change mitigation if carefully planned. Such areas, in particular trees, have the potential to sequester carbon and be a nature-based negative emissions solution. Nevertheless, urban green areas entail important costs and do involve emissions linked to their construction and maintenance. Trees in urban areas also pose challenges in terms of mortality rates since dead trees release GHGs as they decompose. A careful and comprehensive life-cycle assessment is key to correctly assessing the potential of urban green areas to mitigate climate change (OECD, 2019[1]). Trees in poor condition have less ability to provide ecosystem services, since poor conditions impede growth, slow carbon sequestration and can also lead to canopy dieback (University of Florida, 2020[168]). Larger trees have a better capacity to store carbon, to reduce atmospheric pollution and to avoid stormwater runoff. The interception of precipitation and air pollutants increases with greater canopy size and total leaf area (i.e. the total area of all leaves), which is associated with greater height (Munson and Paré, 2022[169]).

Also, green space design can contribute to climate change mitigation. Green space design includes the diversity of the tree population and the share and distribution of open space relative to the tree-covered space. This has proven important for increasing the potential of carbon sequestration (Strohbach, Arnold and Haase, 2012[170]; Hutchings, Lawrence and Brunt, 2012[171]; Nero et al., 2017[172]).

Building heights also interact with environmental quality and natural capital. Limiting building heights, with Floor Area Ratio (FAR) limits in particular, may lead to urban sprawl, leading in turn to higher GHG emissions from commuting and higher housing prices (Borck, 2016[173]; Jedwab, Barr and Brueckner, 2020[174]). On the other hand, Resch et al. (2016[175]) found that the energy use of buildings changes profoundly with height, as heat loss per floor decreases as the building reaches higher. The authors argue that there is a range of heights that contribute most to an energy-efficient urban structure, which lies in a broad range of 7 to 26 stories, depending on population size and building lifetimes. The relationship between building heights and the local wind environment has also been receiving greater attention. This is related to the quality of the urban climate, such as heat island intensity and air pollution, which affect well-being in large cities. Urban ventilation is also a key factor influencing pedestrian comfort (Tsichritzis and Nikolopoulou, 2019[176]; Chen et al., 2017[177]; Chen and Mak, 2021[178]).

Box 2.3. Building, the construction sector and sustainability

- Buildings and the construction sector are major emitters of greenhouse gases and impact the natural environment in various ways. These include CO_2 emissions, the generation of construction and demolition waste, (indoor and outdoor) air pollution, and the consumption of energy and natural resources (European Commission, n.d.[179]; OECD, 2004[180]). In 2021, the global buildings sector consumed an estimated 30% of global energy (IEA, 2022[181]). A further 4% of global energy use and 6% of global emissions in 2021 were due to the production of concrete, steel and aluminium and materials used in the construction of buildings (IEA, 2022[181]). The production of glass and bricks could amount to a further 2-4% of global emissions. Combined, CO_2 emissions from the operation of buildings and the materials used in their construction are estimated to account for around 37% of global energy and process-related emissions in 2021 (UNEP, 2022[182]).
- The transition to the decarbonisation and sustainability of the built environment is still "not on track". After construction activity fell briefly during the COVID-19 pandemic, in 2021, it rebounded to pre-pandemic levels in most major economies. The increased use of fossil fuel gases in buildings in emerging economies drove the largest rise in building energy demand in the last 10 years (IEA, 2021[183]). As a consequence, CO_2 emissions from buildings operations have reached an all-time high, up by 5% and 2%, respectively, compared to 2020 and the 2019 previous peak. To be aligned with reaching net zero carbon emissions by 2050, emissions need to fall by over 98% from 2020 levels (IEA, 2021[183]).
- Buildings and infrastructure are also vulnerable to climate change. Every region across the globe is already experiencing weather and climate extremes, such as heatwaves, flooding, precipitation, droughts and cyclones. With global warming, scientists anticipate increases in the frequency and intensity of these extreme events (UN, 2022[93]). Despite the adoption of the Sendai Framework for Disaster Risk Reduction at the UN World Conference on Disaster Risk Reduction in 2015, direct economic losses and damage to critical infrastructure have increased substantially over the past decade (United Nations Office for Disaster Risk Reduction, 2022[184]). The Sendai Framework is a 15-year (2015-2030), voluntary, non-binding agreement, with seven targets and four priorities for action. The 2030 Agenda for Sustainable Development also recognises and reaffirms the urgent need to reduce the risk of disasters, pointing to specific

objectives, such as reducing the exposure and vulnerability of the poor to disasters, as well as building resilient infrastructure.

- Green buildings can contribute to tackling climate change. The construction of energy-positive and negative-emission buildings and infrastructure can reduce the environmental footprint of the built environment, also bringing benefits to people's well-being and sustainability (OECD, 2019[1]). Designing buildings with passive solutions (e.g. orientation, ventilation) can significantly reduce energy needs (through natural daylight, heat loss reductions, etc.), while also improving thermal comfort and health (IEA, 2019[185]). Moreover, buildings can become carbon sinks, even after accounting for their entire life-cycle emissions, and bring wider well-being and environmental benefits, provided that measurement tools and instruments exist to incentivise net-positive carbon performance (Renger, Birkeland and Midmore, 2014[186]).

Community relations and social capital

Spaces become places when they provide setting for social connections. Spaces that bring people together, enabling people to participate in community life, are such places. Some of these places have been designed with the intention to create opportunities for individuals and groups to interact and form social relations. For example, squares, parks and play areas, are places specifically designed for people to meet up in informal settings (O'donnell et al., 2014[187]). There are also places that "host the regular, voluntary, informal, and happily anticipated gatherings of individuals beyond the realms of home and work" (Oldenburg, 1999[188]). These so-called "Third places" can include bars, churches, libraries, shops and markets (Jeffres et al., 2009[189]). "Non-places", such as motorways, stations and shopping malls, which are not often suitable for socialising, can also provide opportunities for sociability through their design and specific interventions (e.g. community events) (Bagnall et al., 2023[190]; Aubert-Gamet and Cova, 1999[191]). On the other hand, there is strong evidence that interventions in green and blue areas (any natural green space: parks, woodland, gardens; or blue space: rivers, canals, coastal areas) can enhance social cohesion and a sense of belonging, in addition to individual well-being benefits, such as increased physical activity (Bagnall et al., 2023[190]) and opportunities for social interactions especially for the elderly (Yan, Shi and Wang, 2022[160]). The picture is more mixed as to whether different types of urban design/land use interventions have positive impacts on social connections. There is evidence that neighbourhood design can improve social networks and have positive impacts on community well-being, particularly civic participation, and reduced crime. Both positive and negative impacts are reported in cases of urban regeneration, however, as urban regeneration projects can either create social relationships or weaken existing social ties between long-term residents and create a divide between longer-term and newer residents (Bagnall et al., 2023[190]).

Walkable and less dense neighbourhoods are associated with higher neighbourhood social cohesion. Walkability and easy access to destinations are associated with greater social cohesion at a neighbourhood level (Mouratidis, 2017[192]; Kwon, Lee and Xiao, 2017[193]; Mazumdar et al., 2017[194]; Talen and Koschinsky, 2014[195]; Wood, Frank and Giles-Corti, 2010[196]). Residents of dense, mixed-use neighbourhoods appear to form more impersonal neighbour ties, resulting in lower neighbourhood social cohesion (Mouratidis, 2021[197]), even after controlling for the time living in the dwelling (Mouratidis and Poortinga, 2020[198]; Brueckner and Largey, 2008[199]; French et al., 2013[200]; Skjaeveland and Garling, 1997[201]). Daily interactions between neighbours in these conditions tend to be more superficial (Simmel, 1903[202]; Tönnies, 2012[203]). According to (Mouratidis and Poortinga, 2020[198]), this is explained by the following factors: 1) Detached houses, duplexes and row houses in low-density areas might be conducive to more frequent and more meaningful social interaction between neighbours compared to apartment blocks found in denser areas. 2) A lower density may provide residents with greater control over whom they meet and socialise with regularly (Baum and Valins, 1977[204]). The lower concentration of residents means people are more likely to frequently meet a limited number of neighbours. This helps create the trust needed for developing social ties. 3) Residents of dense, inner-city neighbourhoods are enabled to create and maintain bonds with residents of other neighbourhoods more easily due to geographical centrality and higher accessibility. Therefore, they might have a decreased need for socialising with neighbours and might be less interested in forming local social connections.

On the other hand, social interactions are more frequent in denser urban areas. Although these areas result in more impersonal social interaction between neighbours and weaker neighbour ties, they enable their residents to socialise more frequently overall with friends and family and facilitate the development and maintenance of larger overall social networks, since they bring a larger number of people into proximity and provide greater access to "third places" (Balducci and Checchi, 2009[205]; Mouratidis, 2018[206]; Jacobs, 2016[207]; Gehl, 2013[208]). Compact-city residents, although they may not even know their neighbours, tend to have a greater number of close relationships, to socialise more often, to receive stronger social support, and to have better chances of making a new friend or meeting a new partner compared to residents of low-density suburbs (Mouratidis, 2018[206]; Melis et al., 2015[209]). There is, however, also literature suggesting that high-rise buildings are less satisfactory than other housing forms for most people, are not optimal for children (restricting children's play), and lead to more impersonal social relations (Gifford, 2007[210]).

Despite less ease of using transport to connect with others, and consequently greater challenges in making social connections, people in rural areas tend to have a strong community culture (UK Department for Digital, Culture, Media and Sport, 2018[211]). People living in the British countryside are no more likely to report feeling lonely than people in cities. Instead, the UK Office for National Statistics (ONS) found that home and neighbourhood matters, as people who rent are more likely to feel lonely, while people satisfied with their neighbourhood are less likely to feel lonely (ONS, 2018[212]).

The built environment can compound or alleviate loneliness. The European Commission Joint Research Centre (JRC) has conducted a study to explore the concept of "lonely places" (Proietti, 2022[213]). They are identified as "a plurality of places that present a vulnerability in terms of lack or insufficient local endowment, accessibility, or connectivity". A lonely place can be digitally or physically disconnected, poorly equipped with urban amenities and disengaged from participation. Lonely places were identified in remote and rural areas, but also in urban areas. The 2023 US National Strategy to Advance Social Connection of the US Department of Health and Human Services (HHS) (US HHS, 2023[214]) recognises that the built environment (the layout of cities, from the usability and reach of public transportation to the design of housing and green spaces) has a direct effect on social connections, and the first of its six pillars highlights the importance of designing a built environment to promote social connection. Neighbourhoods with high building heights and without communal areas can impede social interaction, with both children and stay-at-home mothers feeling more isolated (Evans, Wells and Moch, 2003[215]). According to the report of the Campaign to End Loneliness hosted by the What Works Centre for Wellbeing, the overall pattern of the built environment, rather than individual solutions to elements of it, matters to alleviate loneliness (MacIntyre and Hewings, 2022[216]). This includes walkable, safe, friendly neighbourhoods, where people can get around, have access to a mix of services from the public, private and voluntary sectors, and can interact and connect at different levels, creating "weak ties", and also develop strong relationships, such as friendships, and then go on to create "strong ties".

Stronger evidence is needed to better identify the impact of the built environment on loneliness. Additional evidence is necessary to strengthen the understanding of the connection between specific features of the built environment, aspects of place-based interventions, and reductions in loneliness in order to improve the design of the built environment. One reason is that it can be difficult to separate the impact of the purely physical environment from that of the social activity and experience which takes place and evolves within it (MacIntyre and Hewings, 2022[216]).

2.5.2. The state of urban design and land use in OECD countries

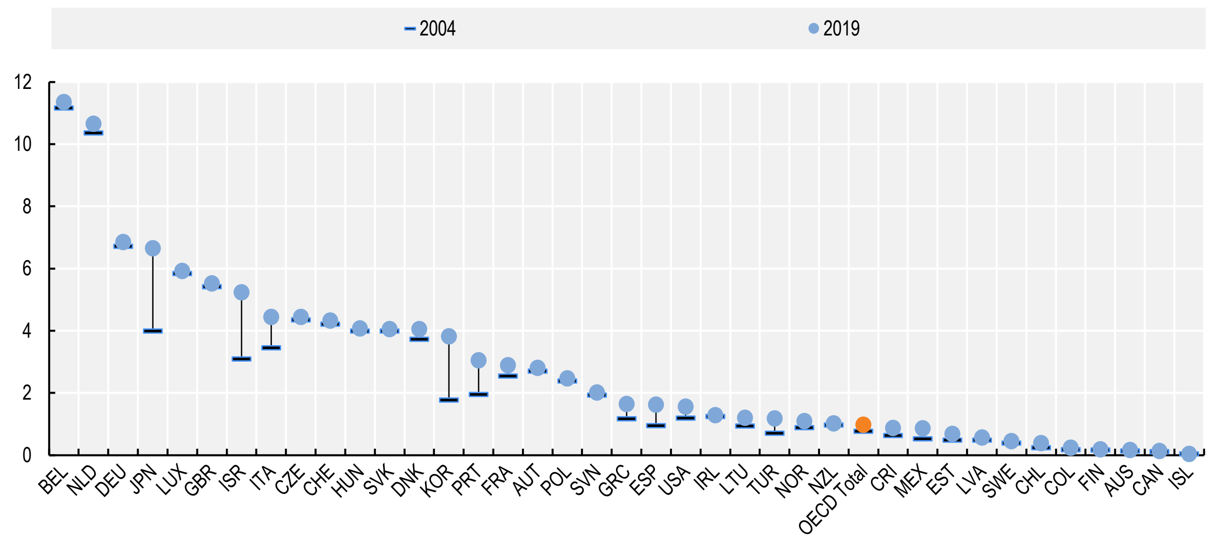
Urban design/land use concerns the organisation of space, making it difficult to quantify as a specific asset. In this section, this is described using indicators related to how the space is organised, first with an overview of the extent and evolution of artificial surfaces, then delving into a number of main categories, such as built-up areas and urban green areas. The quality of urban design/land use is assessed in terms of access or proximity to amenities (urban green areas) and services (hospitals and schools). Internationally comparable data on artificial surfaces are available and presented here at the country level, while more detailed data on the type of artificial surfaces, such as built-up areas and urban green areas, are available for metropolitan functional urban areas. As the number of functional urban areas (FUAs) with available data can vary from country to country, and to facilitate the reading, only information relative to OECD capital cities is presented. *For a detailed description of the indicators included, please refer to Annex 2.A.*

Artificial surfaces

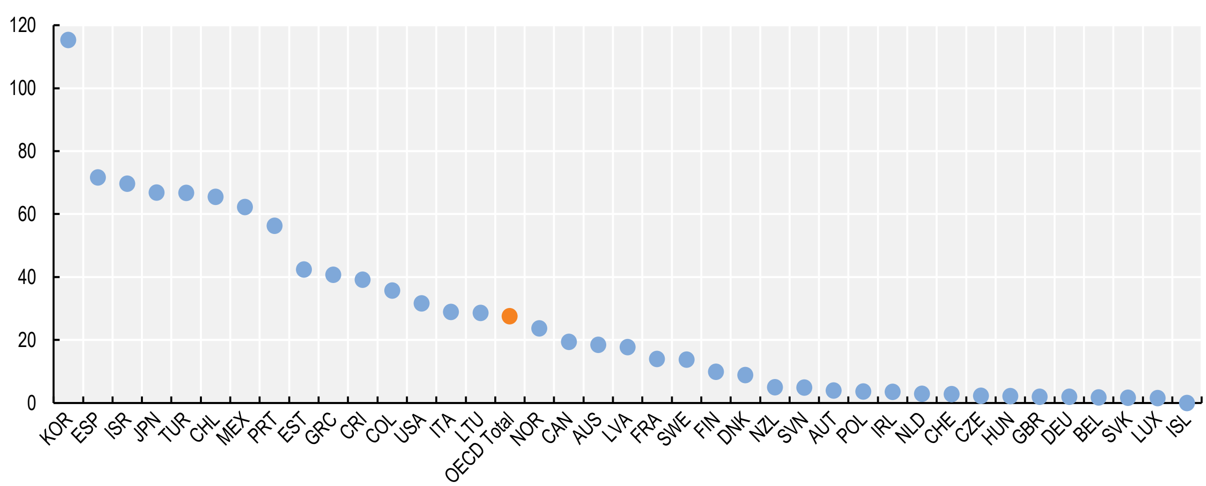
Artificial surfaces cover 1% of the OECD total land surface, on average (Figure 2.17, Panel A). Artificial surfaces are defined by the Central Framework of the System of Environmental- Economic Accounting (SEEA) (United Nations, 2014[217]) as any urban or related feature, including urban parks (developed for leisure and recreational purposes), and industrial areas, waste dump deposits and extraction sites. The stock of artificial surfaces in OECD countries ranges from less than 0.3% of the total land in Australia, Canada, Colombia, Finland and Iceland to more than 10% in Belgium and the Netherlands. The stock of artificial surfaces is highly correlated (0.83) with the country's population density: high-density countries such as Belgium, Germany, Israel, Japan, Luxembourg, the Netherlands and the United Kingdom are covered by a higher share of artificial surfaces, while low-density countries such as Australia, Canada, Finland and Iceland have the lowest share. The correlation is not perfect as, for example, Korea has the highest population density, but not the highest share of artificial surfaces. Compared to 2004, the stock of artificial surfaces has increased by almost 30% (0.2 percentage points) in the OECD area, with the largest increases in Korea (more than 100%), Israel and Spain (around 70%) and Chile, Japan, Mexico and Türkiye (above 60%) (Figure 2.17, Panel B). Iceland is the only OECD country where there has there been no increase in artificial surfaces since 2004, and there are no OECD countries in which artificial surfaces been converted at scale to another type of land use since 2004.

Figure 2.17. The stock of artificial surfaces in OECD countries ranges from less than 0.3% of total land to more than 10% and has increased by almost 30% since 2004

Panel A. Artificial surfaces, as a percentage of total land area



Panel B. Intensity of conversion to artificial surfaces, percentage, 2004-2019



Note: Artificial surfaces are defined by the SEEA Central Framework (United Nations, 2014) as any urban or related feature, including urban parks, and industrial areas, waste dump deposits and extraction sites.
Source: OECD *Land cover in countries and regions* (database), https://stats.oecd.org/Index.aspx?DataSetCode=LAND_COVER (Panel A) and OECD *Land cover change in countries and regions* (database), https://stats.oecd.org/Index.aspx?DataSetCode=LAND_COVER_CHANGE (Panel B).

StatLink https://stat.link/xrlhps

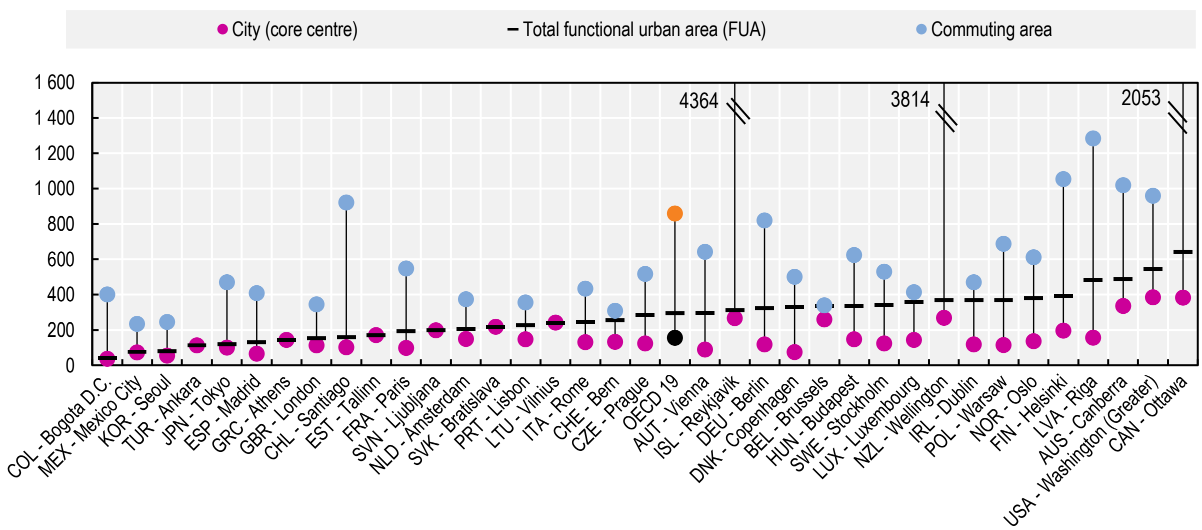
Urban built-up area

Built-up area per capita varies widely among OECD capital cities. The OECD defines "built-up" area as an area with the presence of buildings (roofed structures) (OECD, 2023[218]). This definition largely excludes other parts of urban environments and the human footprint, such as paved surfaces (roads, parking lots), commercial and industrial sites (ports, landfills, quarries, runways) and urban green spaces (parks, gardens). In 2021, there were 292 sqm per capita of built-up area on average in OECD capital cities (Figure 2.18). The surface of built-up area per capita ranged from just above 40 sqm per capita in

Colombia's capital city Bogota to more than ten times higher in Riga (Latvia), Canberra (Australia), Washington (the United States) and Ottawa (Canada). On average in OECD capital cities with available data, nearly 70% of built-up area per capita is residential. In OECD countries, the residential area covers at least 50% of the built-up area per capita, except in Korea's capital city Seoul, where only 35% of the built-up area per capita is residential and more than 60% is commercial (OECD, n.d.[219]). In commuting areas, the built-up area per capita is nearly six times larger than in the core centre, on average. This ratio goes from 1.30 (30% more than in the core centre) in Brussels (Belgium) to more than 16 (16 times higher than in the core centre) in Reykjavik (Iceland).

Figure 2.18. Built-up area per capita in selected OECD capital cities varies from just above 40 sqm to more than 400 sqm

Built-up area, sqm per capita, by functional urban area (FUA) and components (core centre and commuting area), selected OECD capital cities, 2021



Note: OECD 19 is the simple average of the 19 capital cities included in the chart with information available for both the core centre and the commuting areas. Data are not available for Costa Rica nor Israel. Functional urban areas (FUAs), as defined by the OECD and the EU, are composed of a city and its commuting zone. This definition overcomes the purely administrative perimeter to encompass the economic and functional extent of cities based on people's daily movements (OECD, 2022[11]). These indicators were estimated using a deep learning model based on satellite imagery.

Source: OECD *Regions and Cities, City statistics* (database), https://stats.oecd.org/Index.aspx?DataSetCode=FUA_CITY and (Banquet et al., 2022[220]).

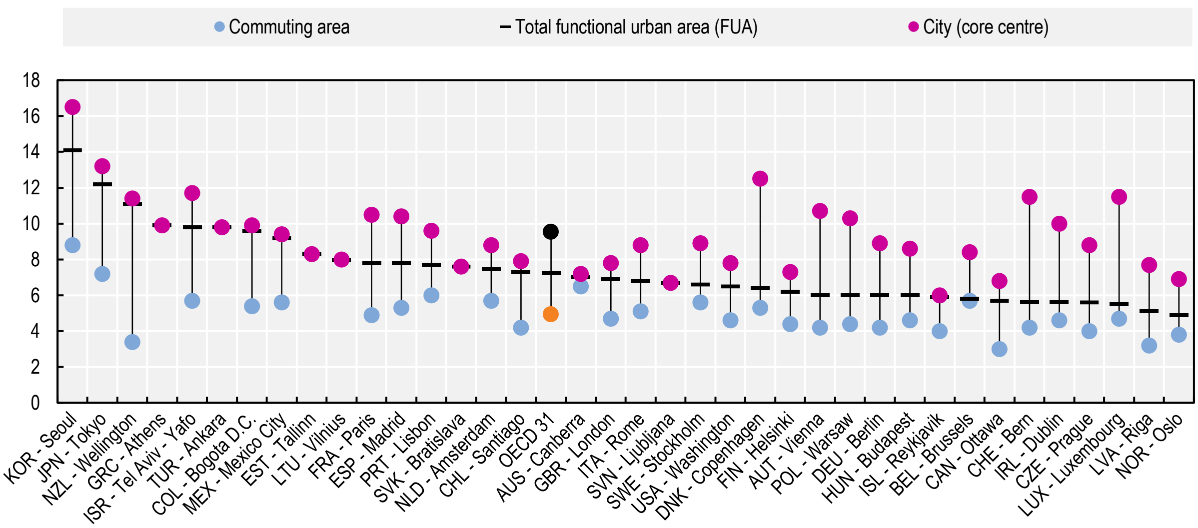
StatLink https://stat.link/6zkbo2

Average urban building height

Built-up area tends to develop horizontally in the commuting area and vertically in the core centre. While built-up area per capita is six times larger in the commuting area, average building height in the core centre is twice that in the commuting areas. The average building height in OECD capital cities is seven metres (Figure 2.19). Buildings in the core centre are twice the height of those in the communing area, on average. The average difference in building height between the core centre and the commuting area varies from 10% in Canberra (Australia's capital city) to almost three-and-a-half times in Wellington (New Zealand).

Figure 2.19. Buildings in the core centre of OECD capital cities are, on average, twice the height of those in the commuting zone

Average building height, metres, by functional urban area (FUA) and components (core centre and commuting area), selected OECD capital cities, 2021



Note: OECD 31 is the simple average of the 31 capital cities included in the chart with information available for both the core centre and the commuting areas. Data are not available for Costa Rica. Data are not available for both core centre and commuting area for Estonia, Greece, Lithuania, the Slovak Republic, Slovenia and Türkiye.

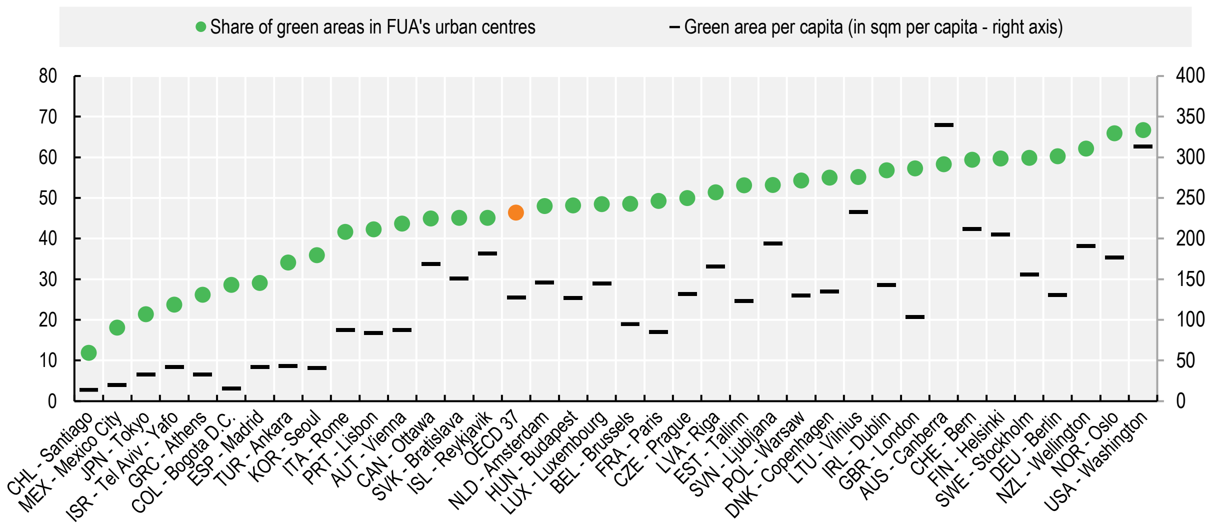
Source: *OECD Regions and Cities, City statistics* (database), https://stats.oecd.org/Index.aspx?DataSetCode=FUA_CITY and European Commission's Global Human Settlement Layer (GHSL), https://ghsl.jrc.ec.europa.eu/.

StatLink https://stat.link/kme17g

Among the OECD capital cities with available data, urban green areas cover 46% of the Functional Urban Areas (FUAs) (Figure 2.20). The share of FUA varies from 12% in Chile's capital city Santiago to 67% in the United States' capital Washington. The correlation between the share of green areas in the FUAs' urban centres and green areas per capita is high (0.80), but not perfect, because it is related to the density of the city: for denser cities the share in FUA is higher than the surface per capita. This definition of urban green areas is broad, as it encompasses all vegetation (trees, shrublands and grasslands) without setting a minimum surface. A stricter definition of green areas referring to areas for recreational use, such as parks, and suburban natural areas that have become and are managed as urban parks, is considered when examining proximity to urban green areas.

Figure 2.20. Green areas as a share of functional urban areas' urban centres in selected OECD capital cities ranges from 12% to 67%

Urban green areas in OECD capital cities, 2020



Note: OECD 37 is the simple average of the 37 capital cities included in the chart for which data are available. Data are not available for Costa Rica. The share of green areas in FUAs is estimated at the urban centre level, using ESA Worldcover data, which provides worldwide land cover data for 2020 at a 10 m resolution. Green areas are vegetation, which includes trees, shrublands and grasslands (OECD, 2022[11]).
Source: OECD *Regions and Cities, City statistics* (database), https://stats.oecd.org/Index.aspx?DataSetCode=FUA_CITY.

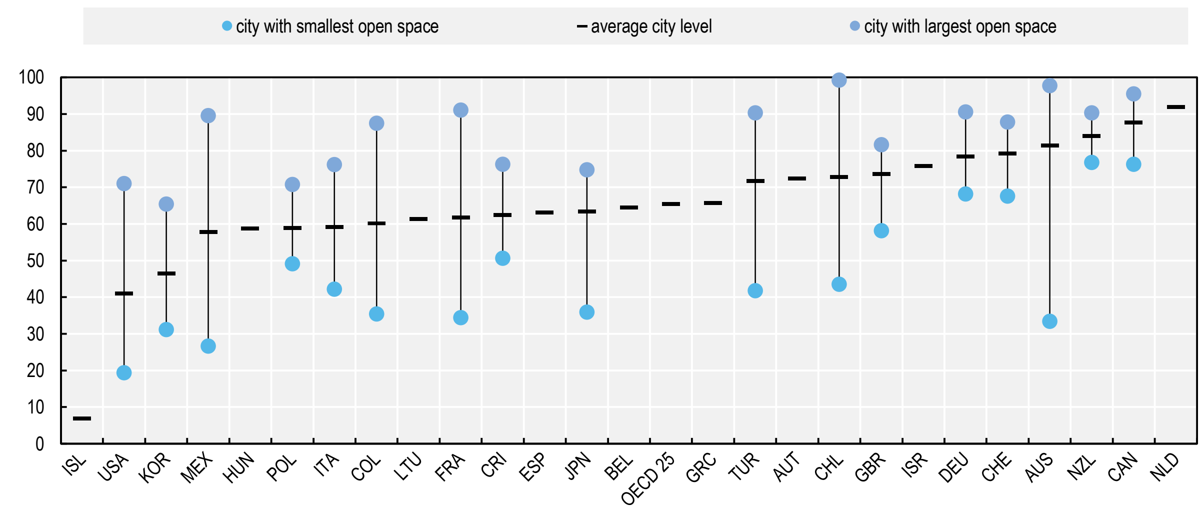
StatLink https://stat.link/gls86c

Open space for public use

On average, 65% of city area was open space for public use in the OECD in 2020. To monitor progress towards the accessibility and inclusiveness of cities and human settlements by 2030, the UN monitors the share of city area that is open space for public use, using SDG indicator 11.7.1. Open public space is any open piece of land that is undeveloped or land without buildings (or other built structures) that is accessible to the public without charge, which provides recreational areas for residents and helps to enhance the beauty and environmental quality of neighbourhoods. The inter-city variability for each OECD country with available data is presented in Figure 2.21. The share of open space ranges from 7% in Iceland to 92% in the Netherlands.

Figure 2.21. 65% of city area is open space for public use on average in the OECD

Percentage of city area that is open space for public use for all, by smallest, largest and average inter-city level, 2020 or latest available year



Note: The latest available year is 2018 for Iceland. The cities with the smallest and largest open space as a percentage of urban area are shown when data for at least two cities in the country are available.
Source: UN *Global SDG Indicator* (database), indicator 11.7.1, https://unstats.un.org/sdgs/dataportal.

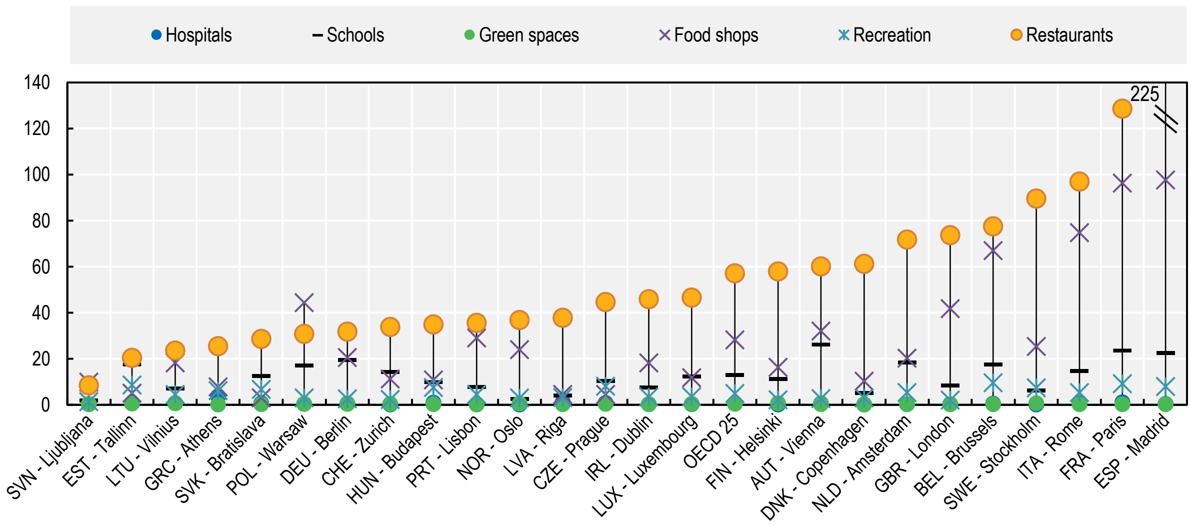
StatLink https://stat.link/7kcrml

Proximity and access to services and amenities

Proximity and access to amenities and services shape the quality of urban design/land use. Access to urban green spaces is available only for selected European cities, as is proximity to services and amenities[14] (here measured as the number of destinations within a selected radius/distance or time). Internationally comparable information on proximity for OECD countries is available with reference to different destinations (hospitals, schools, recreation, food shops, restaurants, green areas) and time thresholds (15 minutes, 30 minutes and 45 minutes). Cities have adopted different thresholds (e.g. "20-Minute Neighbourhoods" for the city of Portland (United States) and Melbourne (Australia), "15-minute city" for Paris (France)). Given the data availability of the three thresholds mentioned above, the 15-minute walking distance and other relevant information referring to European capital cities is presented below. Figure 2.22 shows that the proximity to services and amenities varies widely across European capital cities. In 2018, an average of 57 restaurants, 28 food shops, 13 schools and 5 recreation destinations were reachable within 15 minutes' walking distance, while less than one hospital or one urban green space were reachable. Since 2012, the urban population's access to green areas in cities (with an urban centre of at least 50 000 inhabitants) has been, on average, broadly stable. 69% of people have access to public parks, forests or other recreational green spaces within 10 minutes' walking distance from their home in European urban areas[15] (OECD, n.d.[54]).

Figure 2.22. Proximity to services and amenities varies widely across European capital cities

Number of services and amenities within 15 minutes' walking distance (1 km), by type, European capital cities, 2018



Note: "Hospitals" includes any health care or emergency structure, "Schools" include all pre-university education structures, "Green spaces" include all green urban areas (parks) and forests, as defined by the Copernicus Urban Atlas 2012 land cover/land use database, "Food shops" include any supermarket, bakery, grocery, butcher, specialty store, etc., "Recreation" includes theatres, museums, cinemas, stadiums, tourist and cultural attractions, and "Restaurants" includes any type of restaurant. For further details, please refer to (ITF, 2019[91]). The OECD average includes the 25 European capital cities included in the chart for which data are available. For Switzerland, Zurich instead of Bern is included, as data for Bern are not available.
Source: OECD ITF Urban access framework, https://stats.oecd.org/Index.aspx?DataSetCode=ITF_ACCESS.

StatLink https://stat.link/e07wu3

Two-thirds of residents living in low-income neighbourhoods must rely on cars to get access to opportunities, due to insufficient access via public transport. An OECD study *Transport Bridging Divides* (OECD, 2020[65]) conducted in 32 metropolitan areas found that in half of the metropolitan areas, residents of low-income neighbourhoods have worse access to opportunities compared to residents in high-income neighbourhoods, even when they rely on their cars instead of public transport for getting around the city. Overall differences in accessibility between income groups are also driven by differences in the way high- and low-income households sort across cities. Residents in larger cities tend to be, on average, better educated and have higher income levels than residents of smaller cities (OECD, 2015[221]). As a result, high-income households benefit from better accessibility not only because they live in parts of the metropolitan area where access to opportunities is on average better, but also because many of them live in richer metropolitan areas that enjoy overall better access to opportunities, regardless of the location within the city (OECD, 2020[65]).

Access to opportunities is more limited in rural areas. For example, the aforementioned European Commission Joint Research Centre report on lonely places (Proietti, 2022[213]) concluded that primary school accessibility in European rural areas is lower and people have to travel larger distances to reach a service area. In cities, the EU-wide average distance to the nearest primary school is 2.5 km, while in remote rural areas this average distance is 7.5 km. Of the municipalities examined, 90% of those without a primary school in 2011 were rural.

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Annex 2.A. Definition and measurement of the indicators included in this report

Overall built environment

Built environment stock refers to the value of a country's stock of residential (dwellings) and non-residential buildings (industrial, commercial, educational, health care, public, religious, amusement, sport, recreational and community buildings, non-residential farm buildings, etc.) and civil engineering works (infrastructure, such as highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways; waterways, harbours, dams and other waterworks; long-distance pipelines, communication and power lines; local pipelines and cables, ancillary works; constructions for mining and manufacture; and constructions for sport and recreation). It reflects the reduction in their value due to physical deterioration, normal obsolescence or normal accidental damage. Data are expressed in US dollars per capita at 2015 PPPs and are sourced from the *OECD National Accounts Statistics* database.

Investment in the built environment refers to the total (public and private) investment in both buildings (residential and non-residential) and civil engineering works (infrastructure). Data are expressed as percentage growth rates at constant prices and as percentages of Gross Domestic Product (GDP) and are sourced from the *OECD National Accounts Statistics* database.

Housing

Housing (residential buildings) stock refers to the value of a country's stock of residential buildings (dwellings). Data are expressed in US dollars per capita at 2015 PPPs and are sourced from the *OECD National Accounts Statistics* database.

Investment in housing (residential buildings) refers to total (public and private) investment in residential buildings (dwellings). Data are expressed as percentage growth rates at constant prices and are sourced from the *OECD National Accounts Statistics* database.

Housing affordability (current expenditures) refers to the share of household gross adjusted disposable income that is available to the household after deducting current expenditures on housing. Current expenditures on housing include rent (including imputed rentals for housing held by owner-occupiers) and maintenance (expenditure on the repair of the dwelling, including miscellaneous services, water supply, electricity, gas and other fuels, as well as expenditure on furniture, furnishings, household equipment and goods and services for routine home maintenance). Data are sourced from the *OECD National Accounts Statistics* database and refer to both households and non-profit institutions serving households.

Housing cost (rents and mortgage) overburden refers to the share of households in the bottom 40% of the income distribution devoting more than 40% of their disposable income to housing costs, where the 40% threshold is based on the methodology used by Eurostat for EU member countries. Housing costs include actual rents and mortgage costs (both principal repayment and mortgage interest); in contrast to the housing affordability measure sourced from National Accounts, no imputed rentals for owner-occupied homes are included. No data on mortgage principal repayments are available for Denmark. For Chile, Mexico, Korea and the United States, gross income instead of disposable income is used. Data are drawn from the *OECD Affordable Housing* database, which is sourced from household survey data.

The overcrowding rate adopts the EU-agreed definition (Eurostat, 2023[53]), which considers different needs for living space according to the age and gender composition of the household. A household is considered as living in overcrowded conditions if less than one room is available in each household: for each couple in the household; for each single person aged 18 or more; for each pair of people of the same gender between 12 and 17; for each single person between 12 and 17 not included in the previous category; and for each pair of children under age 12 (Eurostat, 2023[53]). Data are sourced from the *OECD Affordable Housing* database, which uses household survey data.

Poor households lacking access to basic sanitary facilities refers to the share of households with equivalised disposable household income below 50% of the national median without an indoor flushing toilet for the sole use of the household. Flushing toilets exclude toilets outside the dwelling but include flushing toilets in a room where there is also a shower unit or a bath. For Chile, Mexico, Korea and the United States, gross income instead of disposable income is used. Data for Korea refer to a flushing toilet regardless of the type of toilet (Asian or European style). Data are drawn from the *OECD Affordable Housing* database, which is sourced from household survey data.

Housing distress captures people's concern in finding or maintaining an adequate house in the short and long term. It is based on the survey questions: "Thinking about the next year or two, how concerned are you about each of the following? Not being able to find/maintain adequate housing" (for the short-term horizon) and "Looking beyond the next ten years, how concerned are you about the following? Not being able to find/maintain adequate housing" (for the long-term horizon). The possible answers are "1. Not at all concerned; 2. Not so concerned; 3. Somewhat concerned; 4. Very concerned; 5. Can't choose". The indicator presents the percentage of respondents reporting either "somewhat concerned" or "very concerned". Data are drawn from the OECD *Affordable Housing* database, based on the OECD *Risks That Matter* survey.

Infrastructure

Infrastructure (civil engineering works) stock refers to the value of a country's stock of civil engineering works (infrastructure). Data are expressed in US dollars per capita at 2015 PPPs and are sourced from the *OECD National Accounts Statistics* database.

Transport (focus on public transport)

Convenient access to public transport refers to the percentage of the population that have convenient access to public transport in large metropolitan areas. Access to public transport is considered convenient when a stop is accessible within a walking distance along the street network of 500 m from a reference point such as a home, school, workplace, market, etc., to a low-capacity public transport system (e.g. bus, Bus Rapid Transit) and/or 1 km to a high-capacity system (e.g. rail, metro, ferry). Additional criteria for defining public transport convenience include: 1) public transport accessible to all special-needs customers, including those who are physically, visually and/or hearing-impaired, as well as those with temporary disabilities, the elderly, children and other people in vulnerable situations; 2) public transport with frequent service during peak travel times and 3) stops present a safe and comfortable station environment (UN, 2021[55]). Data on types of public transport available in each urban area, as well as the location of public transport stops, are obtained from city administration, transport service providers or, when these are not available, from geospatial data such as those from open data sources (e.g. OpenStreetMap, Google and the General Transit Feed Specification – GTFS feeds). The walking distance is calculated on the basis of the street network (as available by city authorities or from open sources such as OpenStreetMap). Data providers, on the basis of their local knowledge, exclude streets that are not walkable. Finally, the Network Analyst tool (in GIS) is used to identify service areas (i.e. regions that encompass all accessible areas via the streets network within a specified impedance/distance) around any location on a network. All individual service areas are merged to create a continuous service area polygon. The estimation of the population within the walkable distance to public transport is estimated on the basis of individual dwelling or block-level total population, which is collected by National Statistical Offices through censuses and other surveys (UN, 2021[55]). Data are available only for the largest metropolitan areas, as defined by the *Degree of Urbanisation* (DEGURBA) (UN Statistical Commission, 2020[89]). This indicator is SDG indicator 11.2.1, and data are sourced from the *UN Global SDG Indicator* database.

Access to various public transport modes refers to the percentage of the population in large urban areas with access to a public transport mode (bus, tram or metro) within a 10-minute walking distance. Public transport stops are identified using Open Street Map (OSM). The 2022 Mapbox isochrone API then enables to compute isochrones from the identified public transport stops to get to all the areas located within a 10-minute walking distance. Finally, the Global Human Settlement Population layer 2015 allows to understand the share of the population in each functional urban area (FUA) who have access to public transport in less than a 10-minute walk. The OECD, in cooperation with the European Union, has developed a harmonised definition of functional urban areas (FUAs) for metropolitan areas. FUAs are composed of a city and its commuting zone and encompass the economic and functional extent of cities based on people's daily movements (OECD, 2012[90]). The definition of FUA aims at providing a functional/economic definition of cities and their area of influence, by maximising international comparability and overcoming the limitation of using purely administrative approaches. At the same time, the concept of FUA, unlike other approaches, ensures a minimum link to the government level of the city or metropolitan area. Data are limited to large OECD functional urban areas (i.e. above 250 000 inhabitants), due to the poor reliability of Open Street Map (OSM) in identifying public transport stops in smaller cities or rural areas, and they are sourced from the *OECD Regions and Cities* database.

The **effectiveness of public transport** is computed as the ratio between the absolute accessibility for a given transport mode (i.e. the number of destinations that can be reached within a fixed amount of time with a given transport mode) and proximity to potential destinations (i.e. the number of destinations within a set radius). A ratio of one or more means the transport mode performs well, as the number of accessible destinations through the transport mode is higher than those in proximity. A ratio close to zero means that the mode performs poorly, even in providing access to nearby destinations. The ratio summarises many aspects of the effectiveness of the mode in providing access to destinations. In the case of public transport, the indicator captures the frequency of services, the in-vehicle speed, the number of transfers and the distance to the nearest bus stop or station, as its effective performance is compared to a theoretical reference. Transport effectiveness is evaluated over three thresholds and an associated distance: 15 min (4 km), 30 min (8 km), 45 min (12 km). Based on the EC-ITF-OECD Urban access framework, data are obtained combining geospatial data and modelling. Data are sourced from the *OECD ITF Urban Access Framework* database.

Technical infrastructure (energy, water, waste management and digital infrastructure)

Access to improved drinking water sources considers the percentage of the population with access to improved drinking water. Access is defined as water being accessible on the premises (i.e. the point of collection is within the dwelling, compound, yard or plot, or water is delivered to the household) and available when needed (i.e. households report having "sufficient" water, or water is available "most of the time" (i.e. at least 12 hours per day or 4 days per week)). Water is defined as drinkable if it meets international standards for microbiological and chemical water quality specified in the WHO Guidelines for Drinking Water Quality. This indicator is SDG Indicator 6.1.1. For the purposes of global monitoring, water is drinkable if free from microbiological contamination of E. coli (or thermotolerant coliforms) and from the priority chemical contaminants (i.e. arsenic and fluoride). Improved drinking water sources include piped supplies, boreholes and tubewells, protected dug wells, protected springs, rainwater, water kiosks, and packaged and delivered water. Data are sourced from the *UN Global SDG Indicator* database, which are mainly collected through censuses for this indicator.

Access to public sewerage refers to the percentage of the population connected to an urban wastewater collecting system. "Connected" means physically connected to a wastewater treatment plant through a public sewerage network (including primary, secondary, tertiary or other treatment). Individual private treatment facilities such as septic tanks are not covered. Data are sourced from the *OECD Green Growth indicators* database, based on the WHO/UNICEF Joint Monitoring Programme and by Eurostat for EU Member states.

Access to electricity refers to the percentage of the population that have access to consistent sources of electricity. This indicator is SDG Indicator 7.1.1. For the purposes of global monitoring, access rates are only considered if the primary source of lighting is the local electricity provider, solar systems, mini-grids and stand-alone systems. Sources such as generators, candles, batteries, etc., are not considered due to their limited working capacities and since they are usually kept as backup sources for lighting. Data are sourced from the *UN Global SDG Indicator* database, which are mainly collected through household surveys and censuses for this indicator.

Ability to keep the dwelling warm considers the percentage of households that cannot afford to keep their dwelling adequately warm. This indicator is one of the primary indicators identified by the EU Energy Poverty Observatory to measure energy poverty (Thema and Vondung, 2020[123]). The indicator presents some limitations. It depicts an outcome of being in energy poverty, but it does not provide information about the reasons behind this inability to keep the home adequately warm that could be economic (price of energy, lack of resources, etc.), issues with the building (energy efficiency of the home, lack of equipment) or others. Given that it is subjective, the social and cultural characteristics of households strongly influence the declaration of an inability to heat one's home adequately, and what the adequate temperature should be can vary from country to country. Finally, there is the "denial of reality bias": energy-poor people might deny seeing themselves as being in an uncomfortable situation and, therefore, do not declare it. To better understand and monitor the drivers of energy poverty, a set of indicators, rather than a single indicator, should be considered (EU DG for Energy, 2023[124]). The indicator is available for EU members only. Data are sourced from the *OECD Affordable Housing* database, based on the European Survey on Income and Living Conditions (EU-SILC).

Urban design/land use

Artificial surfaces is defined as the percentage of total land area covered by artificial surfaces. Artificial surfaces are defined by the SEEA Central Framework (United Nations, 2014[217]) as any urban or related feature, including urban parks (developed for leisure and recreational purposes), and industrial areas, waste dump deposits and extraction sites. **Change in artificial surfaces (to and from)** is the percentage of artificial surfaces converted to (from) any other land cover type (e.g. agricultural, natural and semi-natural). The denominator used is the "stock" of artificial surfaces at the start of the reference period. Land cover types are based on geospatial data from the Copernicus/European Space Agency and Université catholique de Louvain Geomatics Climate Change Initiative – Land Cover (CCI-LC) Annual Maps: https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-land-cover. Countries' administrative boundaries are based on the latest OECD Territorial grid geographies, where available, and otherwise the FAO Global Administrative Unit Layers (GAUL 2014). For full details of the methodology, please refer to (Haščič and Mackie, 2018[222]). Data are obtained from the *OECD Land cover change in countries and regions* database.

Urban built-up area. "Built-up" areas include residential (discontinuous and continuous urban fabrics and isolated structures) and industrial and commercial areas (industrial, commercial, public, military, and private units, mineral extraction and dump sites, construction sites, land without current use) as defined by the 2018 Urban Atlas classification of land use. This definition excludes other parts of urban environments and the human footprint such as transport infrastructure (fast transit roads, other roads, railways, port, airports), and open space, including urban green spaces (forests, herbaceous areas, open space without vegetation (beaches, bare land), green urban areas, sports and leisure facilities). Data are based on geospatial information modelled through deep learning (i.e. the U-Net model) that is used to classify land cover and land use in EC-ESA satellite imagery for 2021, as documented in (Banquet et al., 2022[220]). Information is available for metropolitan functional urban areas, as defined by the OECD and the EU, which are composed of a city and its commuting zone. This definition overcomes the purely administrative perimeter to encompass the economic and functional extent of cities based on people's daily movements (OECD, 2012[90]). Data are expressed in sqm per capita and sourced from the *OECD Regions and Cities – City statistics* database.

Average urban building height data are calculated in metres and are based on geospatial data. Data are sourced from the *OECD Regions and Cities* – City *statistics* database, which refers to estimates released by the European Commission (EC) Joint Research Centre (JRC) (European Commission Joint Research Centre, 2022[223]).

Urban green areas data include trees, shrublands and grasslands. The share of green areas in functional urban areas is estimated at the urban centre level, using ESA Worldcover data (Zanaga and al., 2021[224]), which provides worldwide land cover geospatial data for 2020 at a 10 m resolution. Data are also presented in sqm per capita. Information is sourced from the *OECD Regions and Cities* – City *statistics* database.

Open space for public use refers to the share of city area that is open space for public use. Open public space is any open piece of land that is undeveloped or land without buildings (or other built structures) that is accessible to the public without charge, which provides recreational areas for residents and helps to enhance the beauty and environmental quality of neighbourhoods. This indicator is SDG indicator 11.7.1, which has been selected to monitor progress towards the accessibility and inclusiveness of cities and human settlements by 2030. UN-Habitat recognises that different cities have different types of open public spaces, which vary in both size and typology. Based on the size, open public spaces are broadly classified into six categories: national/metropolitan open spaces, regional/larger city open spaces, district/city open spaces, neighbourhood open spaces, local/pocket open spaces and linear open spaces. The classification of open public space by typology is described by the function of the space and can include green public areas, riparian reserves, parks and urban forests, playground, square, plazas, waterfronts, sports field, community gardens, parklets and pocket parks. Information is based on geospatial data, combined with population data from censuses and demographic surveys, and inventories of open public space from legal documents and fieldwork. Data are sourced from the *UN Global SDG Indicator* database.

Access to recreational green space in urban areas refers to the share of the urban population who have access to recreational green space within 5 minutes' walking distance from their home. Urban areas are defined as (greater) cities with an urban centre of at least 50 000 inhabitants, and green space refers to green areas with a minimum mapping unit of 0.25 hectares. They are predominantly areas for recreational use such as gardens, zoos, parks, castle parks and suburban natural areas that have become and are managed as urban parks. Forests at the fringe of cities are also included. The underlying method consists of determining an area of easy walking distance – around 5 minutes' walking time (with an average speed of 5 km per hour) – around an inhabited Urban Atlas polygon. Data are sourced from the *OECD How's Life? Well-being* database and have been calculated by Poelman using geospatial data from the European (Copernicus) Urban Atlas polygons.

Proximity to services and amenities is measured as the number of destinations within a selected radius/distance or time. Internationally comparable information on proximity for OECD countries is available with reference to different destinations (hospitals, schools, recreation, food shops, restaurants, green areas) and time thresholds (15 minutes, 30 minutes and 45 minutes). "Hospitals" includes any health care and emergency structure, “Schools” includes all pre-university education structures, “Green spaces” includes all green urban areas (parks) and forests, as defined by the Copernicus Urban Atlas 2012 land cover/land use database, “Food shops” includes any supermarket, bakery, grocery, butcher, specialty store, etc., “Recreation” includes theatres, museums, cinemas, stadiums, tourist and cultural attractions, and “Restaurants” includes any type of restaurant. Based on the EC-ITF-OECD Urban access framework, data are obtained combining geospatial data and modelling. Data are sourced from the *OECD ITF Urban access framework* database.

Notes

[1] As the value of land underlying buildings (residential and non-residential) and civil engineering works is available only for a very limited number of OECD countries (3-4 countries, depending on the type of building/structure), it has been excluded to ensure cross-country comparability.

[2] There are only few initiatives that disaggregate national GHG inventories at the local level. One example is the European Commission’s EDGAR (Emissions Database for Global Atmospheric Research) which provides independent emission estimates at national level and gridmaps at 0.1 x 0.1 degree resolution at global level, using international statistics and a methodology consistent with the Intergovernmental Panel on Climate Change (IPCC) (European Commission, n.d.[226]).

[3] Internationally comparable information on additional characteristics of the house (such as the presence of a leaking roof, damp walls, floors or foundation, or rot in window frames or floor in the dwelling, the perception of the dwelling as too dark) and more detailed housing affordability measures (such as affordability to replace worn-out furniture) are available only for EU countries participating in the EU-SILC survey. This survey also allows to measure multiple housing material deprivations (e.g. the percentage of the population living in overcrowded conditions and without a flushing toilet connected to a sewage system or septic tank). Given the limited geographical coverage, these have not been presented here.

[4] This is consistent with the approach of the OECD Affordable Housing database and the OECD Well-being framework.

[5] IRTAD is a permanent group dedicated to road safety in the ITF-OECD. With 80 members from 41 countries, the group has the objective of improving knowledge about road safety. It serves as a forum for countries to exchange information on methodologies for data collection and analysis.

[6] L_{den} is the sound pressure level averaged over the year for the day, evening and night-time periods, with a +5 dB penalty for the evening and +10 dB for the night.

[7] Estimations for noise costs and cost factors (per unit of travel) are based on estimations of exposure and increasing prices per decibel (dB), themselves based on estimates by the UK Department for Environment, Food and Rural Affairs and consistent with WHO recommendations. Estimations also use weighting factors for noise for different vehicle types and type of roads, i.e. urban (up to 50 km/h speeds) and other roads (80 km/h or higher speeds).

[8] L_{night} is the sound pressure level averaged over the year for the night-time period only.

[9] Additionally, different users can have different preferences and needs. Hence, transport solutions which work for some, may not work for others. For example, evidence has shown that women’s travel patterns are more complex than men's, with more, mostly short trips, using different services, at differing times of

the day, often involving children. While men tend to make few, direct trips at set times and often alone trips (ITF, n.d.[225]). An inclusive approach to transport would account for these differences.

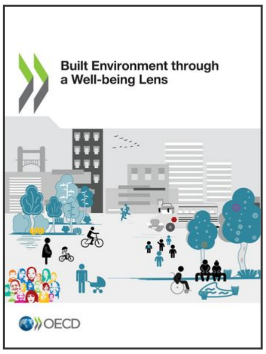
[10] The 2022 Mapbox isochrone API then enabled to compute isochrones from the identified public transport stops to get to all the areas located within 10-minute walking distance. Finally, the Global Human Settlement Population layer 2015 enabled to get the share of the population in each FUA who has access to public transport in less than a 10-minute walk (OECD, 2022[11]).

[11] The framework relies on a grid system of cells with 500 m squared sides created from the INSPIRE 100 m population grid originally developed by the Joint Research Centre (JRC) of the EC. Each 500 m grid cell represents the sum of the population, services and other amenities that are located within it for a total of approximately 1 580 000 cells in the selected 121 functional urban areas (FUAs), 918 000 of which are populated. The Tom Tom system and the Copernicus Urban Atlas 2012 land cover/land use database (for green areas only) are used to determine the number of destinations of interest in each grid cell and their location. The road network is extracted from OpenStreetMaps (OSM) and the public transport network is recreated using schedule data under General Transit Feed Specification (GTFS) standards. For a given FUA, the grid cells of the zoning system serve both as origins and destinations. Travel time is computed between an origin and a destination cell using a Dijkstra fastest path algorithm (i.e. all possible paths between the two points are examined and the one with the shortest travel time is chosen). The travel time is computed door-to-door. To determine the number of destinations of interest in proximity to each cell the model assigns fixed average straight line speeds to each mode based on typical average speeds in European cities, 16 km/h for cars, public transport and cycling, 4 km/h for walking. Information at cell level is then averaged with population weights to obtain the value for the functional urban area. For more details, please refer to (ITF, 2019[91]).

[12] The empirical evidence to define a minimum quantity of water necessary for cooking, personal hygiene, food hygiene and other forms of domestic hygiene is insufficient. The WHO states that experience and expert opinion (Howard et al., 2020[97]) suggest that 20 L/person/day is often sufficient for drinking, cooking, food hygiene, handwashing and face washing, but not other hygiene practices. However, where demands for water are increased – for example, due to increased hand hygiene in response to outbreaks of disease – 20 L/day is likely to be insufficient, and in many cases running water from a tap will be necessary to support sufficient handwashing. Piped water on premises results in larger volumes of water used and can support improved hygiene. Where water supplies are not continuous or not reliable, households typically use less water. Less water is also used where prices exceed the level that households can afford (Howard et al., 2020[97]).

[13] https://valuingwaterinitiative.org/.

[14] Evidence on proximity to urban green areas here presented is broadly consistent with access to urban green areas as featured in the OECD Well-being database. Both indicators refer to the same definition of urban green areas and are calculated using geospatial data based on the European Copernicus Urban Atlas. Discrepancies are due to slightly different geographical coverage (proximity is presented for functional urban areas of capital cities, while access to urban green areas is calculated for cities with an urban centre of at least 50 000 inhabitants), unit of measurement (number of urban green areas versus the percentage of the urban population with access to them), time distance (15-minute versus 5-minute walk) and implied average speed (4 km/h versus 5 km/h). For more details, please refer to (ITF, 2019[91]) for proximity and to (OECD, n.d.[54]) for access to urban green areas.



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