Brick by Brick (Volume 2)

BETTER HOUSING POLICIES IN THE POST-COVID-19 ERA



OECD

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Acronyms

ABS	Asset-backed securities
CMHC	Canada Mortgage and Housing Corporation
CMBS	Commercial mortgage-backed securities
CRE CLO	Commercial real estate collateralised loan obligations
CRTs	Credit Risk Transfer securities
DSTI	Debt service to income
DTI	Debt to income
EPC	Energy performance certificate
EJ	Exajoule
ETF	Exchange-traded fund
ETS	Emission trading scheme
FHA	US Federal Housing Administration
FHFA	US Federal Housing Finance Agency
FSB	Financial Stability Board
FUA	Functional Urban Area
GBRS	Green building rating system
GFC	Global financial crisis
GHD	Geography of Housing Database
GML	Green mortgage loan
GSE	Government-sponsored entity
GT	Gigatonne
IOSCO	International Organization of Securities Commissions
LTV	Loan to value
MBS	Mortgage-backed security
MID	Mortgage interest deductibility
MMF	Money market fund
mREIT	Mortgage real estate investment trust
MSR	Mortgage servicing right
MT	Megatonne
NBFI	Non-bank financial institution
OEF	Open-ended fund
PMI	Private mortgage issuance
REIT	Real estate investment trust
REMF	Real estate mutual fund
RMBS	Residential mortgage-backed securities

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Executive Summary

Housing occupies a central part of life. Its quality directly influences personal health and well-being. Its location shapes education, leisure and work possibilities. Its costs absorb a large share of household income. Its environmental performance determines a fair amount of local and global emissions of greenhouse gases. Its financing helps many buy a home and has implications for macroeconomic stability and resilience.

The COVID-19 pandemic and its aftermath have brought new dimensions to the fore, including not least greater recourse to remote work -- facilitated by digitalisation -- and the associated shifts in housing demand. The sharp rise in fossil fuel prices since the onset of Russia's war of aggression against Ukraine has put additional pressure on household budgets and highlighted the importance of improving energy efficiency in housing.

At the same time, rising awareness about the need to cut greenhouse gas emissions in line with agreed commitments has underlined the critical role of housing in the success of efforts to reach net-zero emissions by mid-century. Moreover, inflation is pushing up construction costs as well as prompting interest rate increases, thereby ending a period of exceptionally low mortgage costs.

Building on the findings of *Brick by Brick: Building Better Housing Policies*, this new volume expands the *Housing Policy Toolkit*[1] to make housing markets more efficient, more inclusive and more sustainable amid new challenges. Most of the policy tools identified in *Brick by Brick* remain appropriate to address these new challenges, but new ones have been added.

A number of policy options can be considered by governments, bearing in mind likely synergies and trade-offs among the three dimensions – efficiency, affordability and sustainability – that have guided the analysis:

- Governments have deployed measures to deal with the negative consequences of the increase in energy prices on vulnerable households and firms. They have introduced targeted means-tested income-based support programmes, energy price caps and other price-based interventions. The design of these support measures needs to strike a balance between social protection in the short term and the attainment of longer-term sustainability objectives. The blurring of energy price signals should be avoided to underpin needed changes in investment patterns, energy use and behaviour in support of the transition to a low-carbon economy. Cost-effectiveness in the use of scarce budgetary resources also calls for well-targeted measures that benefit the truly needy.
- The foundation stone of decarbonisation strategies is to ensure consistent carbon pricing across sources, sectors and over time, accompanied by adequate compensation measures to avoid adverse social effects. Carbon pricing – including properly calibrated taxes on fossil fuels used in homes or emission trading – offers an effective and cost-efficient way of creating carbon-saving incentives. It also prevents the "rebound effect" that can erode the efficacy of other policies: for instance, without carbon pricing, regulations or subsidies for energy performance improvements can see their effect partly or even fully offset by greater use. Importantly, the pricing of direct

[1] www.oecd.org/housing

emissions from homes has to go hand-in-hand with the effective pricing of carbon emissions from power generation to ensure appropriate incentives for energy savings, efficiency investment and greater use of decarbonised energy sources.

- However, effective pricing is not enough to decarbonise the housing sector, given the split incentives in landlord-tenant relations and a lack of knowledge among households about the energy performance of their homes. A policy mix combining appropriately designed energy performance certification for new and existing dwellings and renovation mandates, subsidies for energy retrofitting and possibilities to share energy-bill savings between tenants and landlords can help to overcome these obstacles.
- Advances in housing finance are also vital to decarbonising housing. Appropriate energy performance certification frameworks provide a basis for lenders to better recognise the credit quality attached to energy-efficient homes, reduce funding and lending costs and create markets for products that finance retrofit loans.
- In addition to providing support for decarbonisation, effective housing finance can enhance the resilience of financial markets. This is particularly important as monetary conditions evolve away from historically low borrowing costs. Better absorption of, and resilience to, shocks should result from the efforts made since the Global Financial Crisis to build buffers, including on the borrower side by capping loan amounts relative to house values and debt-service-payments relative to income, and on the lender side by requiring more capital against mortgage loans, better consolidating and monitoring off-balance-sheet housing exposures and deploying counter-cyclical capital buffers.
- The rise of non-bank lenders in housing finance over the last decade requires appropriate monitoring and assessments of systemic implications for the financial sector. Prudential regulations could be further strengthened, including by applying to non-bank lenders a risk-based approach in line with the banking regulatory framework.
- The widespread deployment of high-speed internet and advances in remote conferencing technology have enabled many to work from home, a trend that has accelerated since the COVID-19 pandemic and broadened the range of locational choices. The resulting shift in housing demand – from expensive areas in the city centre towards comparatively more affordable remote areas offering more spacious homes and better access to green space – calls for policies that facilitate supply adjustments. They include land use and zoning regulation changes to unlock land for development, redevelopment or densification in areas in greater demand. Tax policies can also support these shifts by focusing on recurring annual taxes rather than transaction-based levies. Central to this new geography of housing demand is continued investment in digital connectivity and the provision of public services, including performant transport infrastructure.
- Improvements in the environmental quality of urban areas due to increases in the provision of amenities have often led to higher house prices, with adverse consequences for low-income households, especially renters. The provision of social and affordable housing can mitigate these effects. Public investments and compensatory measures can be partly funded with tools, including land value taxes, impact fees and charges on building rights, that capture the increase in land value originating in the environmental improvement.

1 Housing policies for the post-COVID-19 era

The world is facing interconnected challenges arising from the consequences of the COVID-19 pandemic, Russia's war of aggression against Ukraine, high inflation and rising interest rates, and the transition to low-carbon economies. The housing sector is affected, directly and indirectly, calling for appropriate policy responses. The sharp rise in energy prices has increased energy poverty in many countries, undermining affordability. Inflation and rising interest rates are testing the resilience of housing finance. The mainstreaming of remote work and search for better environmental quality are reshaping demand for real estate. This chapter reviews policy options to address these challenges and highlights potential trade-offs.

Recent developments are posing interconnected policy challenges that, directly or indirectly, affect the housing sector. The run-up in energy prices has recalled the urgency to decarbonise housing in pursuit of agreed climate change targets. Tightening monetary conditions to quell high inflation in the wake of the pandemic and the energy price shock have increased housing finance costs. Repeated experiences of lockdowns and increased uptake of working-from-home practices may have changed work-life balances for good, as efforts to protect the environment are also reshaping housing markets.

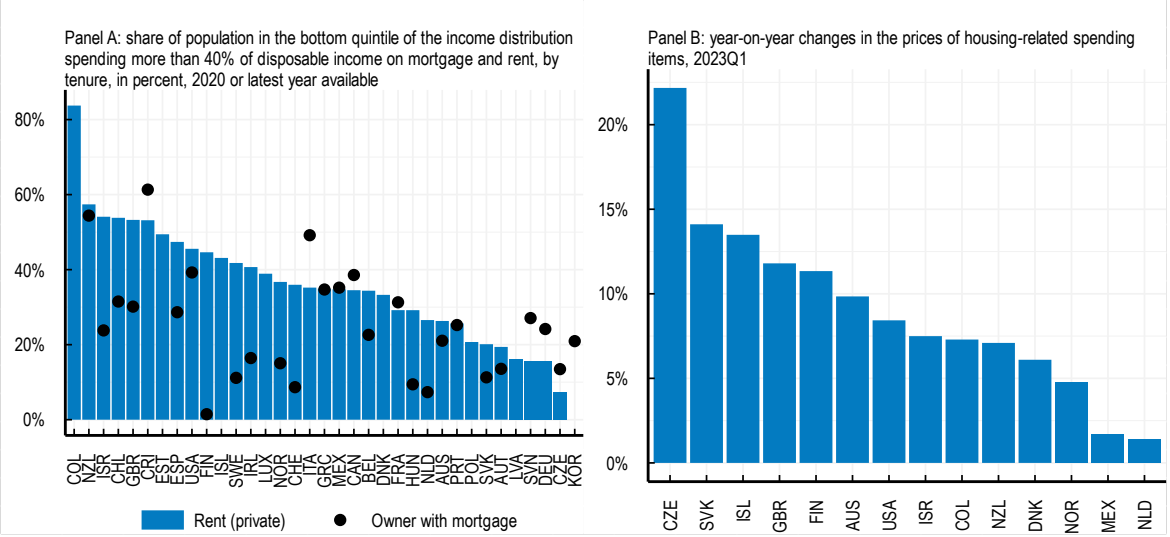
This chapter examines how public policies can respond to these challenges. It identifies tools that policymakers can mobilise to provide affordable homes, ensure the efficient functioning of housing markets and preserve today's and tomorrow's environment while recognising that some policy options involve trade-offs among these goals. The chapter draws on the analyses and recommendations developed with greater detail in the rest of the book, including policy tools to decarbonise housing (Chapter 2), mobilise housing finance to fund the climate transition in addition to making the economy more efficient and resilient (Chapter 3), reap the benefits of an emerging new geography of housing shaped by the digital revolution and demand for environmental amenities (Chapter 4).

Monitor the impacts of the pandemic and cost-of-living crises on housing affordability

Low-income households, many of whom were already overburdened by rental and mortgage costs before the pandemic, are at risk of further housing stress. Prior to the COVID-19 pandemic and the cost-of-living crisis, on average in the OECD, more than one in three low-income tenants in the private rental market spent over 40% of their disposable income on rent alone and were thus considered overburdened by housing costs (Figure 1.1, Panel A). Meanwhile, overburden rates among low-income homeowners with a mortgage reached 61% in Costa Rica, 54% in New Zealand and 49% in Italy, with considerable variation across OECD countries (Figure 1.1, Panel A). The sharp price increases in housing-related spending items experienced in 2022 exacerbate the pressure on household budgets and will likely increase overburden rates even further (Figure 1.1, Panel B). These developments should be monitored closely and evaluated together with recent income support and subsidies introduced by governments across OECD countries.[1]

[1] See "Coping with the cost of living crisis - Income support for working-age individuals and their families", (OECD, 2022[21]).

Figure 1.1. Current inflationary pressures are likely to result in more households becoming overburdened by housing costs

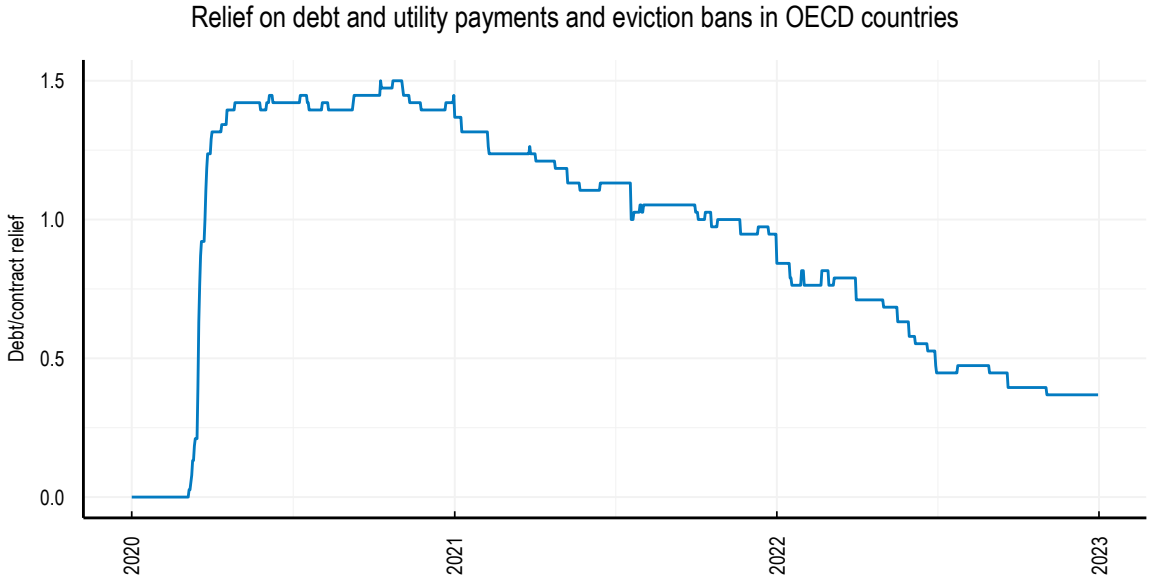


Note: Panel B: Housing-related expenditures include i) actual and imputed rents for housing, ii) maintenance and repair spending and iii) water, electricity, gas and other fuels, and miscellaneous services, as defined in the Classification of Individual Consumption According to Purpose (COICOP). The figure covers only 14 economies because it excludes countries for which homeowners' imputed rents data are missing in the source. By contrast, countries with missing data for maintenance and repairs of dwellings (Mexico and Colombia) are included in Panel B, as this group of items has a much smaller weight than imputed rents.
Source: OECD databases on Affordable Housing (Panel A) and Consumer Price (Panel B).

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Higher interest rates, rising construction and labour costs, high house prices and the lifting of temporary COVID-related housing support measures carry implications for affordability over the near and medium terms (Figure 1.2). There is a risk of an uptick in evictions and homelessness (Box 1.1), as temporary housing support (such as eviction bans and mortgage forbearance) introduced at the onset of the pandemic are phased out. Recent data available for some countries suggest a drop or stabilisation in the tenant eviction rate in 2021 compared with pre-pandemic figures. For example, eviction orders carried out in Italy decreased from 32 546 in 2015 to 9 537 in 2021, while evictions dropped in the United Kingdom (England) from 41 453 to 9 471. Eviction bans and mortgage forbearance schemes were always conceived as temporary interventions to deal with more structural challenges, as they fail to address the root causes of housing cost vulnerability.

Figure 1.2. Pandemic-related temporary relief measures have been phased out across many OECD countries



Note: The "debt/contract relief" variable records if governments are freezing financial obligations for households (e.g., stopping loan repayments, preventing services like water from stopping) or banning evictions. The figure above displays the mean across all 38 OECD countries for data through 1 January 2023. For each country, coding is carried out in the following way: 0 no debt/contract relief; 1 narrow relief, specific to one kind of contract; 2 broad debt/contract relief.
Source: OECD calculations using data from Hale, T. et al. (2021), "A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker)", *Nature Human Behaviour*, Vol. 5/4, pp. 529-538, https://doi.org/10.1038/s41562-021-01079-8.

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However, the current context is complicating a key structural response to make housing more affordable: the construction of new social and affordable housing development, which was already in short supply prior to the pandemic. Indeed, over the past two decades, public investment in housing has declined on average across OECD countries, and particularly since its peak in 2009 (Figure 1.3). Total public investment in housing and community amenities, a broad category that includes both public capital transfers and direct investment in many areas, including housing development, community development, water supply and street lighting, dropped by nearly 30% between 2009 and 2020. Total public investment in housing development alone was nearly cut in half between 2009 and 2020.

Box 1.1. Ending homelessness: Support to governments to improve measurement and policy responses

As temporary housing support measures introduced at the onset of the COVID-19 pandemic, such as eviction bans and rent freezes, are lifted in OECD countries (Figure 1.2), there is a risk of rising homelessness and housing precarity. While the pandemic first spurred rapid government responses to support people experiencing homelessness, their subsequent withdrawal, combined with the cost-of-living crisis, further strains many economically vulnerable households across the OECD.

Monitoring homelessness trends and implementing pro-active policies to prevent homelessness and help people experiencing homelessness to transition to stable housing should be a priority for policymakers in the OECD. Notwithstanding the challenges associated with data collection during the

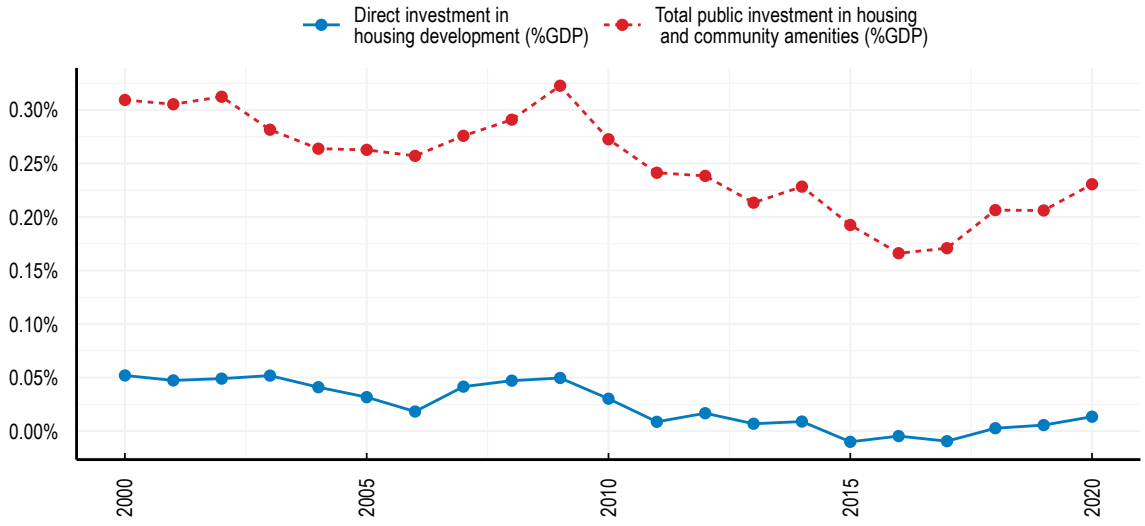
pandemic, homelessness remains hard to measure and compare across countries.[2] Because there are many pathways into homelessness and people's experiences with homelessness differ – from temporary or transitional periods without housing, to more chronic or repeated periods of homelessness – the policy responses to prevent homelessness and help people transition into stable housing must be tailored to individual needs, preferences and circumstances.[3]

Building on OECD data and analysis, the OECD is working to address the measurement gap and help governments develop effective solutions to end homelessness. Concretely, the OECD will develop i) a mapping of the existing evidence base, data collection methods on homelessness; ii) a monitoring framework to help governments better measure and monitor homelessness; and iii) a policy toolkit that provides guidance and good practice to combat homelessness and housing exclusion in OECD and EU countries.

Source: (OECD, 2015[1]; OECD, 2020[2]; OECD, 2021[3]; OECD, 2022[4]; Jarrett, 2021[5]).

Figure 1.3. Public investment in housing has dropped considerably since its peak in 2009

Total public investment in housing and community amenities, and in housing development, OECD-30 average, % GDP



Note: Total public investment in housing and community amenities includes both direct investment and public capital transfers. Housing and community amenities includes housing development, water supply, street lighting, R&D in housing and the provision of community amenities. Housing development include the acquisition of land for the construction of new dwellings and the improvement or maintenance of the existing housing stock. OECD-30 average refers to the unweighted average across 30 OECD countries and excludes Canada, Colombia, Korea, Mexico, New Zealand, Türkiye and the United States.
Source: OECD calculations drawing on the OECD National Accounts Database (Government expenditure by function) doi:https://doi.org/10.1787/5b0629cc-en.

StatLink https://stat.link/e24gv5

In the current context, increases in construction costs arising from more expensive raw materials, machinery and labour, and more demanding energy-efficiency standards (see Chapter 2), as well as rising interest rates (see below), are driving up development costs (Figure 1.4). As a result, many developments

[2] For more information on the methodological difficulties and available data, see (OECD, 2020[2]; OECD, 2021[3]; OECD, 2022[4]).

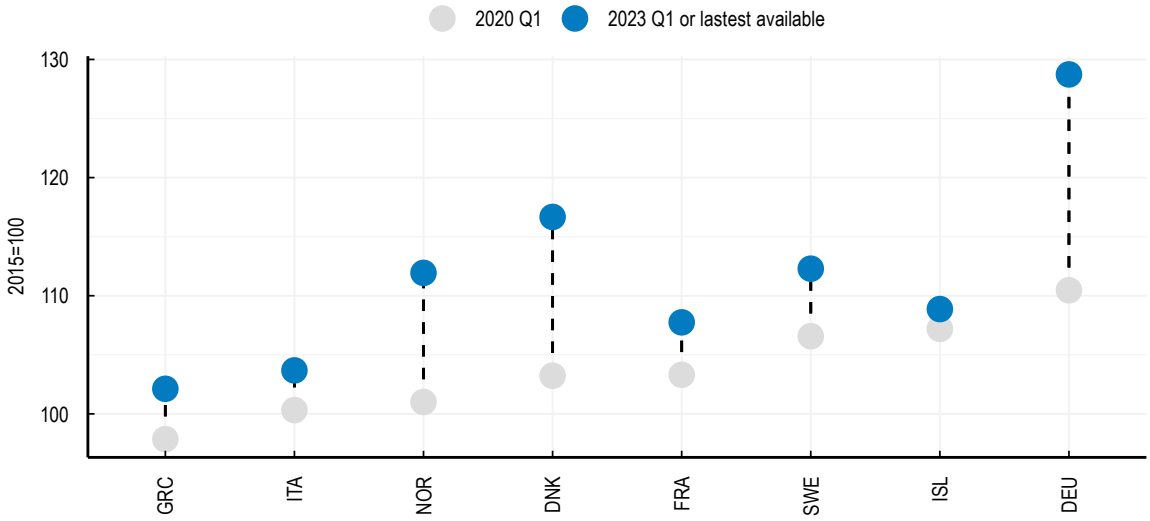
[3] For a more detailed presentation of policy options, see (OECD, 2020[2]; OECD, 2015[1]).

have been put on hold, especially in social and affordable housing, where developers are limited in their ability to raise rents to pass on higher costs to tenants. In Germany, municipalities and representatives of the construction sector predict that 70% of planned social and affordable housing projects are at risk. In the United Kingdom, planned affordable developments may not materialise or will deliver less than expected under England's Affordable Homes Programme.[4] More expensive development costs are also fuelling pressure on an already strained rental market, which could drive up rents for vulnerable tenants further. For instance, in the United Kingdom, in November 2022, private rental prices saw the largest annual percentage increase since records began in January 2016.[5]

Taking a long-term systemic approach to investing in affordable and social housing could help better manage some of these risks and put the sector on a more stable footing. A number of OECD countries have established revolving funds with the aim to create a long-term, sustainable mechanism to channel investment into affordable and social housing (Box 1.2).

Figure 1.4. Homebuilding costs have been rising much faster than inflation

Real residential construction cost indices, 2015=100



Note: Real residential construction cost refers to the construction cost index for new residential buildings, in national currency deflated by the consumer price index.
Source: OECD Main Economic Indicators and OECD Analytical Database.

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[4] Information on the German and UK examples come from (Tagesschau, 2022[18]) and (Department for Levelling Up, Housing and Communities, 2022[19]).

[5] See (U.K Office for National Statistics, 2023[20])

Box 1.2. Revolving funds to invest in affordable and social housing

To boost investment in housing, a number of OECD countries have established revolving funds, or more complex systems achieving the same effect, to finance the construction of affordable and social rental dwellings. These funds channel part of the rents or loan repayments into new affordable and social housing developments. The key features in establishing and operating a dedicated funding mechanism vary widely across countries, including with respect to the institutional set-up of the scheme, the funding and financing arrangements, and decisions around management and monitoring (Table 1.1).

Table 1.1. Framework for establishing and operating a revolving fund scheme to channel investment in affordable and social housing

	Institutional set-up	Funding and financing	Management and monitoring
Frame	• Enabling legislation • National housing policy • Structure of the funding approach	*Investment environment:* • Land-use regulations • Infrastructure • Size of existing rental market	*Management of the units:* • Eligibility criteria • Allocation criteria • Rent-setting approach • Maintenance of units • Financing building improvements
Scope	• Scope of the housing activities financed • Geographic scope of the activities financed	*Funding sources:* • Funding sources • Revolving fund mechanisms • Impact of funding scheme on public finances	
Tools	• Actors and expertise involved in the funding approach	*Financing instruments:* • Long-term loans • Incentives for affordable housing investments	*Management of the Fund:* • Monitoring and control of the Fund • External auditing requirements • Tenant protections and complaints

Institutional set-up

Institutional issues include decisions about the structure, function and scope of activities of the funding scheme, as well as the enabling legislation, policy environment and various actors involved in the scheme.

- The *structure of the funding scheme* varies widely: for instance, such schemes may be established within a dedicated, stand-alone institution (such as Denmark's National Building Fund) or via existing funding institutions to which additional resources are allocated (such as Latvia's Housing Affordability Fund); the fund may be a public or not-for-profit entity – or it may not be a formal entity at all (as in Austria and the Netherlands, where the entire system, led by housing associations, functions as a revolving fund scheme).
- The *scope of activities* supported through the funding scheme may include new construction of rental and/or owner-occupied housing, renovations and/or demolitions of existing dwellings, and/or investments in broader infrastructure and neighbourhood improvements.
- *Relevant actors* engaged in the scheme may include the central government, including ministries as well as other public agencies; sub-national actors (regions, municipalities, municipal housing companies); housing developers (including non-profit, limited-profit and co-operative housing developers); and commercial banks as well as international development banks.

Funding and financing

Financial matters include identifying potential funding sources at different stages, the different financing instruments, and the investment environment. Typically, such funds are established with initial equity (often but not always from public resources), often complemented by concessional or commercial loans and/or government guarantees. The funding schemes use a share of tenant rents (and, in the case of Austria, a share of the developers' profits) to finance new construction, renovations and/or the purchase of existing dwellings.

Examples from OECD countries

OECD country experiences include:

- *Denmark's National Building Fund:* A dedicated, stand-alone, self-governing funding institution that was established by housing associations to promote the self-financing of construction, renovations, improvements and neighbourhood improvements. Funding is based on a share of tenants' rents and contributions from housing associations to mortgage loans.
- *Austria's affordable and social housing model:* Austria's funding approach relies on limited-profit housing associations that operate revolving funds under the supervision and with the steering of the federal, regional and municipal governments. Projects developed by limited-profit housing associations are typically financed by multiple sources, including tenant contributions, housing associations' own equity, and public and commercial loans.
- *The Slovak Republic's State Housing Development Fund:* A fund established to finance the housing priorities of the government, the fund is an independent entity supervised by the Ministry of Transport and Construction. Originally financed exclusively from the State budget, the fund currently draws on a small amount of government funding and European structural funding, along with repayments on the loans it issues.
- *Latvia's Housing Affordability Fund:* Latvia has established a new funding scheme to channel investment in affordable housing, with initial funding from the EU Recovery and Resilience Facility, with the possibility for additional resources from State and commercial loans. In a first phase, the fund intends to finance the construction of new affordable rental housing outside the Riga capital area, which will be leased at below-market rents to households that meet income threshold requirements.
- *Slovenia's Housing Fund:* a dedicated fund for housing established to finance and implement the National Housing Programme. The Housing Fund is a public finance and real estate fund that provides long-term loans with a favourable interest rate to public and private entities to purchase, maintain and renovate non-profit rental housing or owner-occupied dwellings. The fund also invests in construction and land for development and supports the construction, refurbishment and renovation of housing for vulnerable groups.
- *The Netherlands' affordable and social housing model:* Housing associations have access to a guarantee fund (the Social Housing Guarantee Fund, or WSW). This system of housing associations operates as a sort of "revolving fund", benefitting from lower interest rates thanks to the WSW and their mutual co-operation agreement to bail out housing associations. Furthermore, the Dutch State and municipalities act as guarantors of last resort for bank loans.

Source: (OECD, 2020[6]; OECD, 2023[7]; OECD, 2023[8]).

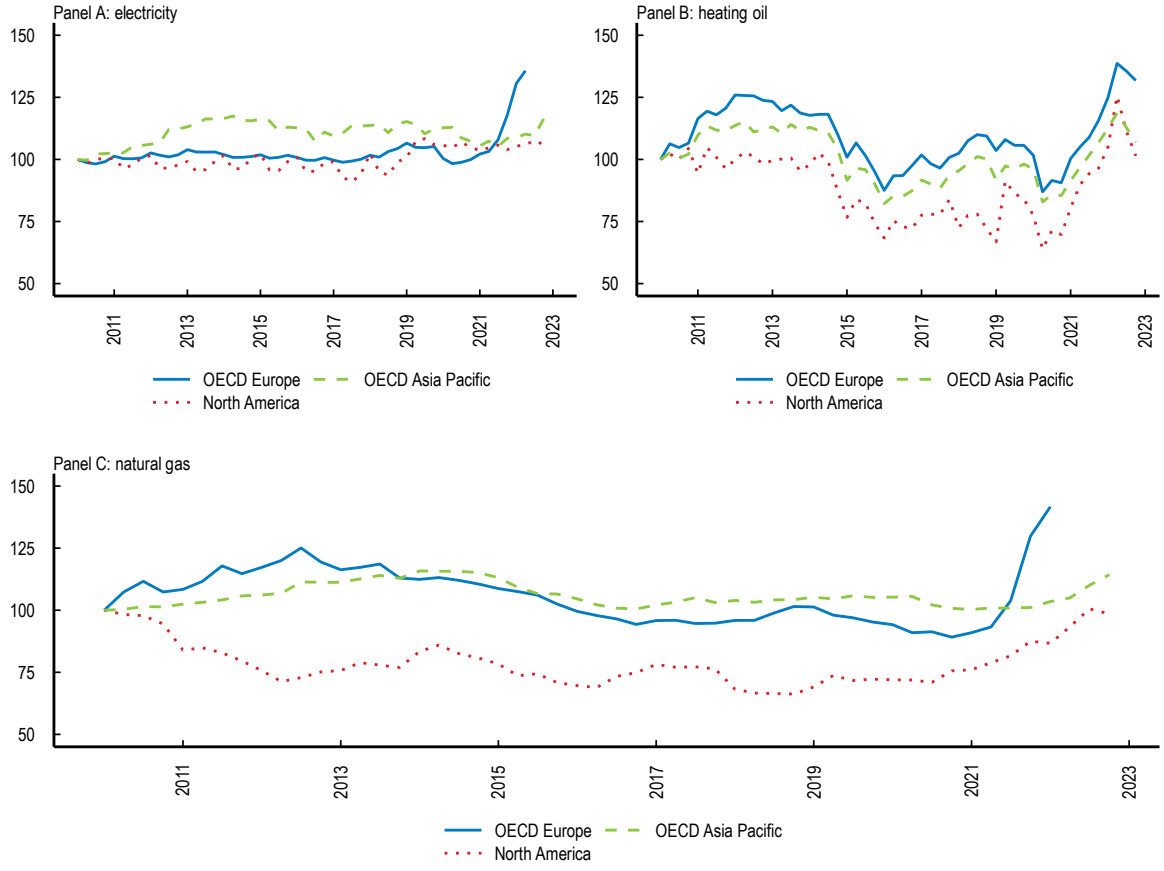
Face the energy crisis by laying the groundwork for low-carbon housing

Home energy costs have been highly volatile

Household spending on energy has risen sharply as a result of the fossil fuel price shock triggered by the onset of the war in Ukraine (Figure 1.5). In some countries, droughts have put further upward pressure on electricity prices. Heating and hot water account for an average of 75% of home energy use across OECD countries (Chapter 2).

Figure 1.5. Home energy costs soared, especially in Europe

Real retail energy price index, 2010Q1 = 100



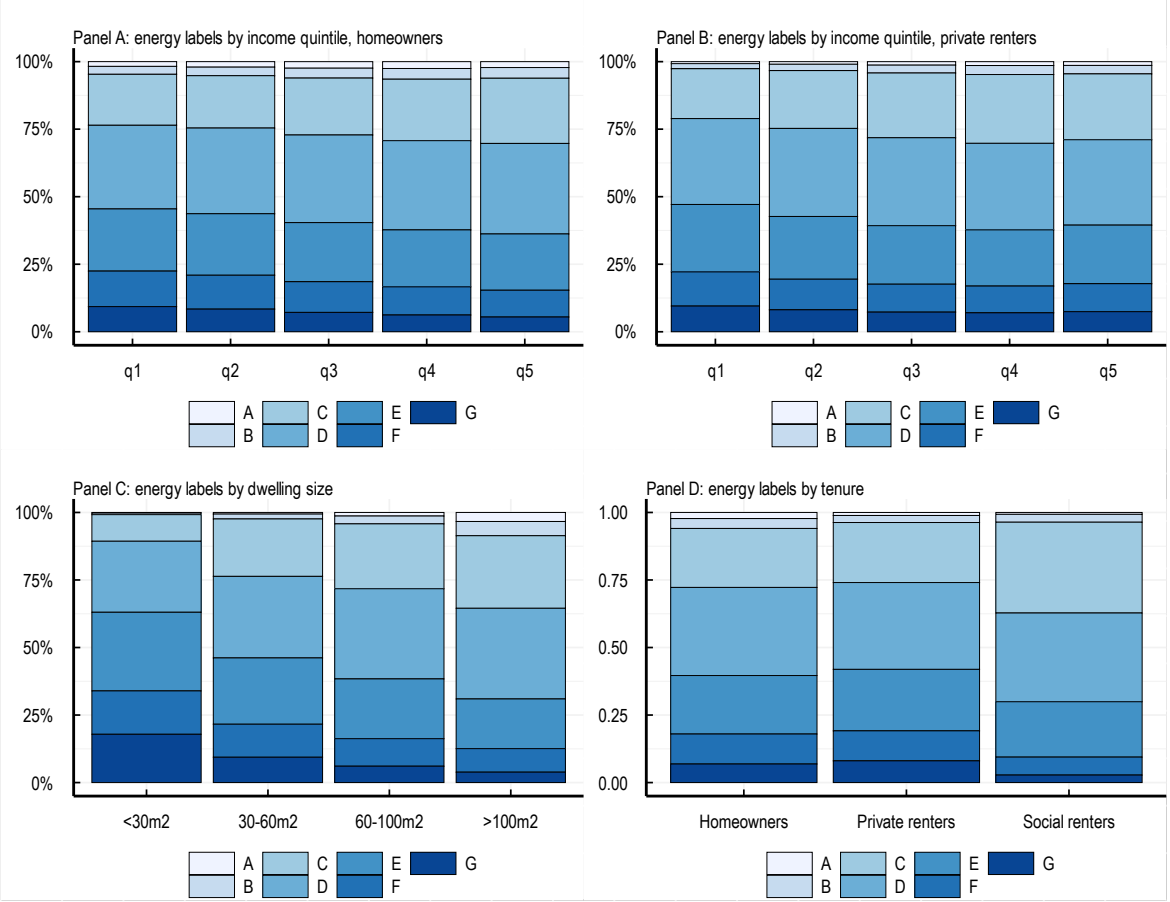
Note: Real retail energy price corresponds to the sub-indices for energy products of the CPI deflated by the CPI. OECD Asia + Oceania includes Japan, Korea, Australia, and New Zealand, North America includes Canada and the United States.
Source: IEA Energy Prices Database.

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Energy price shocks pose particularly acute difficulties for low-income households and those living in poorly insulated homes. These characteristics often reinforce each other (Figure 1.6). Because households use energy at home to fulfil basic needs, they cannot respond to sharp price rises by quickly reducing consumption. As a result, low-income families spend a higher share of their income on energy (Figure 1.7), although the difference vis-à-vis higher-income groups is relatively modest in several countries.

Figure 1.6. The energy performance of homes varies according to household income, dwelling size and tenure status

The case of France, 2022



Note: The housing stock includes all primary residences on 1 January 2022 in metropolitan France. The energy certificate labels are estimated for the entire housing stock on the basis of 310 000 energy certificates collected by Ademe from December 2021 to March 2022 and tax data. Certificates classify energy efficiency from high (A) to very low (G).
Source: France's National Observatory of Energy-Efficiency Retrofitting.

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Figure 1.7. Home energy costs weigh particularly heavily on low-income households

Share of housing-related energy spending in household consumption by income group, 2020 or latest available



Note: Top (bottom) income corresponds to the fifth (first) quintile of the income distribution in the Czech Republic, France, Japan, Mexico, the United Kingdom and the United States. In Germany and Spain top (bottom) income refers to monthly income higher than EUR 5 000 (below EUR 1 300 in Germany and below EUR 1 000 in Spain). In Denmark top (bottom) income refers to yearly income above DNK 1 000 000 (under 250 000 DKK).
Source: Causa, Soldani and Luu (2023[9]) and OECD calculations.

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Decarbonising housing has become more urgent

The sharp rise in fossil fuel prices has brought to the fore the need to decarbonise the housing sector by enhancing the energy efficiency of buildings and promoting a shift towards greater use of green fuels for direct and indirect energy use. Better insulated homes with energy-efficient appliances reduce energy consumption and mitigate the impact of energy price spikes on household finances. Greening the sources of energy used in buildings further reduces the sector's dependence on fossil fuels. Greater home energy efficiency and low-carbon energy sources would also reduce the need for short-term relief measures to lighten the burden on household budgets from fossil fuel price shocks (Table 1.2).

Table 1.2. Selected short-term energy cost relief measures, 2022-23

Country	Name	Description
France	Energy check	Supplementary "energy checks", of EUR 100-200 have been paid to the 40% lowest-income households in 2022 in addition to the "energy checks" paid since 2008 to the poorest households. This measure complements the tariff shield applicable in 2022-2023, which caps retail electricity and gas prices.
Germany	Energy relief plan	The plan aims to help ease the energy crisis for industries and households with EUR 200 billion of support. The fund, to last until 2024, is set to finance energy price caps and subsidies. Households will benefit from a price cap of 80% of their usual gas-consumption bill starting in March 2023 until the end of April 2024. They will pay EUR (0.12/check) per kilowatt hour for the first 80% of last year's use of gas.
Nether-lands	Energy price cap	From 1 January to 31 December 2023, the energy price of all small consumers of energy – households, self-employed people, small businesses and associations – is capped. Up to a consumption of 1 200 m³, the price of gas will be kept under EUR 1.45 per m³. Electricity will be available at EUR 0.40 per kWh for a maximum consumption of 2 900 kWh. In 2022, small consumers are receiving EUR 190 discounts on their energy bills of November and December.
Spain	Gas price cap	The Spanish government capped wholesale gas prices to lower the electricity bill for households, since natural gas prices are the key driver of the electricity price on the Spanish power market. The average electricity price is expected to fall significantly to around EUR 130 per megawatt hour on average over 2023 from EUR 210 in the first quarter of 2022.

United Kingdom	Energy Price Guarantee	This scheme aims to reduce the unit cost of electricity and gas so that a household with average energy use pays around GBP 2 500 a year for their energy use. The scheme entered into effect on 1 October 2022 to run at least until April 2023. As a result, an average household is estimated to save GPB 1 000 a year. Energy suppliers are fully compensated by the government for the savings delivered to households.

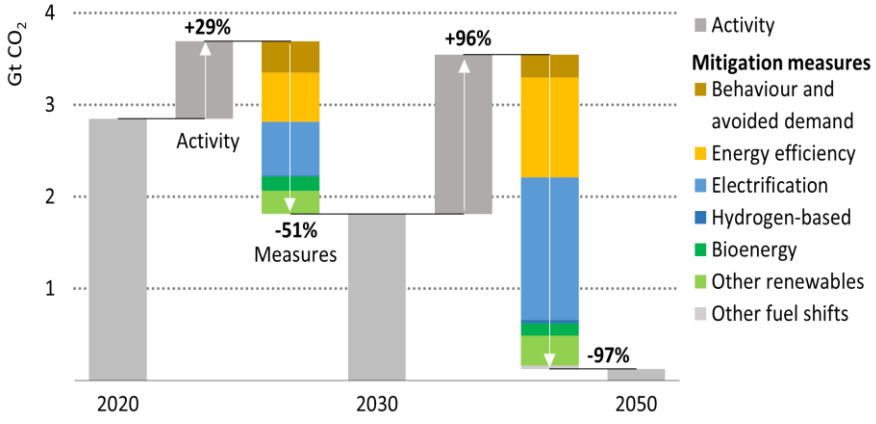
Source: *Decarbonising Homes In Cities in the Netherlands: a Neighbourhood Approach*, OECD (2023[10])

An array of tools is available to put housing-sector emissions on track to net zero

Together with greater energy efficiency, the other pillar of housing decarbonisation is the phasing out of fossil fuel use in homes coupled with the decarbonisation of electricity generation. Natural gas, fuel oil and coal boilers need to make way for electricity and, to a lesser extent, biomass (such as wood) and renewables (such as rooftop photovoltaic panels) (Figure 1.8). Electrification helps to decarbonise the housing sector to the extent that power generation shifts to carbon-free sources: in this respect, the reduction of housing-related emissions also depends on the success of efforts to decarbonise electricity generation.

Figure 1.8. Energy efficiency and electrification are the two main pillars of housing decarbonisation

Breakdown of global building-sector direct CO_2 emission reductions by measure in the IEA Net Zero scenario



Note: OECD or country breakdowns are unavailable for the IEA Net Zero scenario. Activity refers to demand created by rising population as well as increased per capita floor area and income. Behaviour refers to demand changes resulting from user decisions such as changing heating or cooling temperatures. Avoided demand refers to changes flowing from technology developments such as smart appliances.
Source: *Net Zero by 2050 – A Roadmap for the Global Energy Sector*, IEA (2020[11]).

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Efforts to decarbonise housing would have the additional benefit of reducing vulnerabilities to fossil fuel price swings. Still, their primary purpose is to contribute to achieving net-zero emissions by 2050 in line with agreed climate change targets. Housing is central to the success of climate change mitigation strategies, as the sector is responsible for more than a quarter of CO_2 emitted on average in OECD countries. Over the past two decades, housing-related emissions declined by 17% on average across OECD countries, even though a much faster reduction, well beyond what the current announced policies are expected to achieve, is required to get to net zero emissions by 2050.

As detailed in Chapter 2, effective policy packages to decarbonise buildings need to price housing-related emissions while deploying additional measures that consider the sector's specificities that make pricing alone insufficient. Pricing is a powerful tool to create incentives to avoid emissions in housing as in other sectors (D'Arcangelo et al., 2022[12]). Properly calibrated taxes on fossil fuels used in homes or emission trading offer an effective way of pricing residential emissions (Table 1.3).In countries where indirect taxes

are already high, the pricing of fossil fuels used in homes need not imply additional taxes but may require a reorganisation of tax rates to better align them with emissions of CO_2 and other pollutants.

The pricing of direct emissions from homes has to go hand-in-hand with the effective pricing of carbon emissions from power generation. This combination is important for three reasons: first, to create incentives to substitute electricity for fossil fuels in homes; second, to ensure that the power used in electrified homes comes from low-carbon sources; and third, to create appropriate incentives for energy saving and investment in energy retrofitting.

Carbon pricing needs to be complemented by additional policies. This is because of split incentives along the tenure spectrum. Importantly, landlords have weak incentives to invest in electrification and insulation if the resulting energy-bill savings accrue to tenants and if renovation costs cannot be passed on to tenants through higher rents. Tenants also have weak incentives to invest, because rental contracts are often too short for lower future energy bills to compensate for often onerous upfront investments. Indeed, the period before investments in home energy retrofitting break-even is usually long, especially for insulation (Chapter 2). Challenging coordination issues can also arise among homeowners in multi-apartment buildings. Such factors explain why the housing sector responds more weakly to changes in carbon pricing than other sectors, such as transport, industry or power generation.

Against this background, a variety of policy interventions can complement carbon pricing, ranging from environmental regulation through subsidies and financial support (Table 1.3). Regulation is well suited to phasing out fossil fuel boilers, mandating net-zero standards in new construction and rolling out energy-performance certification for buildings. It is particularly important to extend energy performance certification to all buildings, not only new ones, because new construction accounts for less than 1.5% of the building stock in OECD countries, making the energy renovation of existing homes a necessity (Figure 1.9). Tighter regulation in this area often triggers resistance, which can be overcome by a combination of mandates and financial support through subsidies (Chapter 2). The timeline for phasing-in net-zero-compatible requirements needs to take into account the pace at which the renovation sector can grow whilst acquiring the necessary competencies and the availability of the needed raw materials. Another consideration for the timing of energy retrofitting mandates is to avoid triggering a sharp depreciation of the value of housing assets that might create financial-stability risks.

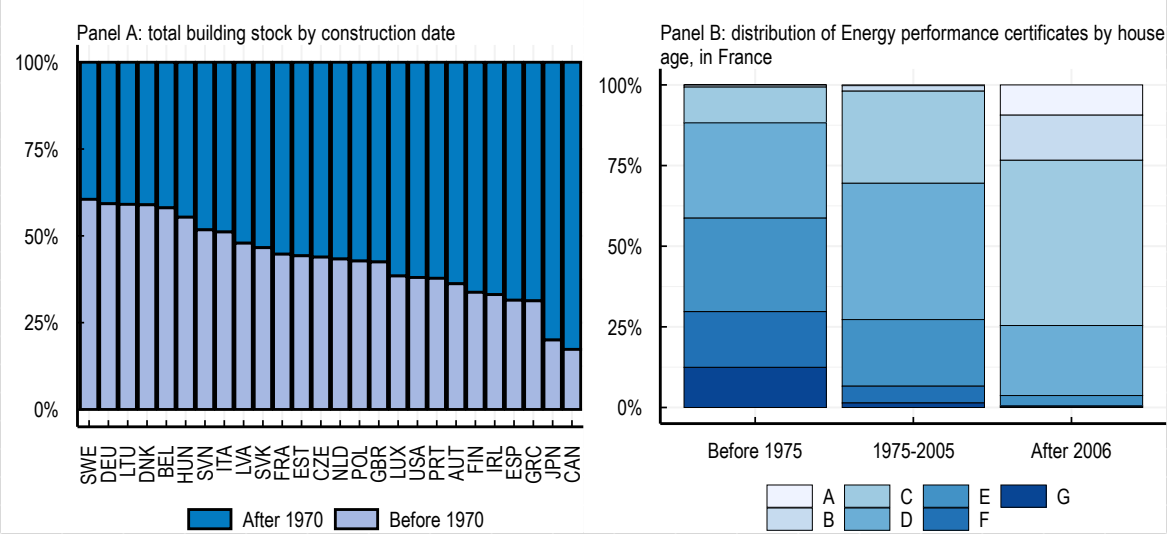
Table 1.3. Main measures to decarbonise the housing sector

	Advantages	Limitations
Carbon pricing:	Creates incentives for emission reductions Necessary for most other measures to be fully effective	Insufficient on its own due to housing specificities such as landlord-tenant split incentives, frequent low awareness and lack of information about home energy efficiency and funding issues
- Carbon tax	Fairly straightforward to administer Provides revenue	Exacerbates energy poverty especially in the short term Regressive along the income distribution before revenue use
- Tradeable permits	Easy to administer if traded upstream Provides revenue if auctioned	Exacerbates energy poverty especially in the short term Regressive before revenue use Creates windfall gains if grandfathered
Carbon regulation:	Delivers carbon-efficiency gains directly	Can see their direct effects partly offset by greater demand ("rebound effect")
- Ban on fossil fuel boilers	Prompts electrification	Requires decarbonisation of power generation Can be unpopular
- Energy performance labelling mandates for buildings	Guarantees awareness of energy performance	Slow to take up if applied only at the time of transactions (sales or new leases) Unpopular if required outside transactions
- Net-zero compatible building standards	Ensure that new homes are compatible with net zero	Entail some increase in building costs Insufficient on their own as the stock is only slowly renewed
- Net-zero upgrade requirements on existing homes	Provide very fast progress	Very unpopular except if coupled with large subsidies Require a sufficiently developed energy renovation sector May involve high costs relative to decarbonisation options

		available in other sectors
Subsidies:	Help to fund options with long pay-off periods	Can result in rebound effect unless backed by carbon pricing
- For renovation or the deployment of existing technologies	Help to overcome the up-front cost of renovations Receive strong support	Can be very costly for the public purse Can be inefficient, if they involve a high cost per tonne of avoided CO_2 emissions
- For research and development	Very useful especially on the basic research side of the R&D spectrum	Require carbon pricing for technologies to become attractive on the market
Property regulation:		
- Allow a split of the energy saving bill between landlords and tenants	Reconciles the incentives of tenants and landlords towards energy-efficiency improvements	Requires modifying rent-adjustment contracts, involving administrative complexity and potential opposition
- Lower the bar for votes on energy renovation work in multi-family buildings	Avoids stalemates that can prevent energy-efficiency improvements	Possible opposition from liquidity-constrained owners
Financial policy		
- Require that the green labels given to buildings and real estate-backed financial products are transparent and comparable	Helps green real estate finance get scale Makes it possible for a renovation-funding market segment to develop Allows lenders to recognise the credit quality associated with high energy-efficiency homes	None

Note: The table summarises the main advantages and limitations of the measures. For more detail, see Chapter 2 for pricing, regulation and subsidies and Chapter 3 for financial policy.
Source: OECD.

Figure 1.9. A large share of the building stock is more than 50 years old in OECD countries



Notes: Panel A: Year of data collection: EU - 2014 (Austria - 2009), Canada - 2018, Japan - 2008, US - 2019.
Panel B: The housing stock includes all primary residences on 1 January 2022, metropolitan France. The energy certificate labels are estimated for the entire housing stock on the basis of 310 000 energy certificates collected by Ademe from December 2021 to March 2022 and tax data. Certificates classify energy efficiency from high (A) to very low (G).
Source: EU Buildings database, Canada National Energy Use database, NAHB 2021, and OECD calculations (Panel A); and France's National Observatory of Energy-Efficiency Retrofitting (Panel B).

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Financial markets can do a great deal to decarbonise housing

There is scope for making greater use of financial markets to accelerate the decarbonisation of housing. Financial intermediaries can play an important role and help smooth the costs of investment in the energy retrofitting of homes over often very long pay-off periods. However, financing for energy renovation is in short supply, especially by comparison with consumer loans or mortgages. Yet, empirical evidence suggests that investment in energy efficiency improvements tends to be capitalised in house prices and reduce homeowners' future energy bills, bolstering borrowers' loan repayment capacity, which should be reflected in lower borrowing costs.

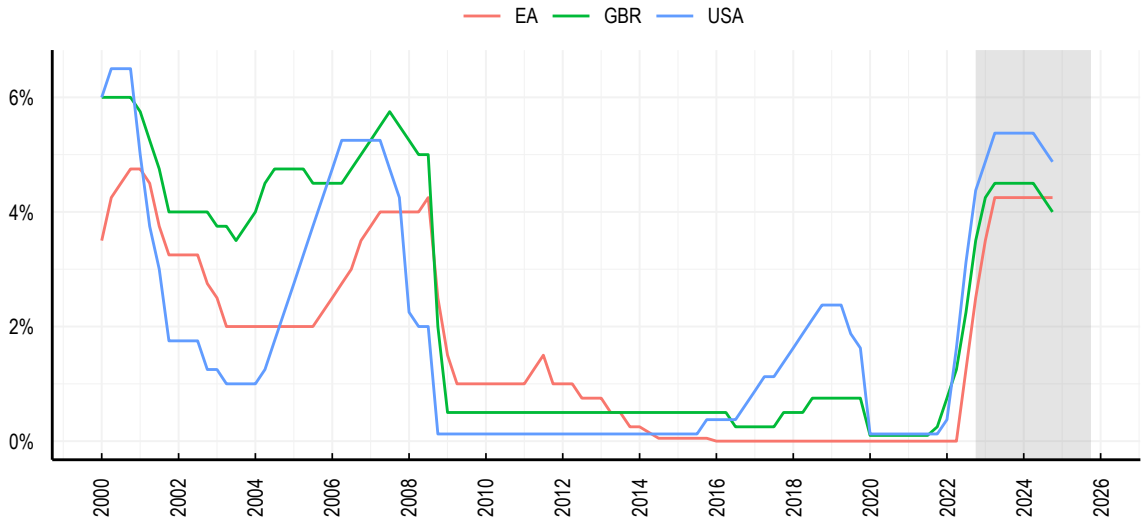
A requirement for progress in this area is to instil greater transparency and comparability in the energy efficiency labelling of real-estate-backed financial products (Table 1.3 and Chapter 3). The fragmentation and opaqueness of this market prevent lenders and their funding markets from reflecting the lower risk attached to loans for the energy retrofitting of homes. Scaling up the market for green housing finance products requires reliable, internationally comparable energy performance certification of all buildings, not just those for sale or rent, with sufficient transparency of the related financial products, lending or investment vehicles.

Maintain resilience in the face of a turning housing cycle

Conditions have changed in the housing market. For buyers, after a prolonged period of low interest rates, nominal interest rates have risen across OECD countries (Figure 1.10), as monetary authorities grapple with high inflation. Even if household incomes partly adjust to inflation, higher nominal interest rates reduce the mortgage servicing capacity of households for a given level of house prices. On the supply side, together with higher interest rates, sharp increases in raw material, machinery and labour costs are making development more expensive (Figure 1.4).

Figure 1.10. Nominal interest rates have risen sharply

Key monetary policy interest rates

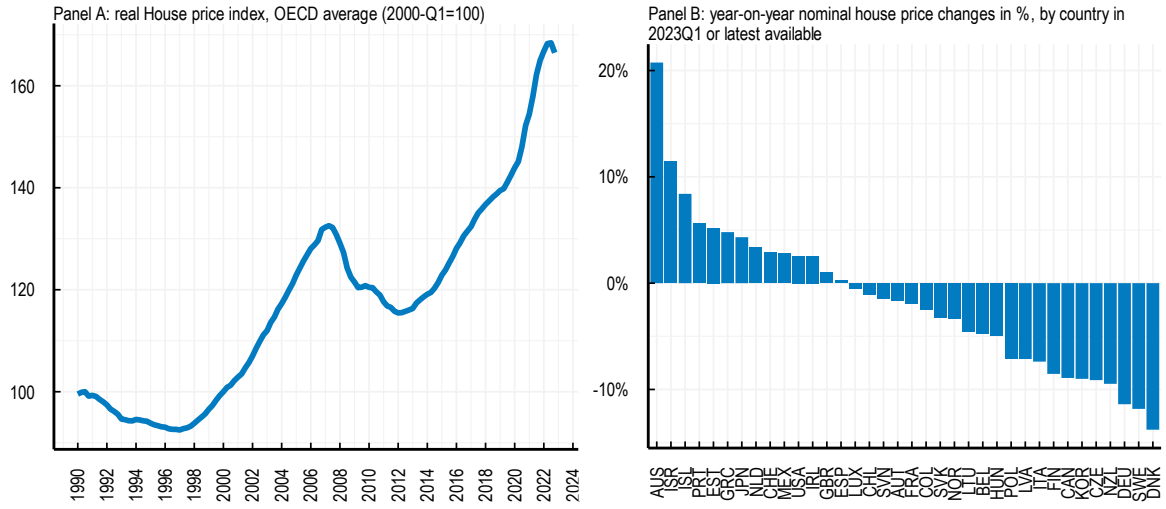


Note: The shaded area corresponds to projections.
Source: OECD Economic Outlook, March 2023.

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As a result of these developments, housing markets are facing a turn in the cycle in many countries. Real house prices, which stand at elevated levels after a long period of strong increases, have recently started to decline in a number of OECD countries (Figure 1.11). A turn in the housing cycle could potentially test financial stability by reducing the capacity of households and developers to service loans, threatening the value and credit quality of loans and other financial assets related to housing. In many OECD countries, mortgage debt stands at higher levels, even relative to income, than at the onset of the global financial crisis (Figure 1.13). In this environment, monetary and prudential authorities have been sharpening their focus on housing markets (Figure 1.12).

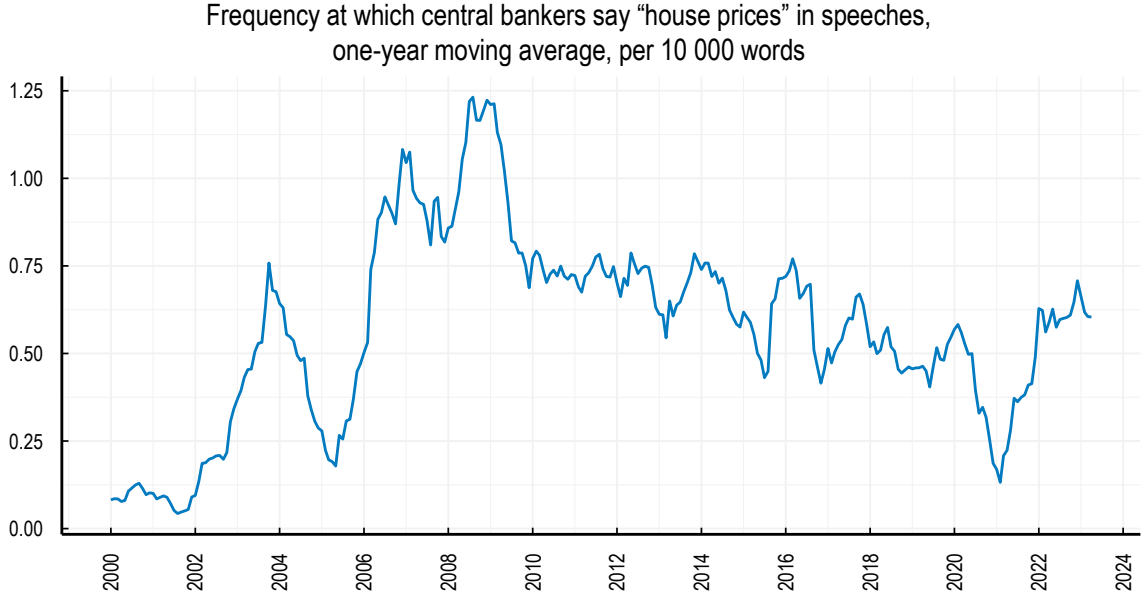
Figure 1.11. Real house prices are high but may have peaked in many countries



Note: Nominal house prices deflated by the private consumption deflator from the national account statistics.
Source: OECD Analytical House Price Indicators.

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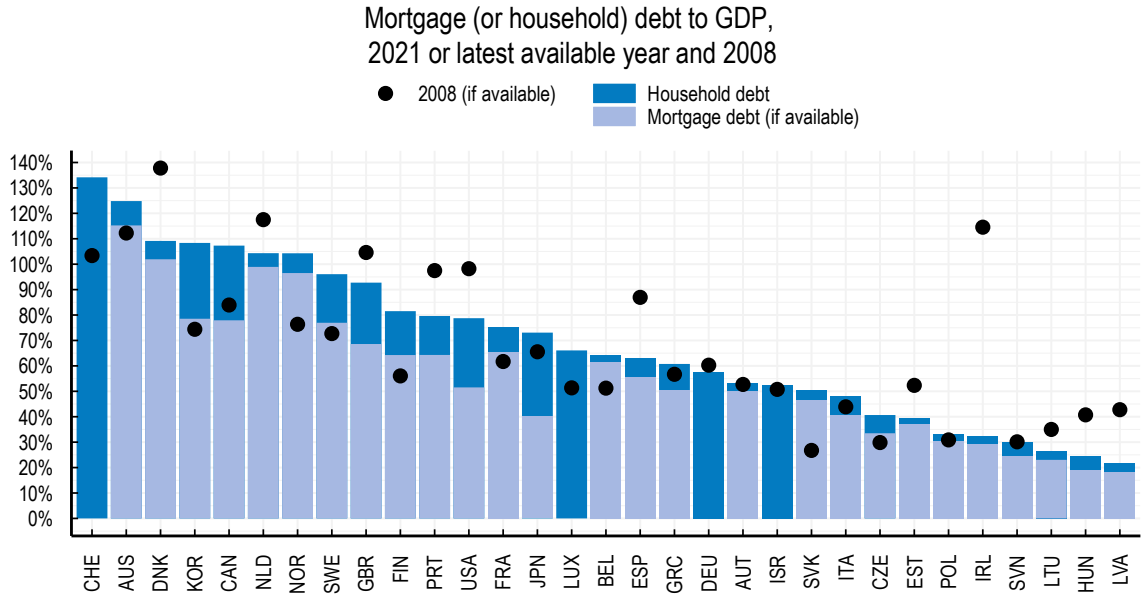
Figure 1.12. Central bankers are monitoring house prices with renewed attention



Note: The y axis shows the frequency at which “house price” or “house prices” appear in official speeches by central bankers.
Source: BIS repository of central banker speeches and OECD calculations.

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Figure 1.13. Household debt has risen in many countries



Note: Data for 2020 for Austria, Bulgaria, Estonia, Finland, France, Croatia, Ireland, Israel, Italy, Japan, Korea, Lithuania, Luxembourg, Latvia and Slovakia. Data for 2019 for Greece.
Source: OECD Analytical Database.

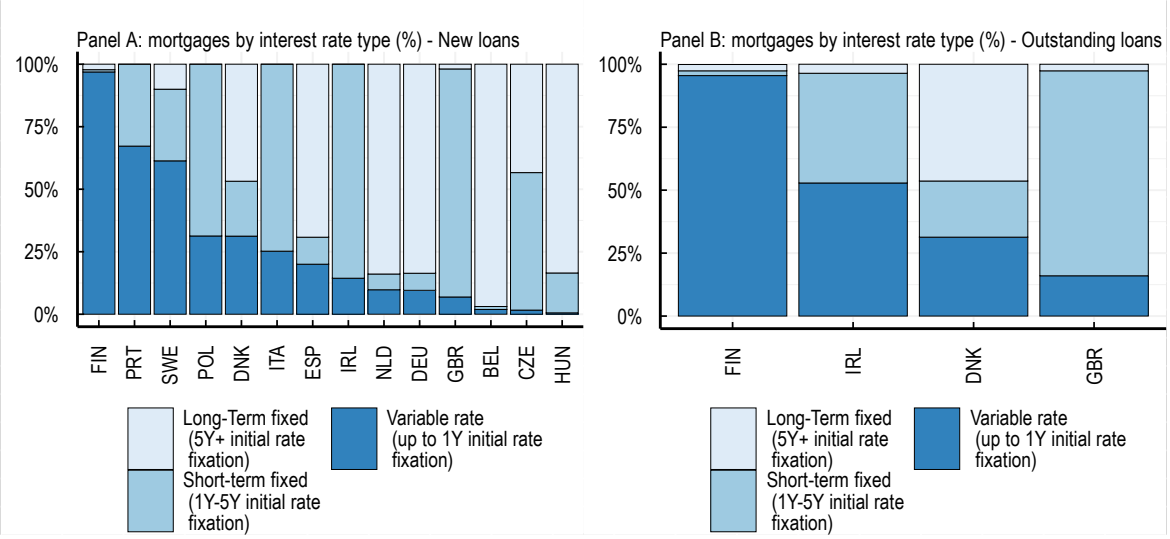
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The transmission of tightening monetary conditions to housing borrowing costs is swifter where mortgages feature variable interest rates. Variable-rate mortgages represent the majority of existing and new loans in several OECD countries (Figure 1.14). The pressure associated with rising borrowing costs is particularly strong on low-income borrowers with adjustable-rate mortgages. In countries such as the United Kingdom and Sweden, the interest rates of the majority of outstanding mortgages are fixed during the first five years, and borrowers face the prospect of interest rates increases when they renew their mortgage. [6]

As further developed in Chapter 3, OECD countries have deployed an array of macroprudential measures to safeguard financial stability in the face of housing market pressures. On the borrower side, many regulators have imposed limits on loan amounts relative to house values (loan-to-value, LTV caps), debt-service to income ratios (DSTIs), and/or debt amounts relative to income (DTI). As for lenders, regulators have, among other measures, been requiring banks to hold more equity capital against mortgages, build additional counter-cyclical capital buffers where necessary, and better consolidate their mortgage-related commitments to other market players on their balance sheets. Structural measures, such as personal income tax reforms that gradually withdraw mortgage interest relief for homeowners, also contribute to make housing finance more efficient and stable (Table 1.4).

[6] UK Office for National Statistics (2023).

Figure 1.14. A number of countries have a large share of variable-rate mortgage lending



Note: Data on adjustable-rate mortgages refer to the amount of gross lending. Data on new mortgages in Panel (A) refers to data from the second quarter of 2022. Data on outstanding mortgages in Panel (B) refers to the latest available data (second quarter of 2022), except for Ireland (first quarter of 2022).
Source: European Mortgage Federation.

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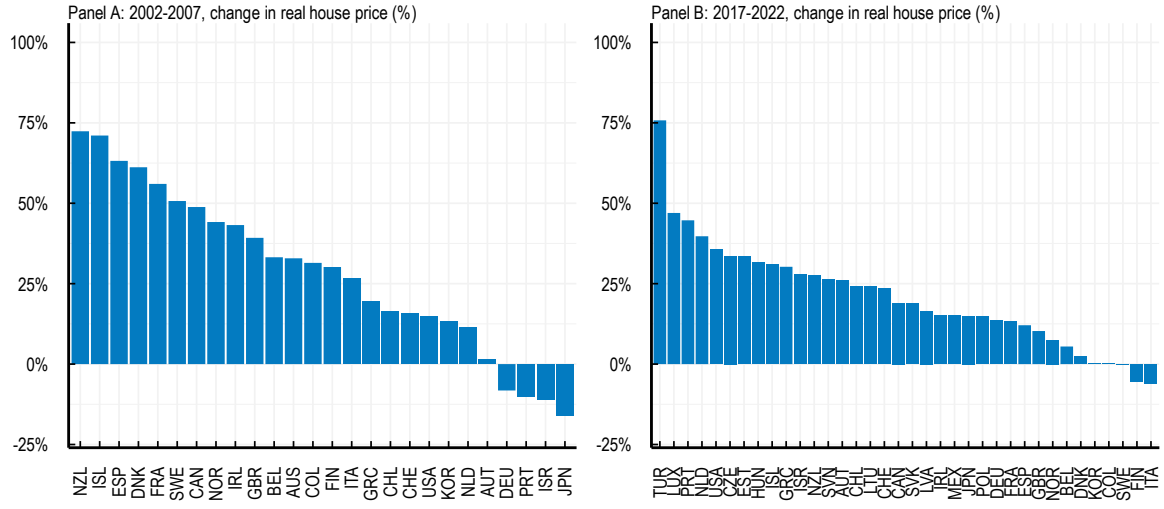
Table 1.4. Selected policy tools for housing finance

	Advantages	Limitations
Gradually withdrawing mortgage interest relief for homeowners	Avoids encouraging excessive mortgage debt build-up Reduces upward pressure on house prices Yields substantial tax revenue	May narrow access to homeownership before prices adjust to the reform Increases the overall tax burden except if accompanied by other tax changes
Macroprudential policy:		
Lending side		
- Capital requirements - Leverage caps	Makes financial intermediaries more resilient to non-performing loan Reduces upward house price pressures	May limit access to housing finance
- Implement a risk-based approach to the regulation of non-bank mortgage lenders and services	Reduces the risk of contagion from non-bank housing-finance market players	May limit access to housing finance
- Impose capital buffers and additional liquidity requirements on real-estate investment trusts and mutual funds	Enhances capacity to absorb losses or funding shortages	Could reduce funding channeled by real estate investment trusts and mutual funds
- Adapt capital and liquidity surcharges to cyclical conditions	Reduces financial amplification of housing-market swings	May be difficult to calibrate in real time
Borrowing side		
- Cap loans in relation to property value	Limits excessive borrowing	Makes housing finance sensitive to the housing price cycle
- Cap debt service payments in relation to borrower's income	Reduces housing debt overhang	Makes housing finance sensitive to interest rate changes
- Cap housing debt in relation to borrower's income	Avoids excessive borrowing even in a low-interest environment	

Note: The table summarises the main advantages and limitations of the measures. For more detail, see Chapter 3.
Source: OECD.

The experience of OECD countries suggests that these measures are effective at improving financial and economic resilience.[7] While substantial, the rise in real house prices prior to 2022 was not as strong as prior to the global financial crisis (Figure 1.15). Banks globally have ample liquidity, providing them with buffers against adverse scenarios.[8] Many countries have counter-cyclical buffers in place (Chapter 3). This suggests that policymakers have the needed tools to address risks that may emerge from housing markets and prevent adverse feedback loops from house price reductions to financial markets more generally.

Figure 1.15. Real house prices rose strongly before 2022 but overall not as much as before 2007



Note: Real house prices are calculated as nominal indices deflated by the private consumption deflator.
Source: OECD Analytical Database.

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The digital revolution has been a key driving force behind the rapid expansion of housing finance, some of which require particular regulatory vigilance in the current environment. Non-bank mortgage lenders and mortgage servicers, which have expanded considerably over the past decade (Chapter 3), need to be monitored to ensure that they do not provide undue levels of liquidity and maturity-transformation that could pose systemic risks. There is also a risk of spillovers if real estate mutual funds (REMFs), which face large outflows, respond by suspending redemptions. A central option to mitigate this risk would be to impose capital buffers and strengthen liquidity requirements.

Facilitate the reshaping of housing markets amid the rise of remote work and environmental concerns

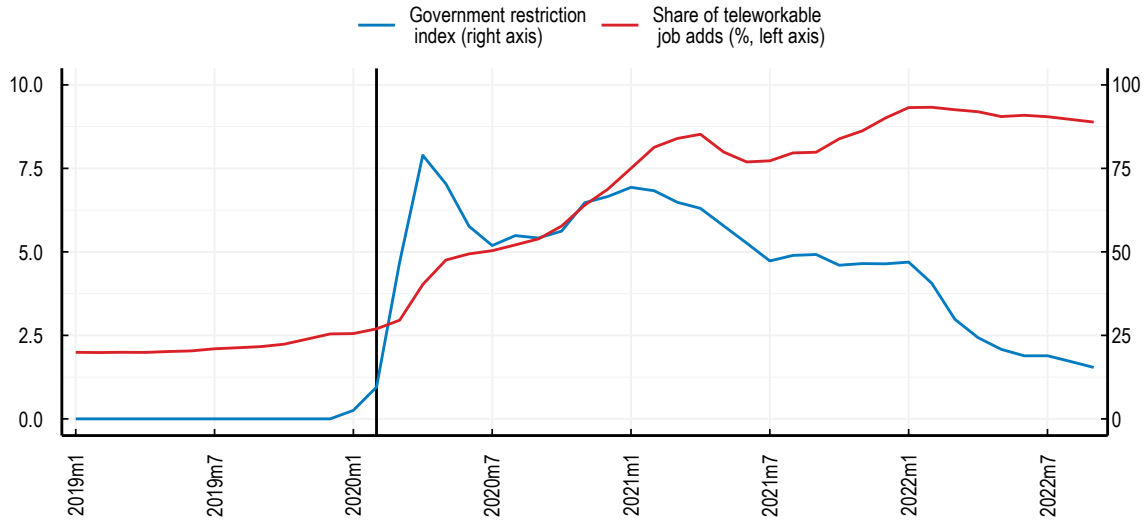
Digitalisation is reshaping housing location choices due to the increased uptake of remote work enabled by the spread of high-speed internet and advances in remote conferencing (OECD, 2021[13]). This trend was accelerated during the pandemic (Figure 1.16), and there are increasing signs that partial working from home is becoming the norm in many sectors. Surveys and job postings indeed indicate that remote work is set to remain much more prevalent than before the COVID-19 pandemic.[9]

[7] See Chapter 3 in OECD (2021[3]).

[8] This assessment is taken from IMF (2022[24]).

[9] See (Adrjan et al., 2021[15]; Barrero, Bloom and Davis, 2021[22]; Aksoy et al., 2022[23]).

Figure 1.16. Remote work is here to stay



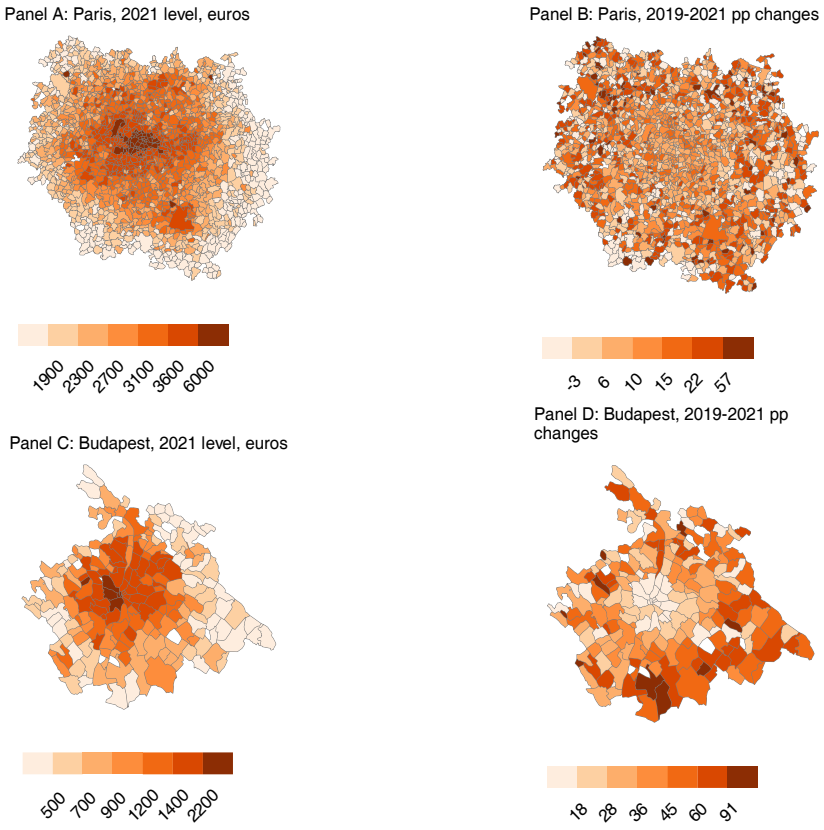
Note: The stringency of restrictions is measured with the Oxford COVID-19 Government Response Tracker (Hale et al., 2021[14]). Based on job data using proprietary information contained on the online job site "Indeed" for 20 countries, see the source for methodological detail.
Source: "Will it stay or will it go? Analysing developments in telework during COVID-19 using online job postings data" (Adrjan et al., 2021[15]).

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As a result of these forces, housing demand has been shifting, especially within large metropolitan areas (Figure 1.17). Accordingly, empirical evidence suggests a changing "house price gradient" with a shallower decline in house prices as the distance from urban centres increases (Figure 1.17). In other words, price differences between city centres and suburban areas have narrowed in many large urban areas since 2019, while they had been widening in the run-up to the pandemic (Chapter 4). This phenomenon is more prevalent where the take-up of remote work has been most pronounced.

Figure 1.17. House prices have risen faster around large cities than in their more expensive cores

Average house price per square meter by postcode

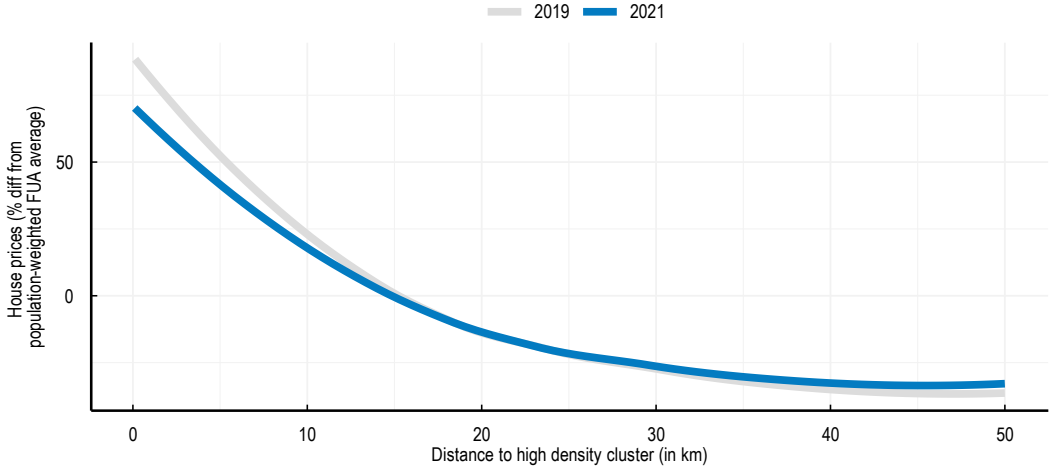


Source: French open data (DVF), Hungarian Central Statistics Office and OECD calculations (see Chapter 4).

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Figure 1.18. Price pressures have typically been stronger in suburbs than city centres

Average across monocentric cities with more than 1.5 million inhabitants across 16 OECD countries



Note: The graph shows the deviation of house prices from the Functional Urban Area's (FUA) population-weighted average house price as a function of the distance to the respective urban centre, averaged across locations of monocentric cities with a population of more than 1.5 million.
Source: "Urban House Price Gradients in the Post-COVID-19 Era" (Ziemann et al., 2023[16]).

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The new geography of housing demand poses challenges for policy (Table 1.5). First and foremost is the need to unlock supply where demand is growing fast to avoid price pressures that would further undermine affordability without prompting urban sprawl or exacerbating environmental challenges.[10] This includes frequently revisiting urban boundaries, overcoming fragmentation across levels of government in the governance of land-use planning responsibilities and rethinking urban passenger transport systems. It is also vital that housing policies refrain from measures that discourage new supply, such as overly restrictive rental regulations. Shifting emphasis towards recurrent property taxes rather than transaction levies can facilitate residential mobility, ideally with split rate taxes where land is taxed higher than structures to favour compact development.

To reap the benefits of the working-from-home revolution and avoid the emergence of new inequalities, governments need to ensure widespread access to digital services. This starts with the provision of a secure and efficient digital infrastructure covering remote areas as well as dense urban areas. The development of digital government solutions can make access to public services more inclusive. Finally, it is vital to close the digital skill gap by providing tailored lifelong learning and training solutions to children, students, apprentices, parents and the elderly alike.

Table 1.5. Selected options to promote widely shared gains from the new geography of housing and better urban environmental amenities

	Advantages	Limitations
Make land-use regulations more flexible in accordance with urban strategies including by relaxing building height restrictions in high-environmental-quality areas and more generally allowing densification in areas where demand expands	Unlocks supply; curbs house price growth Reduces the risks of urban sprawl and traffic congestion Broadens access to environmental amenities	Vulnerable to political economy headwinds
Make landlord-tenant regulations more balanced and flexible	Facilitates residential and labour mobility	May create vulnerabilities among current low-income tenants if insufficiently balanced
Move towards recurrent property taxes rather than transaction taxes	Facilitates residential and labour mobility	May require compensatory measures to avoid hardship for “house-rich, income-poor” households
Ensure widespread access to high-speed internet	Enables remote work	Can involve substantial budgetary costs especially in sparsely populated areas
Ensure access to lifelong digital training	Narrows digital divides	Implies costs for employers and/or the government
Systematically assess distributional consequences when designing environmental interventions	Allows better incorporation of the objective of sharing the benefits of improvements	Distributional effects may be difficult to estimate ex-ante and measure ex-post
Supply social and affordable housing in areas benefitting most from improvements in environmental amenities	Makes access to high environmental quality more inclusive	Entails budgetary costs Vulnerable to political economy headwinds
Deploy land-value capture mechanisms	Mitigates distributional effects Facilitates investment in infrastructure and amenities	May be legally and administratively complex

Note: The table summarises the main advantages and limitations. For more detail, see Chapter 4.
Source: OECD.

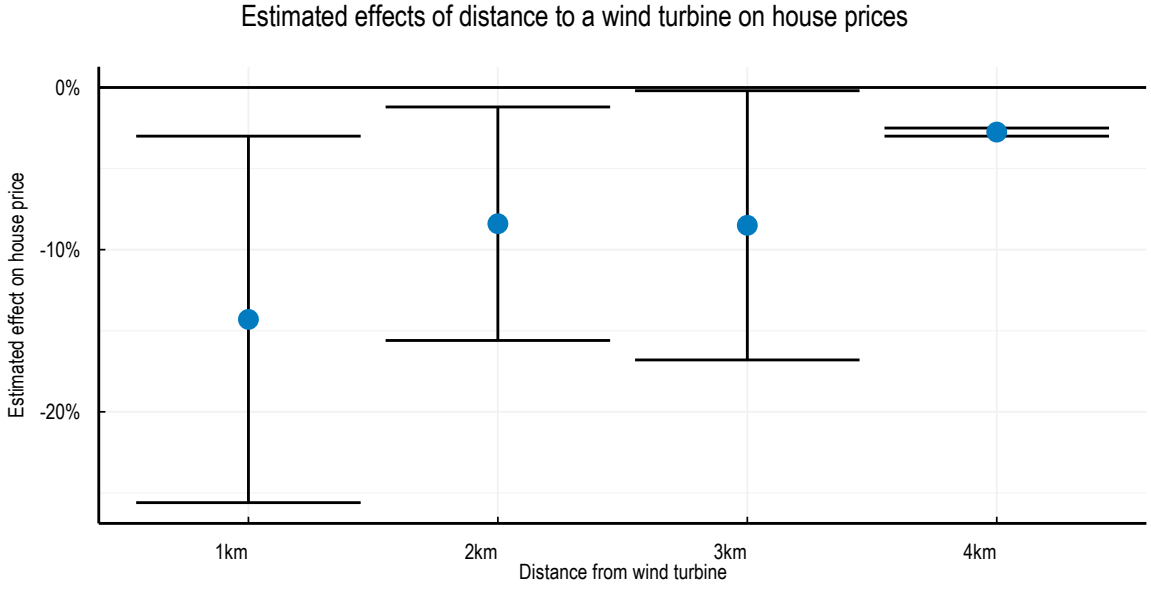
Changes in housing demand also highlight the role of access to green spaces and environmental amenities, such as clean air and water, and lower noise levels in urban areas, and the possible distributive effects of urban environmental policies. Living in a place surrounded by a high-quality environment makes

[10] This is one of the key themes in the original issue of *Brick by Brick: Building Better Housing Policies* (OECD, 2021[3]).

specific locations more attractive to residents, which is likely to push up house prices, undermining affordability for low or middle-income households. Consequently, environmental policies to improve urban amenities and reduce pollution can have negative distributional consequences (Chapter 4). Better provision of environmental amenities can price out low-income households: would-be renters and buyers face this effect immediately, whereas incumbent low-income renters may ultimately have to leave the area if rents become too expensive for them.

Complementary measures can mitigate these adverse side-effects to ensure that low-income households can afford to live in sought-after areas of high environmental quality (Table 1.5). Providing social and affordable housing in the areas benefiting most from better amenities is an important policy tool. Mechanisms to capture part of the value generated by environmental improvements offer a way to fund such provisions, even if there is limited precedent for their use (Chapter 4). Environmental policy can also have distributional consequences, as illustrated by the adverse house price effects of deploying wind turbines (Figure 1.19). These examples underscore the importance of reconciling environmental and social objectives, including through redistributive measures, to enhance the acceptability of decarbonisation policies.

Figure 1.19. Decarbonisation efforts can have adverse effects on house prices



Note: The intervals depict the range of estimates in the studies surveyed by the source. The points represent median estimates.
Source: "Provision of urban environmental amenities: A policy toolkit for inclusiveness", (Farrow et al., 2022[17]).

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2 Decarbonising Housing

Housing accounts for more than a quarter of CO_2 emissions in OECD countries. Even if housing-related emissions have been trending downward, a step change is required to meet agreed net-zero emission targets by 2050. The burning of fossil fuels in homes will have to make way for carbon-free energy sources. This transformation will need to be accompanied by the decarbonisation of electricity generation. The energy efficiency of new as well as existing buildings will also need to improve through a mix of regulation, incentives and financial support. This chapter discusses the decarbonisation of the housing sector and reviews policy options to accelerate the transition to net-zero emissions.

Main policy lessons

Housing accounts for more than a quarter of CO_2 emissions in OECD countries, placing the sector at the centre of efforts to decarbonise economies. Progress is under way. Over the past two decades, housing emissions shrank by 17% on average across OECD countries. Even so, a step change is needed. Currently implemented and firmly planned policies would only deliver one-sixth of the housing emission reductions required to achieve decarbonisation by 2050.

Policy options for more rapid decarbonisation of housing include:

- Decarbonisation strategies should ensure consistent carbon pricing across sources, sectors and over time. Carbon pricing – including properly calibrated taxes on fossil fuels used in homes or emission trading – offers an effective and cost-efficient way of creating carbon-saving incentives. Carbon pricing is key to underpin the needed large-scale changes, including to avoid the "rebound" of emissions that can follow other measures if they are unaccompanied by pricing. Effective carbon rates are currently low in most countries, and rates differ across sectors. Not even one-half of OECD countries apply explicit carbon taxes to direct emissions from buildings, while excise taxes are often misaligned with the carbon content of fuels.
- Various market imperfections specific to the housing sector call for going beyond carbon pricing with a well-coordinated mix of policies. This is the case, for example, of split incentives between landlords and renters to invest in energy efficiency improvements. Adjusting rent-setting rules to allow both landlords and renters to benefit from energy savings resulting from investments in energy retrofitting would strengthen incentives for renovation.
- Regulatory measures are important complements to carbon pricing. Energy performance certification should be extended to all properties and cover not only those for sale and rental. Reliable information would raise awareness about the benefits of home improvements. Also, energy efficiency standards for appliances and new buildings should be strengthened further to ensure full alignment with the net-zero emission target.
- Compensatory measures can be used to offset adverse effects on vulnerable social groups. Such transfers should maintain incentives to reduce greenhouse gas emissions, for instance by tying them to household income and property size while avoiding links to energy use.
- Public support programmes for energy efficiency improvements should focus on retrofitting the least efficient housing units. Subsidies should be paid depending on the actual energy efficiency gains and be capped and means-tested while taking account of fiscal capacity. Countries should abolish the remaining subsidies on fossil fuel boilers.
- Social housing can play a leading role. Building new and retrofitting existing social housing units according to high environmental standards would directly contribute to decarbonisation, reduce the risk of energy poverty for tenants, and help to develop capabilities and capacity in the retrofitting business sector.
- Housing and environmental policies are highly decentralised in many countries. Reforms and resources are needed to align incentives and agendas across levels of government. Local-level regulations, spending power and resources must be consistent with national decarbonisation goals.

Track emission trends and the achievement of targets

In 2020, the residential sector accounted for more than a quarter of the total CO_2 emissions in the OECD area. Emissions emanate from space and water heating, cooling, ventilation, lighting and the use of appliances and other electrical plug loads. Also, the construction of homes is emission-intensive, given the role of concrete and steel in current building technologies. A step change is needed to reduce emissions to attain the agreed net zero emission target by 2050. Apart from developing decarbonisation strategies, policy must go well beyond environmental matters and encompass economic, social, innovation, tax and spending policies, as well as governance arrangements, to drive transformational change.

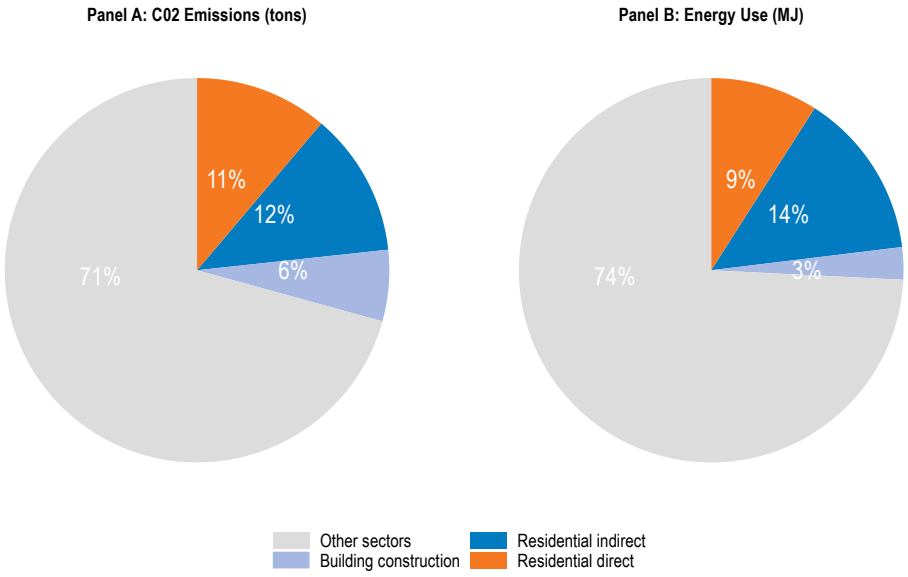
This chapter identifies policy options to decarbonise the housing sector. It focuses on housing-specific aspects. Notably, two specific decarbonisation topics that are not covered in this chapter relate to questions raised by the energy-market turmoil that struck Europe in 2022 (discussed in Chapter 1) and issues related to green finance (addressed in Chapter 3). The chapter also abstracts away from mobility-related emissions and does not discuss urban policies aiming at integrating the spatial organisation of residential, commercial and industrial areas with a view to reducing commuting.

Housing accounts for a large share of emissions in OECD countries

The residential sector accounts for nearly a quarter of overall CO_2 emissions in OECD countries (Figure 2.1). Emissions vary considerably across countries, depending to a large extent on income, climate conditions, the country's energy mix and the energy efficiency of buildings (Figure 2.2). Several high-income countries with high heating needs, such as the Nordic countries, have nevertheless achieved a low carbon footprint in their residential sector primarily through the electrification of energy use at home coupled with reliance on carbon-free electricity production.

Figure 2.1. Housing accounts for a large share of overall CO_2 emissions

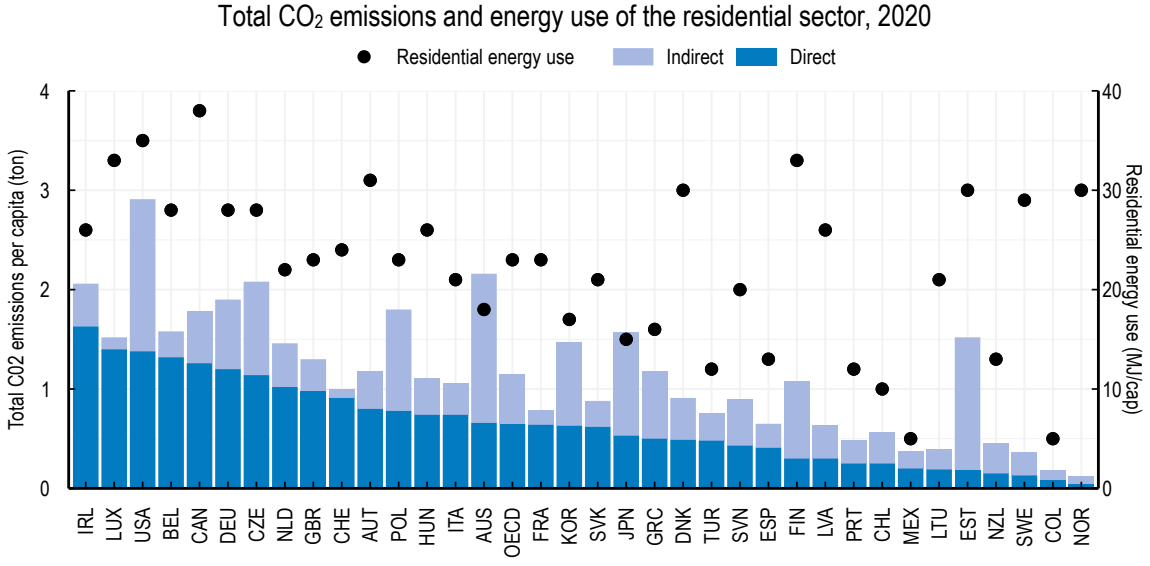
Sectoral decomposition of OECD CO_2 emissions and energy use, 2020



Note: Data are unavailable for four OECD countries (Colombia, Costa Rica, Iceland and Israel). 2019 data were used for 12 OECD countries (Argentina, Austria, Canada, Denmark, Estonia, Greece, Lithuania, Netherlands, Poland, Slovakia, Spain and Sweden). Building construction refers to the direct and indirect (embodied) emissions corresponding to the ISIC 41 sector classification. The residential sub-sector includes all energy-using activities in apartments and houses, including space and water heating, cooling, ventilation, lighting, and the use of appliances and other electrical plug loads. The breakdown between direct and indirect emissions is based on the proportion of final residential energy used from electricity and district heating. Indirect emissions are calculated as follows: Energy use $*(p_e+p_{dh})*EF$ where p_e=proportion of energy generated by electricity, p_{dh}=proportion of energy generated by district heating, and EF is the emission factor for electricity and district heating.
Source: Energy Efficiency Indicators database (IEA, 2021[1]), Emissions Factors database and OECD calculations.

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Figure 2.2. Several countries have high home energy needs, but low CO_2 emissions



Note: Residential energy use is measured on the right axis. Indirect and direct CO_2 emissions are measured on the left axis. The breakdown between direct and indirect CO_2 emissions is based on the proportion of final residential energy used from electricity and district heating. Indirect emissions are calculated in the following way: Energy use *(p_e+p_{dh})*EF, where p_e=proportion of energy generated by electricity, p_{dh}=proportion of energy generated by district heating, and EF is the emission factor for electricity and district heating.
Source: Energy Efficiency Indicators (IEA, 2021[1]), Emissions Factors database (IEA, 2021[2]), and OECD calculations.

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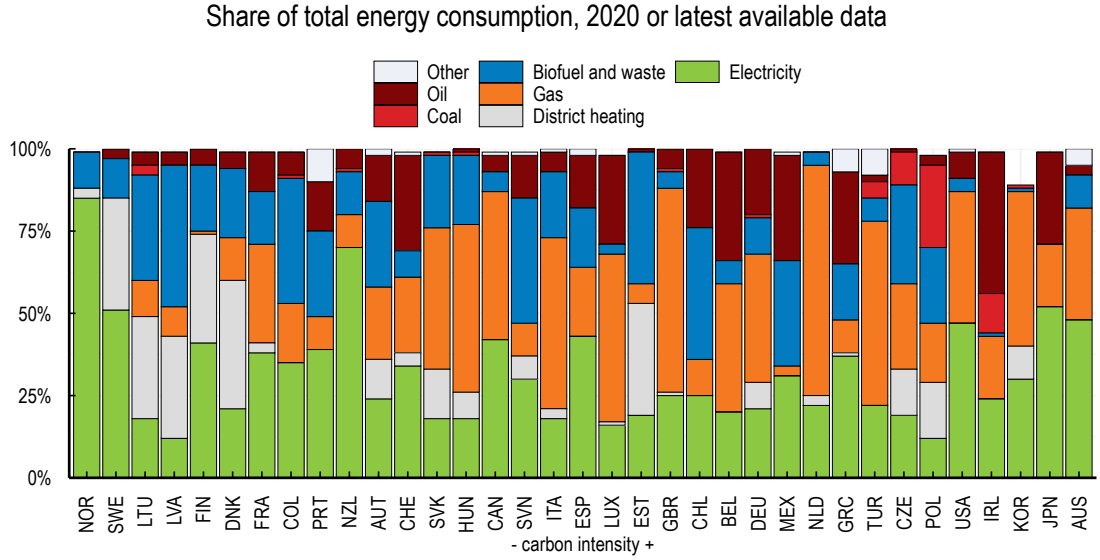
In 2020, around 25% of the final energy supply to the residential sector still originated from individual gas-powered systems, 10% from oil combustion, 3% from coal combustion and 15% from biomass and waste combustion. Biomass is renewable and does not contribute to climate change. Nonetheless, it can be an important source of local air pollution. As much as 40% of the residential sector's energy use was supplied by electric power generation (30%) and district heating (less than 10%), generating no direct CO_2 emissions. Differences across countries are considerable (Figure 2.3).

A few countries, such as the United States, the Czech Republic or Germany, combine high per capita energy use and extensive reliance on fossil fuels, resulting in high emissions per capita. The Nordic countries, in contrast, display low emissions despite high per capita energy consumption. Other countries, such as Australia, Japan and Korea, have relatively high emissions despite comparatively low energy consumption per capita. The discriminating feature is the carbon content of the energy used. Coal has the highest carbon content, followed by oil and gas.

In Norway and New Zealand, the residential sector, which is mostly electrified (around 70% of energy use), is carbon-free, mainly thanks to large-scale hydropower. While essential, electrification does not guarantee a low carbon footprint, as illustrated by Australia, Korea and the United States, where electricity is mainly produced by fossil fuels. Consequently, these countries display very high carbon intensity despite a high level of electrification (Figure 2.3).

Electrifying homes is central to decarbonising them but requires a parallel decarbonisation of power generation. Except for Estonia, countries with a high share of district heating show a low carbon intensity, reflecting the technology's ability to use renewable energy sources when producing heat.

Figure 2.3. Carbon intensity depends on the extent of direct emissions and the energy mix



Note: 2019 data were used for 12 countries (Austria, Canada, Chile, Colombia, Denmark, Greece, Latvia, Lithuania, the Netherlands, Norway, Slovenia, and Spain). Countries ranked by increasing carbon intensity (emissions per unit of energy used).
Source: Energy Efficiency Indicators (IEA, 2021[1]) and OECD calculations.

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Where and how are emissions trending down?

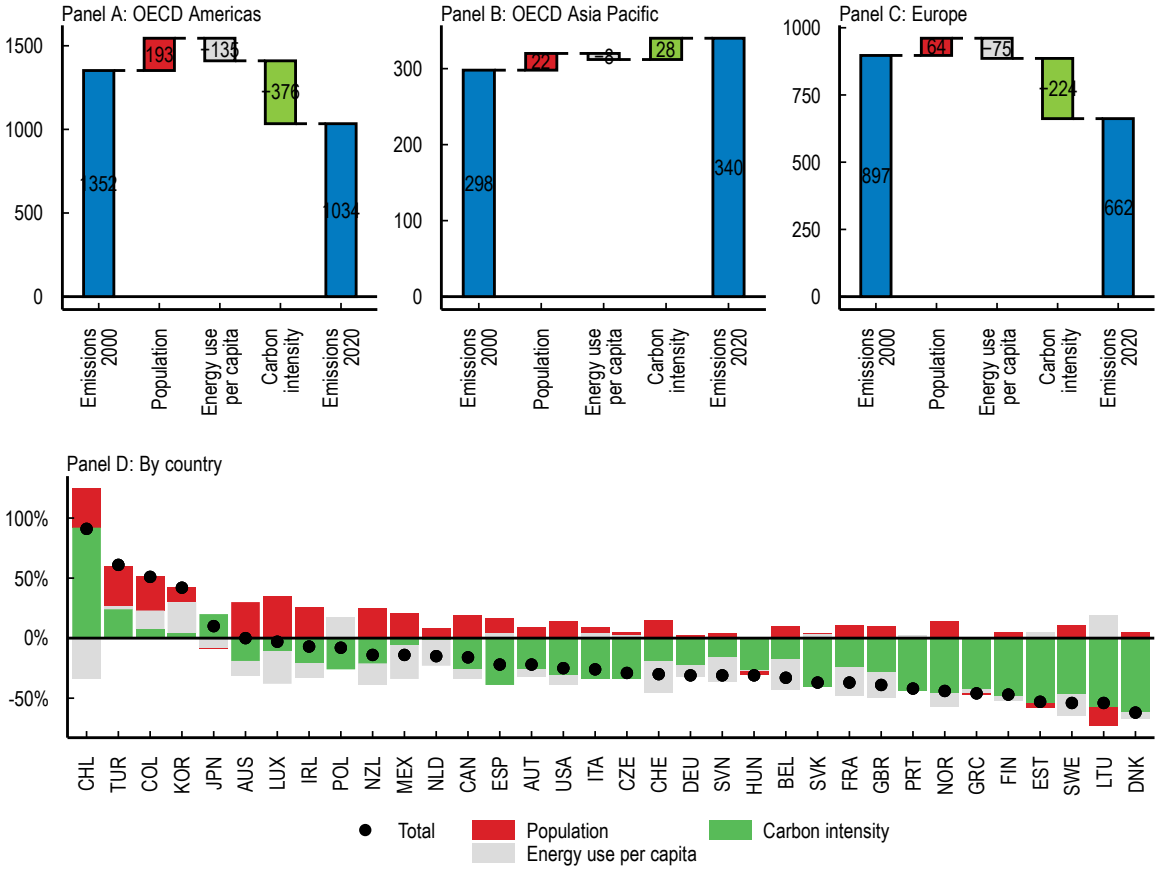
OECD-wide housing-related emissions have declined by 17% from 2000 to 2020, notwithstanding an increase in population and the number of dwellings (Figure 2.4). The energy efficiency of homes and appliances has improved, and many countries have successfully started to reduce the carbon content of the energy supplied. By contrast, in non-OECD countries, total CO_2 emissions from the buildings sector have risen considerably (IEA, 2021[3]), reflecting strong economic growth, fast urbanisation and limited progress in reducing CO_2 intensity, as coal and other fossil fuels remain central to the energy mix of many emerging-market economies, including the largest non-OECD member countries (Huo et al., 2021[4]).

The gentle OECD-wide average decline over the last 20 years hides a wide variation in cross-country performance. In Estonia, Lithuania, Sweden and Denmark, emissions have declined by more than 50%, while they have risen by more than 50% in Chile, Colombia and Türkiye (Figure 2.4, Panel D). Denmark exhibits the steepest decarbonisation of the residential sector (Figure 2.4, Panel D), thanks to a drastic reduction in carbon intensity due to a shift from coal and natural gas to carbon-free heat generation systems relying on electricity production via renewable resources such as wind power. Since the late 1990s, Denmark has also pioneered gas-powered district heating networks, recently upgraded at a relatively low cost to biomass and waste-powered primary energy sources. Chile, in contrast, displays the highest increase in residential CO_2 emissions, mainly because of a rising carbon intensity due to the extensive use of oil, natural gas and coal combustion by households. In addition, wood and biomass combustion is still used by about ¼ of the households (Figure 2.3). Similarly, indirect emissions have tended to increase due to the fast expansion of coal-powered electricity plants. In addition to Chile, Australia, Colombia, Japan, Korea and Türkiye are the other OECD countries where emissions from the residential sector increased from 2000 to 2020.

Energy use per capita and carbon intensity – CO_2 emissions per energy unit – have declined on average in the OECD area. The average fall in energy use per capita, however, masks that this variable increased in nearly half of the OECD countries. By contrast, the reduction in carbon intensity, which is determined by the CO_2 content of the fuels used, has been more uniform.

Figure 2.4. The factors behind past housing emission reductions vary a lot across regions

Drivers of the evolution of total CO_2 emissions of the residential sector, 2000-2020, MT CO_2/year



Black dots represent the total CO_2 emission change between 2000 and 2020. Carbon intensity refers to CO_2 emissions per unit of energy used. Data are unavailable for three OECD countries (Costa Rica, Iceland and Israel). 2019 data were used for eight countries (Austria, Canada, Colombia, Denmark, Spain, Estonia, Lithuania, and the Netherlands).

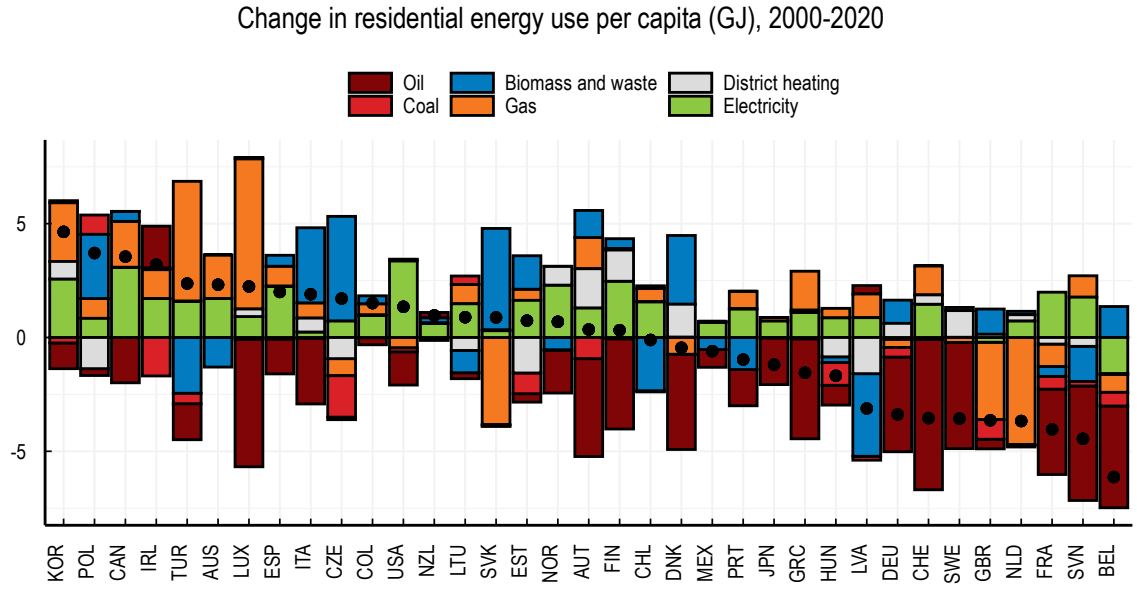
The decomposition follows the additive index decomposition (LMDI) method pioneered by Ang (2015[5]), and is used in a similar context by (D'Arcangelo et al., 2022[6]).

Source: Energy Efficiency Indicators (IEA, 2021[1]), World Energy Outlook (IEA, 2021[7]), and OECD calculations.

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The decline in the direct use of coal by households, the most carbon-intensive fuel, has been minor in recent years in most countries because it had been largely phased out prior to 2000 (Figure 2.5). The use of oil, the second-most carbon-intensive fuel, has declined in all countries (except in Ireland), substantially so in many of them, and has been replaced by lower-carbon sources. The phase-out of oil boilers is partly policy-driven. A few countries, such as Austria, Finland, France and Spain, have mainly replaced oil products with less-carbon-intensive or carbon-free energy sources (electricity and district heating). In Belgium, the Czech Republic, Denmark, Italy, Slovakia and the United Kingdom, the substitution is mainly due to the more extensive use of biofuels and waste combustion. Canada, Luxembourg, Korea and Türkiye are countries that have switched from oil to gas, which reduces the carbon intensity at the margin but prolongs fossil fuel dependency and has been creating acute energy price pressures for households after the Russian invasion of Ukraine and the reduction of Russian gas deliveries to Europe.

Figure 2.5. The change in the residential energy mix has been far from uniform across countries



Note: Black dots represent the total change in energy use per capita.
Source: Energy Efficiency Indicators (IEA) and OECD calculations.

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Achieving net-zero emissions will require strategies and policy reform

Most OECD countries have committed to achieving net-zero emissions by 2050, with a few countries having committed to reaching the target earlier. National climate plans differ in the detail they provide about measures for particular sectors, such as housing, and the specific requirements for sub-national entities (see final section), households or firms. 16 OECD countries have explicit climate targets and commitments for the housing sector.

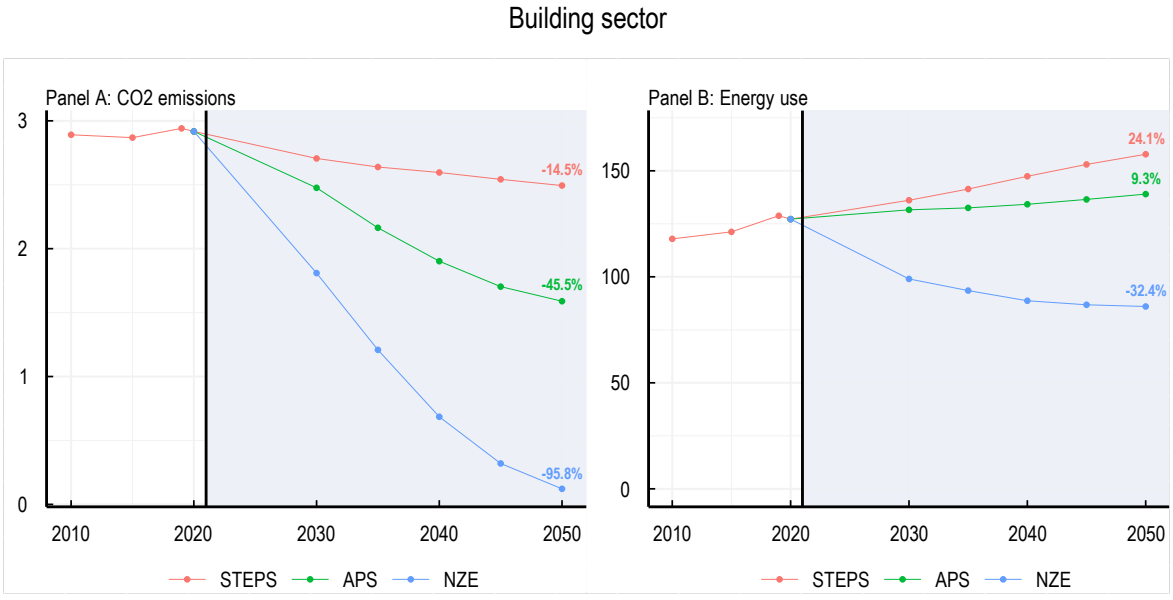
An example of a national plan focussing on the buildings sector is Japan's 2050 Carbon Neutral Goal, which focuses on better insulation, low carbon power generation and energy reduction by 20% in the residential sector and 50% in the commercial sector (Ministry of Economy, 2020[8]). Germany is another country that has set sector-specific targets in its Climate Action Plan. For the buildings sector, it has drawn up a roadmap to reach a virtually climate-neutral building stock and sets a goal to reduce emissions by two-thirds by 2030 compared to 1990. Among the measures to achieve this goal, Germany has introduced zero-emission standards for new buildings and for the existing building stock to undergo extensive retrofitting (BMUB, 2016[9]).

Housing-sector targets accompanied by policy strategies are important to provide guidance for developing implementation plans and strengthening accountability. However, the pace of emission reductions in the housing sector should be set, taking into account efforts made in other sectors and potential differences in the relative cost per ton of carbon abated across sectors. A reduction pace that entails a higher degree of effort per ton of carbon compared with other sectors would be cost-inefficient and imply lower greenhouse gas emission reductions than what could be achieved for the same cost with homogenous marginal costs (Blanchard and Tirole, 2021[10]).

The IEA Net Zero Emissions (NZE) framework (IEA, 2020[11]) provides scenarios that draw a normative path for the emission reduction targets set in the Paris Agreement. Accordingly, under current policies, world CO_2 emissions in the buildings sector would only decrease by 14.5% from 2020 to 2050 on the back of a 24.1% increase in energy consumption (Figure 2.6). In strong contrast, the reduction reaches 32% of

energy use and 95.8% of CO_2 emissions by 2050 in the IEA NZE scenario. Even already announced but not yet implemented policies would cut 2050 emissions only by nearly half from the 2020 level, showing the large gap separating current policy pledges from what is required to reach net zero by 2050.

Figure 2.6. Global IEA scenarios to 2050 underscore the magnitude of required changes



Note: World CO_2 emissions and world energy use refer to the buildings sector only and includes residential, commercial, and institutional buildings. The Stated Policy Scenario (STEPS) projects energy consumption and emissions under currently implemented or firmly announced policies. It assesses on a sector-by-sector basis the different pledges made by governments. Some announced policies that are unlikely to be implemented in due time are not incorporated. The Announced Pledges Scenario (APS) is a variant of STEPS and assumes that all pledged policies are fully enacted into policies. Policies in countries that have not yet made a net-zero pledge are assumed to be the same as in the Stated Policies Scenarios. The Net Zero Emissions (NZE) scenario sets out a pathway for the global buildings sector to achieve net zero CO_2 emissions by 2050. Variables are only available at the world level. No regional or country detail is provided by the IEA for the NZE scenario.
Source: World Energy Outlook 2021 (IEA, 2021[7]) and OECD calculations.

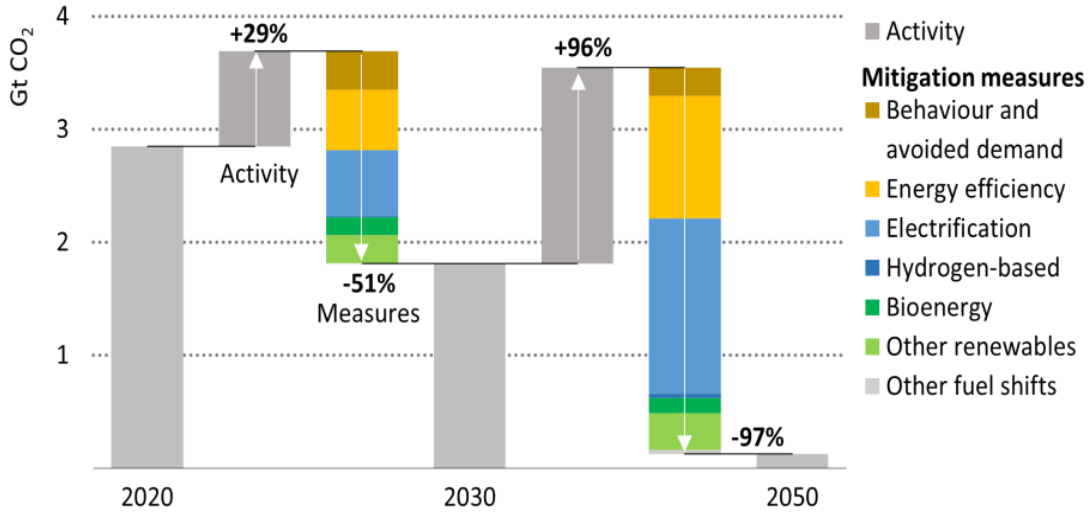
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In addition to electrification and decarbonised power supply, around 40% of the reduction is expected to come from lower energy use (Figure 2.7). The reduction in energy use results from the higher environmental quality of new buildings, retrofits of existing buildings and more efficient technologies for appliances, supplemented to a lesser extent by behavioural changes, such as warmer target indoor temperatures in the summer and cooler ones in the winter (IEA, 2020[11]).

To nearly eliminate direct building-sector emissions by 2050, the IEA highlights the need to reduce carbon intensity drastically through a massive transition from fossil fuel combustion to the use of carbon-free electricity and renewables (e.g., rooftop solar panels) (Figure 2.8). In the NZE scenario, both oil and gas combustion in homes are phased out by 2050: this stands in stark contrast with current policies, under which fossil fuels would still represent around 40% of residential energy supply by 2050.

Figure 2.7. Decarbonising housing requires mass electrification and strong energy efficiency gains

Global direct CO_2 emission reduction by mitigation measure in buildings in the IEA NZE Scenario

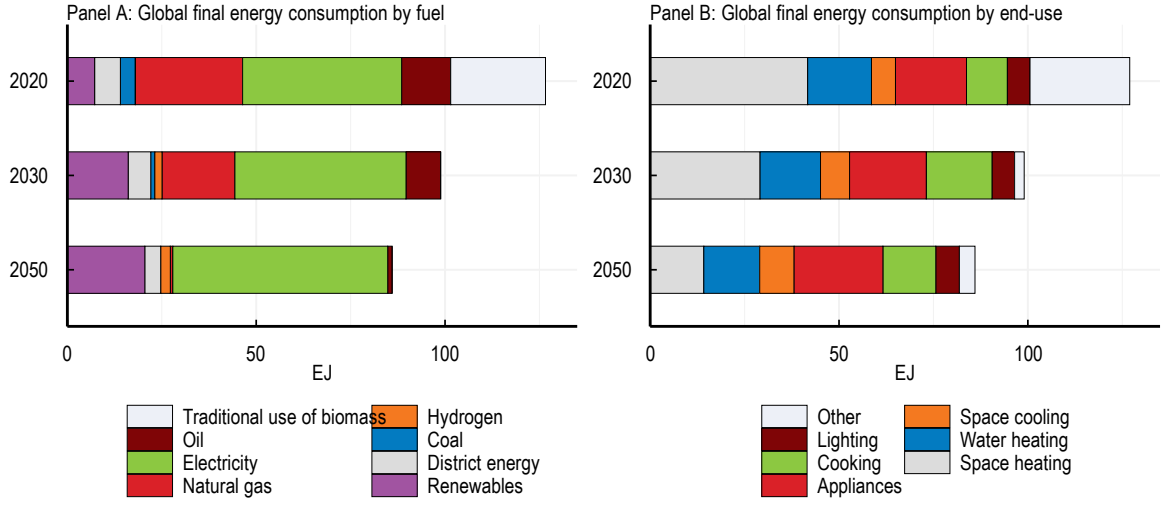


Note: No OECD or country breakdowns are available for the IEA NZE scenario. Activity refers to change in energy service demand related to rising population, increased floor area and income per capita. Behaviour refers to change in energy service demand due to user decisions, e.g., changing heating temperatures. Avoided demand refers to change in energy service demand from technology developments, e.g., digitalisation.
Source: "Net Zero by 2050 – A Roadmap for the Global Energy Sector", (IEA, 2020[11]).

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Figure 2.8. The fuel mix will be dominated by electricity complemented by home renewables

Global final energy consumption (EJ) by fuel and end-use application in buildings in the IEA net-zero scenario



Note: No OECD or country breakdowns are available for the IEA NZE scenario. Other includes desalination and the traditional use of solid biomass, which is not allocated to a specific end-use.
Source: "Net Zero by 2050 – A Roadmap for the Global Energy Sector", (IEA, 2020[11]).

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Reflect housing and local specificities in decarbonisation strategies

Incentive mismatches and behavioural biases

Housing decarbonisation efforts are fraught with biases in behaviour. For example, people often overestimate the insulation efficiency of their homes, which discourages investment in energy retrofitting. This phenomenon is compounded by various demand-side behavioural biases, such as myopia and time inconsistencies, which also discourage investment from raising energy efficiency. Even where efforts are made to raise awareness about the importance of such investments through information campaigns, take-up of subsidised energy efficiency investments remains low, suggesting that non-monetary costs and rational inattention are major obstacles to home improvements.

Energy retrofitting efforts are also stymied by incentive mismatches along the tenure spectrum. For example, landlords have limited incentives to invest if the benefits of improved energy efficiency accrue to tenants in terms of greater home comfort and lower energy bills, and the costs of investment cannot be reflected in higher rents due to rental contract regulations. As for tenants, investment is discouraged if the associated costs cannot be shared, at least in part with landlords, or rental contracts are too short to allow for the amortisation of home improvement costs.[1] Incentive mismatches also arise for multifamily dwellings, such as apartment buildings and condominiums, including those built and managed by non-profit housing associations (Box 2.1).

Policy can address some of these issues. For example, information campaigns are valuable tools to raise awareness about buildings' thermal characteristics, energy efficiency and the actual renovation process, including administrative help or financing options. Several local governments have implemented such campaigns, even though their effectiveness in changing behaviour is difficult to ascertain. Energy labelling is another policy intervention to raise awareness about energy efficiency, but it needs to apply to all properties, not only those for sale or rental, as is the case in most countries. Greater flexibility in landlord-tenant regulations can go a long way to allow for the sharing of energy retrofitting costs in a manner that better aligns incentives for investment. The provision of social housing based on state-of-the-art energy efficiency regulations and standards has the double benefit of addressing affordability considerations while reducing energy use in the residential sector.

Box 2.1. Multi-ownership, housing associations and CO_2 abatement decisions

The tenure structure differs considerably across countries, regions and cities. In Paris, for instance, 95% of buildings are in multi-ownership, and housing associations own 30% of the Dutch housing stock. In the case of multi-ownership, typically, a building management company is charged with the maintenance and repair of common areas, the building envelope and utility installations while also coordinating decisions by the owners about energy efficiency improvements. While maintenance and repair decisions are usually paid out of an accumulated fund, other decisions need voting by the apartment owners on an investment proposal by the building management company.

In the Dutch case, for instance, 70% of the occupants need to agree on such a proposal, and then financing has to be secured, even though the rent may not exceed a certain threshold (Van Oorschot, Hofman and Halman, 2016[12]). However, subsidies from national and local governments exist for the retrofitting of apartments, including in the case of tenants who need to move out (de Feijter, van Vliet and Chen, 2019[13]).

[1] Allcott and Greenstone (2012[33]), Gerarden et al. (2017[34]) and de Mello (2022[67]) review the evidence on the split incentives problem and find that owner-occupiers are considerably more attentive to energy-saving opportunities than renters.

Strict voting and financing arrangements also exist in many other countries (Table 2.1.).Some countries have eased the voting rules recently: Belgium reduced the required voting shares from ¾ of the votes to a ⅔ majority, while Austria reduced a ⅔ majority to a simple majority or a ⅔ majority of the votes that cover at least ⅓ of the owners. Reducing the voting-right threshold may not be the only and sufficient pre-requisite for reducing obstacles to renovating multiapartment complexes. For loans granted to finance retrofitting, the bank would have to require high (perhaps higher than set in the country) agreement rates.

Table 2.1. Voting requirements to approve retrofitting of multi-owner properties

	Maintenance	Renovations	Participation in vote
Australia	Simple majority	Simple majority	All management committee members
Austria	Simple majority	Simple majority or two-thirds of a third of the owners	The owners
Belgium	Not specified	Communal parts: 2/3 majority Mandatory work to comply with standards: simple majority Other works: 4/5 majority	Not specified, votes calculated on the basis of share values
Finland	No majority requirements	Simple majority	All property shareholders
Germany	Simple majority	3/4 majority	Not specified
Netherlands	70% majority	70% majority	All tenants
Poland	No majority requirements	Unanimity or majority (depending on the community)	All property shareholders, votes calculated on the basis of share values
Portugal	No majority requirements	2/3 majority	Not specified
Romania	Not specified	2/3 majority	Not specified
Spain	Simple majority	Simple majority	Members present at the meeting
USA	Differs by co-ownership	Differs by co-ownership	Differs by co-ownership
China	Not specified	2/3 majority	Not specified

Note: Simple majority stands for 50% + one vote.
Source: European Commission and Joint Research Center (2018[14]), de Feijter, van Vliet and Chen (2019[13]), Matschoss et al. (2013[15]).

The German government pursues an innovative approach to overcome the split incentive problem. In 2021, Germany introduced a carbon tax on heating in the building sector. In 2022, the government announced that the carbon tax liability would be split between landlords and tenants depending on the building's emission performance. Tenants in low-emission housing will bear most of the tax, while landlords will be liable for the majority of the additional tax for carbon-intensive rental dwellings. This measure reduces the carbon tax burden of tenants and encourages landlords to undertake investments to improve the emission performance of the homes they own while still providing incentives to tenants to reduce their carbon footprint. A key factor for the success of this measure is to ensure that landlords are not able to pass their higher tax burden onto their tenants (e.g., through higher rents) without making the associated investments (OECD, 2022[16]).

Pricing social costs explicitly using carbon taxes and emission trading schemes

Carbon pricing is a powerful tool to bring down emissions. However, effective carbon rates are low in the housing sector in the OECD area on average (Figure 2.9). In most OECD countries, housing-related emissions are priced through the taxation of fossil fuels, some of which are labelled carbon taxes as the rate is explicitly linked to the carbon content of the fossil fuels. On the other hand, emission trading is rare (Box 2.2).

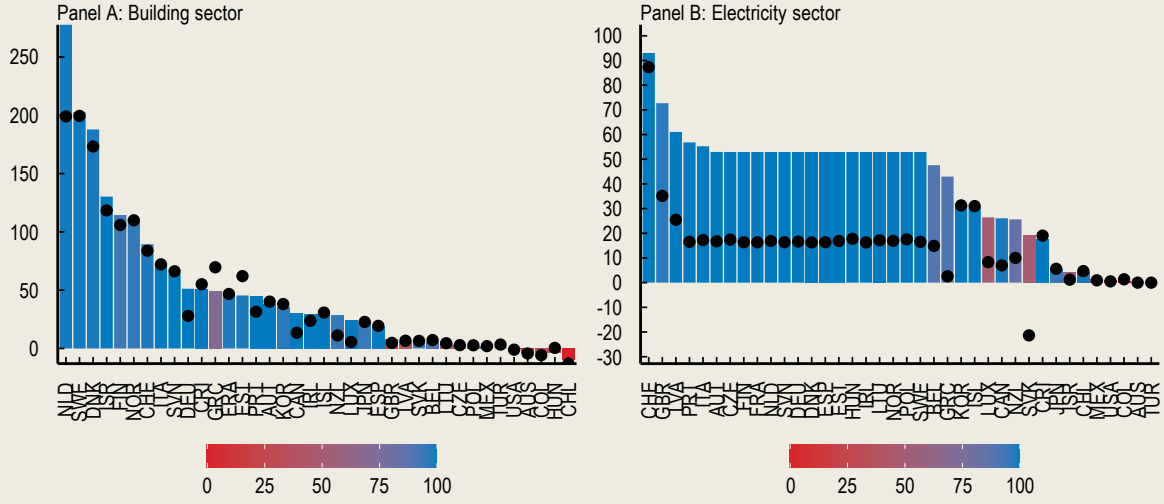
Box 2.2. Effective carbon rates are low in most countries

Currently, several countries levy a carbon tax and almost all excise duties on fossil fuels. The EU emission trading scheme covers mainly large plants in industry and electricity generation. However, Austria and Germany have decided to extend emission trading to the heating of buildings from 2026 (D'Arcangelo et al., 2022[6]),[2] and the EU is discussing including buildings in the EU emission trading scheme from 2026.

Net effective carbon rates (ECRs) on buildings are highest in Israel, the Netherlands and the Nordic countries. Only a few countries have so far achieved a net ECR above EUR 60, which is a mid-range estimate of current carbon costs (OECD, 2021[17]). In many countries, including Australia, the United States and many Eastern European countries, effective carbon rates are still at or close to zero. On the other hand, carbon pricing is more developed in the power generation sector, especially in Europe. This raises electricity prices and undermines the electrification of buildings.

Figure 2.9. Carbon rates are low and cover a limited share of housing emissions in many countries

Net effective carbon rates (EUR/tCO_2), 2021



Note: The net effective carbon rate is composed of emission trading prices, carbon taxes, fuel excise taxes minus fossil fuel subsidies. The height of the bars refers to net effective carbon rates in 2021, while the black dots denote net effective carbon rates in 2018. The colour of the bars indicates the share of emissions covered in 2021. The electricity sector refers to electricity generation, and the effective carbon rates do not incorporate electricity excise taxes.
Source: (OECD, 2022[18])

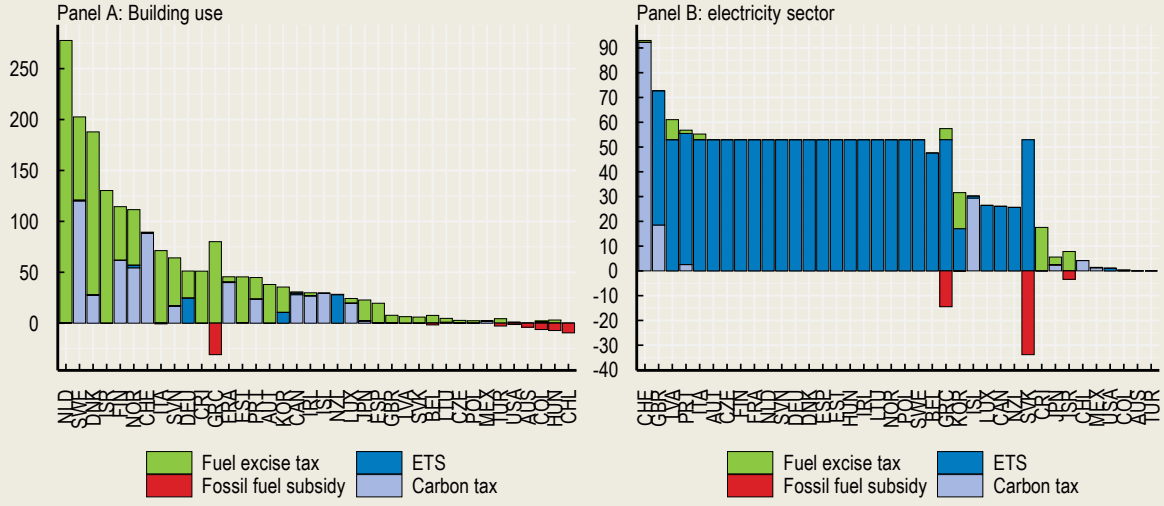
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Apart from the low effective rates in many countries, excise taxes, rather than carbon taxes and emission trading prices, dominate the building sector (Figure 2.10). Excise taxes, which were historically mainly introduced for revenue-raising purposes, are often misaligned with the carbon content of energy sources. The tax base of excise taxes should be refocused to reflect the carbon content of fuels, which would provide better abatement incentives for given tax receipts. On the other hand, before the energy crisis, fossil fuel subsidies existed only in a few OECD countries: they were sizable only in the Greek buildings sector. Since the onset of the energy crisis, they have spread, especially in Europe: an important policy challenge will be to roll them back as energy prices normalise.

The effective carbon rates do not include electricity excise taxes paid by end-users. Such levies distort the pricing of energy products. First, as mentioned above, excise taxes are poorly targeted as they are not aligned with the carbon content of the energy product used to generate electricity. Second, electricity is already taxed at the production stage via emission trading systems, explicit carbon taxes and fuel excise taxes on the energy source used to generate electricity (Figure 2.10). The additional levy at the consumption stage makes electricity more expensive than natural gas for the end-user in some countries, notably Germany and the United Kingdom. This undercuts the installation of heat pumps, which need electricity (German Council of Economic Experts (2019[19]). In the United Kingdom, taxes and charges on electricity equivalent to a price of GBP 70-80 per tonne of CO_2 are, in part, financing feed-in tariffs and other support policies for renewable energy products. In contrast, fossil fuels for heating are practically untaxed (OECD (2022[20]). Narrowing the gap between electricity and natural gas prices would accelerate the uptake of heat pumps in new buildings and foster deployment in existing buildings (IEA, 2021[21]).

Figure 2.10. Effective carbon rates are a long way from being similar across sectors or countries

Estimated effective carbon rates, EUR per tonne of CO_2, 2021



Source: (OECD, 2022[18]) and OECD calculations.

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Direct carbon pricing may have a limited effect on emissions in the housing sector. First, while some sectors are highly responsive to price signals, housing is not, mainly because direct emissions from coal, oil and gas for heating and cooling are more challenging to reduce. Second, long renovation cycles for housing, as well as incentive mismatches and behavioural biases discussed above, lead to underinvestment in energy retrofitting by households.[3]

[2] Emission trading will take place among the fuel providers (not households). In Germany, a carbon tax has been in place since 2021.

[3] Roofs in Germany, for instance, are, on average, replaced every 50 years. Similarly, only two per cent of heating systems are being replaced per year (German Council of Economic Experts, 2019[19]).

The role of environmental standards, regulations and certification

Price signals can be strengthened or complemented with other policy interventions. This includes energy performance labelling/certification, as well as standards and regulations.

Labelling and certification facilitate the comparison of the energy performance among properties and appliances and thus allow price formation to reward investment in the improvement and maintenance of the thermal characteristics of buildings as well as the purchase of energy-efficient appliances. To be effective, labelling and certification need to apply to all properties, not only new ones and those for sale or rental, as in most countries where the system is available. Certification will become mandatory in France for multifamily properties, and the revision of the Energy Performance of Buildings Directive will extend the requirement for buildings undertaking large renovations in all EU countries (Box 2.3).

Box 2.3. The EU Directive on the Energy Performance of Buildings

In the European Union, energy performance certification currently only applies to new buildings and those for rental or sale. A colour-letter rating is used on a scale from A to G, where A is highly efficient, and G is highly inefficient. The ENERGY-STAR labelling programme is the main certification scheme in the United States. In Japan, the Energy Label Programme, which provides a five-star rating, is mandatory for many appliances. Similar systems exist in Australia and New Zealand. In the United States, energy performance certification is voluntary.

In December 2021, the European Union proposed a revision of the Energy Performance of Buildings Directive and the Energy Efficiency Directive. The objective of the amendment is to consolidate the three main objectives of the original directives: increase energy efficiency, in particular for low-income households; lower energy consumption and foster job creation in the green building sector.

The directive sets a common framework for emission reduction targets of at least 60% by 2030 in the buildings sector relative to 2015 and the achievement of climate neutrality by 2050. In addition, the directive highlights several intermediate milestones and strategies to change energy sources and increase the pace of renovations.

For the transition to renewable energy, three targets are set. Renewables in the buildings sector should account for 49% of energy use by 2030. The increase in the use of renewable energy in heating and cooling should be 1.1 percentage points per year. The increase in district heating and cooling is planned to be 2.1 percentage points per year. As a complement, the phase-out of fossil fuels should be completed by 2040 at the latest. The phase-out will be underpinned by a sunset clause for financial incentives that use fossil fuels in buildings to ensure that no remaining incentives are given to install boilers powered by fossil fuels from 2027 onwards.

Regarding the renovation of energy-inefficient buildings, the directive sets an objective of renovating at least 3% of the total floor area of all public buildings annually. The renovation plans for the private sector will focus on the most energy-inefficient buildings with the objective that the worst-performing 15% of the building stock will need to be upgraded from label G to at least F by 2030 (and at least E by 2033).

The tracking of the worst-performing properties will be ensured by the extension of mandatory energy performance certificates with increased reliability, quality and digitalisation for all public buildings, all buildings for rent or sale and all buildings undergoing a major renovation. A building renovation passport will be put in place, complementing the introduction of a legal requirement to put energy efficiency first in planning and investment decisions.

The coverage of mandatory minimum energy performance standards (MEPS) for appliances, such as lighting, refrigerators and space cooling, is nearly complete in the OECD (IEA, 2021[22]). Beyond coverage, the stringency of MEPS matters. In the European Union, for instance, new refrigerators now must be 75% more efficient than ten years ago, while comparative labels were rescaled in 2021 to help consumers identify the most efficient products. Progress remains limited in some areas. For example, lighting policies in many countries have not yet phased out halogen lamps, which are only about 5% more efficient than incandescent bulbs.

Energy efficiency standards matter for new buildings because of their long lifespan. Mandatory building energy codes are in place in most OECD countries, though they are voluntary in some US states and Canadian provinces. On the other hand, several US states have codes that are stricter than the national one. Codes in many countries have also become stricter over time. Standards embedded in building codes, because they have been locked in for several decades, need to be aligned with long-term climate objectives. In Europe, the revised Energy Performance of Buildings Directive aims at building only near-zero emission homes from 2030 (Box 2.3). Empirical evidence suggests that labelling/certification indeed supports price formation, with a premium in sale prices and rents associated with better-rated properties. This is also the case with standards (Box 2.4).

Box 2.4. Effects of labelling/certification and standards on price formation

Some studies find significant positive correlations between labelling/certification and house prices, while others argue that adequately controlling for other property characteristics wipes out that effect, except for upper-tier quality buildings (Marmolejo-Duarte and Chen, 2022[23]).

Evidence for the United States shows that zero-energy homes are more than 10% more expensive than standard homes but only 5% more expensive when taking into account federal and state financial incentives. Zero-energy homes also lead to heating energy cost savings and a higher resale price (Zero Energy Project, 2022[24]).

Building insulation standards bring far smaller savings on cooling energy costs as, even in well-insulated homes, many households open their windows at times during hot days, negating the benefits of insulation (Davis, Martinez and Taboada, 2020[25]). Also, the strictness of the near-zero emission standard will affect the affordability of new homes. The primary energy requirements for single-family houses varied by a factor of six among EU countries in 2021 (BPIE, 2022[26]).

Incentivising decarbonisation using subsidies and tax breaks

Raising the relative price of carbon can also be implemented through subsidies and tax incentives. These interventions can speed up the deployment of new technologies by overcoming upfront cost barriers since they directly fill an immediate financial gap. However, funding such subsidy schemes requires raising additional tax revenues elsewhere in the economy either currently or, if via borrowing, in the future. There are reasons for and against the use of debt to finance decarbonisation subsidies: on the one hand, emission reductions will benefit future generations that will have to repay the debt; on the other hand, the required fast pace at which emissions now need to be reduced stems from the lack of sufficient action by past and present generations. Another difficulty with decarbonisation subsidies is to determine the benchmark emissions against which reductions will be measured. Therefore, it is important to assess carefully the effectiveness of subsidies in emission reductions and avoid potential risks of distorting market developments and deadweight losses.

Bertoldi et al. (2021[27]) provide an overview of existing schemes in Europe.[4] Some subsidy schemes and their characteristics are summarised in Table 2.2. In Germany, for instance, subsidies can only be obtained after prior advice from independent experts. In all the schemes shown in Table 2.2, subsidies partly fund the installation of new equipment up to a ceiling. Tax incentives for retrofitting are generally capped as a percentage of costs, up to a ceiling, and may take the form of a deduction or credit (OECD, 2021[17]). The most generous programme is probably the Italian Superbonus 110 scheme (110% tax credit for improvements raising the dwelling's energy-efficiency level by at least two levels). The main criticisms of this scheme are the lack of evidence on the actual energy efficiency gains, and the risk that overpricing by construction firms may be tolerated because homeowners do not bear the intervention costs (Brugnara and Ricciardi, 2021[28]). In 2023, the programme has been extended for one year but scaled down to 90% of the costs and is henceforth subject to means-testing as only households with an annual income of less than 15.000€ are eligible.

Table 2.2. Characteristics of some subsidy schemes

	Germany	France	United Kingdom	Italy
Name	"Deutschland macht's effizient", KfW's "Energy-efficient construction and retrofitting"	"MaPrimeRénov", now a part of "FranceRénov"	"Green Deal"	"Superbonus"
What is subsidised?				
- Energy advice	Yes	Yes	No	No
- Energy efficiency improvements	Yes	Yes	Yes	Yes
- Renewable energy	Yes	Yes	Yes	No
- Other	N/A	N/A	N/A	Seismic improvements
Energy performance and control	Ex-ante and ex-post	Ex-ante and ex-post	Ex-ante	Ex-ante and ex-post
Subsidies provided	Loans, grants, tax breaks	Loans, bonuses, reduced tax rate	Grants	Tax deduction
Subsidy rate	Up to €25,000 for heating system improvement; Up to €120,000 for a complete renovation of a house	€1,000 for heating system improvement; Up to €8,000 for the installation of solar thermal; €20,000 as standard maximum amount (insulation, heating, general works; €30,000 for extended retrofit works	£5,000 as standard amount per household £10,000 for low-income households	110% on the tax base of the retrofitting costs
Does the subsidy rate depend on energy efficiency improvements?	Yes	Yes	No	Yes
Does the subsidy rate depend on income?	No	Yes	Yes	No
Possible rent increase after renovation	8%	N/A	N/A	N/A

Note: The UK has a £3,500 cap on landlord participation in the financing of energy retrofits in rented properties, which means that the rest of the costs are borne by the renters or the state. The vouchers for the UK's "Green Deal" cover up to ⅔ of any chosen improvement.
Source: (Federal Ministry for Economic Affairs and Climate Action of Germany, 2022[29]; Ministry of the Economy and Finance and the Recovery of France, 2022[30]; Government of the UK, 2022[31]; Brugnara and Ricciardi, 2021[28]),

[4] Bertoldi et al. (2021[27]) also discuss other schemes that reduce energy bills and emissions. For instance, utility sponsored programmes can provide rebates or incentives to homeowners to invest in energy-efficiency improvements, initial investments by utilities can be paid back by the utility bill and energy efficiency obligations for energy companies and energy performance contracting with energy services companies can exist.

The effectiveness of subsidies in reducing emissions is often assessed to be higher by engineering studies than ex-post economic analysis. This is the experience of France (Blaise and Glachant, 2019[32]) and the United States (Allcott and Greenstone, 2012[33]; Gerarden, Newell and Stavins, 2017[34]), where the Weatherisation Assistance Program provides means-tested federal aid to low-income households. This means that subsidies can have a high cost in terms of a ton of CO_2 abated. Reasons include the rebound effect (better insulation leads to higher inside temperature, eating up some of the savings), or that some of the investments, such as the triple glazing of windows, has only a limited effect on emissions (Allcott and Greenstone, 2012[33]; Gerarden, Newell and Stavins, 2017[34]; Levinson, 2016[35]). Subsidies also risk funding renovation work that would have been undertaken anyway: empirical estimates put the proportion of deadweight losses at 40 to 85% (Nauleau, 2014[36]).

To become more effective, subsidy schemes and tax incentives should focus on energy efficiency gains that can be achieved through renovation. This is the case in Germany, where rules have been tightened for new dwellings from mid-2022 and gas boilers will no longer be subsidised, and recently in France (MaPrimeRénov). Moreover, renovation packages should be assessed ex-ante by independent energy performance experts and also ex-post (Haut Conseil pour le Climat (2020[37])). An independent assessment raises awareness of the benefits of improved energy performance and trust in the accuracy of the advice. The French Haut Conseil pour le Climat (2020[37]) also suggested that the renovation of the worst-performing houses (F and G), where energy efficiency gains are largest, should become mandatory. The French Parliament recently decided that French apartments of the worst-performing category G could no longer be rented from 2023 and that energy performance requirements for landlords would be further tightened.

Finally, several countries still provide subsidies or tax incentives to install fossil-fuel-fired equipment, such as gas boilers. In the European Union, for instance, gas boilers were still subsidised by 19 of the 27 EU countries in 2021 (Vikkelsø, 2021[38]). The supply disruptions following Russia's war of aggression against Ukraine have triggered the phasing out of such incentives in several countries. Thus, in April 2022, the Czech Republic and Slovakia, countries where the share of gas for the residential sector represents around 30% of energy use (Figure 2.3), have decided to stop subsidising the installation of gas boilers. They will, instead, subsidise the installation of heat pumps and solar panels.

Addressing trade-offs and policy interactions

Deploying multiple policy instruments risks sending incoherent and conflicting signals. The large variety of policy instruments is a potential source of complexity and inefficiency. For example, subsidising the development of solar and wind electricity in Europe is costly for the public purse, but it will have no effect on emissions, at least in the short run, since the electricity sector is covered by the EU-ETS system. These subsidies simultaneously reduce the demand for allowances by the electricity sector and the emission price. This mechanically generates an equivalent increase in emissions by the other sectors covered by the ETS (waterbed effect). In short, the solar and wind subsidies accrue at least in part to the cement and steel industries (Blanchard and Tirole, 2021[10]; German Council of Economic Experts, 2019[19]).

Another example is the taxation of electricity. Many countries levy electricity excise taxes, partly to fund the installation of solar energy and wind turbines. While that promotes the installation of solar panels, excise taxes are typically poorly aligned with the carbon content of the fuel used to produce the electricity. Moreover, they increase the price of electricity for the end-user, which undercuts the installation of heat pumps running on electricity.

On the other hand, housing decarbonisation policy strategies can take advantage of complementarities across measures. For instance, energy-efficiency standards are more effective when combined with price signals. Without appropriate pricing, higher energy efficiency is likely to lead to greater energy use, the so-called "rebound effect". There have been examples where, in the absence of energy price changes, tighter insulation standards delivered much lower cuts in energy use than anticipated (Levinson, 2016[35]). Finally, there are policy interactions across levels of government, which are reviewed in the final section.

Deploy complementary policies

Identifying key technologies for the path to net-zero emissions

Space and water heating account for 75% of residential energy consumption. Stricter building codes and improved energy performance have allowed many countries to reduce energy consumption. However, a considerable share of heating consumption relies on fossil fuels via oil and natural gas boilers, with the exceptions of New Zealand and especially Norway, which have made good progress in electrifying heating systems (Figure 2.3).

District heating

District heating systems have a high potential to decarbonise buildings as they allow for the integration of clean energy mixes (Box 2.5). The share of renewable sources and decarbonised electricity in global district heat production increases from 8% in 2020 to 35% by 2030 in the NZE scenario, which alone reduces the heat-related direct CO_2 emissions of buildings by one-third (IEA, 2021[39]). Electric heat pumps, assuming low-carbon electricity production, also contribute to reducing the carbon footprint of residential buildings. In 2020, only 7% of heating needs were satisfied by heat pumps. The NZE scenario assumes that globally installed heat pumps will increase by 233% in 10 years, from 180 million in 2020 to 600 million by 2030 (IEA, 2021[21]).

Box 2.5. The revival of district heating

District heating and cooling systems are powerful tools for decarbonising buildings. Modern networks with low operating temperatures can integrate up to 100% of renewable sources to supply energy-efficient buildings. District heating and cooling is particularly important in high-density areas where decentralised solutions would not allow for the direct integration of available clean energy sources or efficient operations, for example, due to space or infrastructure constraints (IEA, 2021[39]).

Many buildings and industrial sites rely on district heating and cooling, ranging from large urban networks in Beijing, Seoul, Milan and Stockholm to smaller networks, for instance, for university and medical campuses (IEA, 2021[39]). Central Stockholm has one of Europe's largest district heating and cooling systems, with a distribution system of 3 000km. Close to 90% of the city's buildings are connected to the district heating network, which uses several innovative energy sources, such as excess heat and wastewater.

The district heating technology, which has been in operation since the late 1870s, has evolved over time, giving rise to improved energy efficiency, lower operating temperatures, better storage and facilitated integration of renewable energy sources, such as geothermal heat or biomass. The latter makes district heating a particularly appealing ingredient of decarbonisation strategies. Not only does it reduce the upfront investment costs when switching to new, carbon-free energy sources, but it also helps scale up renewable energy production's use and lowers CO2 abatement costs.

A fifth generation of technologies, where exchanges between the central system and the final users would occur with heat feedback loops, is currently under development. At the core of these improvements is the interaction with individual heat pumps, the latter being used as boosters to adapt to demand and take advantage of new energy sources to power these networks. For instance, since 2019, a nearby closed coal mine has been used in the Mijnwater Heerlend project in the Netherlands as a way to store heat and cool before redistributing it to the network through an ultra-low temperature (10°C-30°C) network. This new way of thinking about district heating would allow for making the most of local heat sources, such as geothermal wells, dams, aquifers and even datacentres.

Rooftop photovoltaic panels

Solar photovoltaic (PV) generation is becoming the lowest-cost renewable energy source almost everywhere. However, the installation of solar PV on rooftops often faces regulatory obstacles and political economy headwinds. Sustained efforts will be necessary to ensure the sevenfold increase of solar PV capacities from 2020 to 2030 consistent with the NZE scenario. Currently, the rooftop market only represents less than half of the worldwide solar PV energy production capacity (IEA, 2022[40]).

Energy consumption for space cooling increases rapidly with rising living standards, particularly in areas with fast population growth. In 2020, around two billion air-conditioning units were deployed worldwide, accounting for almost 16% of the building sector's final electricity consumption (IEA, 2021[41]). The NZE scenario assumes a 50% increase in the energy efficiency of air-conditioning appliances.

Building energy codes

Most countries still lack mandatory building energy codes (IEA, 2021[42]). The NZE scenario requires worldwide coverage of such requirements by 2030 and also assumes an acceleration of retrofitting to increase the share of zero-carbon-ready buildings to around 20% by 2030 (Table 2.3).

Appliances

The share of appliances and electronic equipment in households' final energy consumption has risen globally, with significant regional differences. While in the emerging-market economies, there has been a sharp increase in the share of appliances in energy use, the opposite is true for the more advanced economies, thanks to the increased efficiency of refrigerators, washing machines or dishwashers (IEA, 2021[43]). The NZE scenario assumes global coverage of today's state-of-the-art technologies so that the increase in energy efficiency offsets the projected increase in the use of appliances.

Light bulbs

In 2010, incandescent light bulbs were still the norm, although their energy efficiency was already only a fraction of the newly emerging LEDs. Since then, the energy efficiency of the latter has continued to increase, together with the widespread deployment of LEDs amid increasing affordability (IEA, 2021[44]). The success of LEDs is a prime example of how the scaling-up of energy-efficient technologies can reduce their price and pave the way for the replacement of carbon-intense technologies. As a result, the lighting energy intensity per dwelling has declined by more than 30% from 2010 to 2019 on average across the OECD.

Smart buildings

Smart buildings, seizing the opportunities delivered by digitalisation through the connectivity of appliances and the automation of electricity demand, are the foundations for future "zero carbon-ready" residential structures. The NZE scenario requires retrofit rates for buildings to be "zero-carbon ready"[5] to reach about 2.5% a year by 2030 in the advanced economies and 2% a year by 2030 in the emerging-market economies.

Smart grids

A major driver of decarbonisation in the housing sector is electrification coupled with carbon-free energy production. Nevertheless, some of the less carbon-intensive energy sources are intermittent and non-

[5] A zero-carbon-ready building is highly energy efficient and either uses renewable energy directly or uses an energy supply that will be fully decarbonised by 2050, such as electricity or district heating.

dispatchable, which poses challenges. Smart grid systems can help, but investments will have to triple during 2020-30, accounting for around 40% of all necessary capital investments in NZE scenario.

Table 2.3. Key milestones in the building sector on the road to net-zero

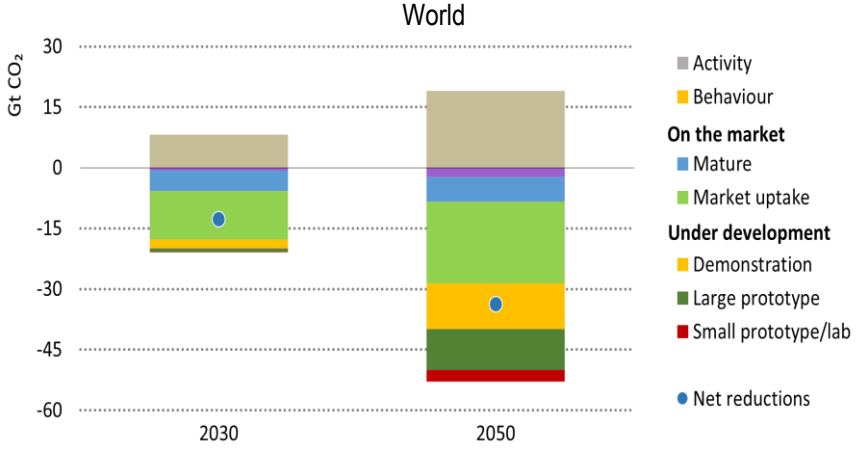
	2020	2030	2050
Buildings			
Share of existing buildings retrofitted to the zero-carbon-ready level	<1%	20%	>85%
Share of zero-carbon-ready new building construction	5%	100%	100%
Heating and cooling			
Stock of heat pumps (million units)	180	600	1,800
Million dwellings using solar thermal	250	400	1,200
Avoided residential energy demand from behaviour	n.a.	12%	14%
Appliances and lighting			
Appliances: unit energy consumption (index 2020=100)	100	75	60
Lighting: share of LED in sales	50%	100%	100%
Energy access			
Population with access to electricity (billion people)	7.0	8.5	9.7
Population with access to clean cooking (billion people)	5.1	8.5	9.7
Energy infrastructure in buildings			
Distributed solar PV generation (TWh)	320	2,200	7,500
EV private chargers (million units)	270	1,400	3,500

Source: "Net Zero by 2050 – A Roadmap for the Global Energy Sector", (IEA, 2020[11]).

Supporting innovation in clean technologies

While the emission reductions in 2030 mostly rely on available technologies, those under development today account for almost one-half of the emission reductions needed in 2050, according to the NZE scenario (Figure 2.11). Striving for decarbonisation coupled with the increasing demand for energy, particularly in buildings, inevitably calls for continued investments in innovative technologies to bring buildings-related CO_2 emissions on track to net-zero. Yet, after a sharp rise in patenting of low-carbon energy innovations in end-use technologies of buildings from 2000 to 2013, patenting activity has declined more recently (IEA, 2021[45]). Abatement costs are still too high for many technologies, especially those still at the demonstration or prototype development stage.

Figure 2.11. Clean technology innovations are critical for decarbonising buildings



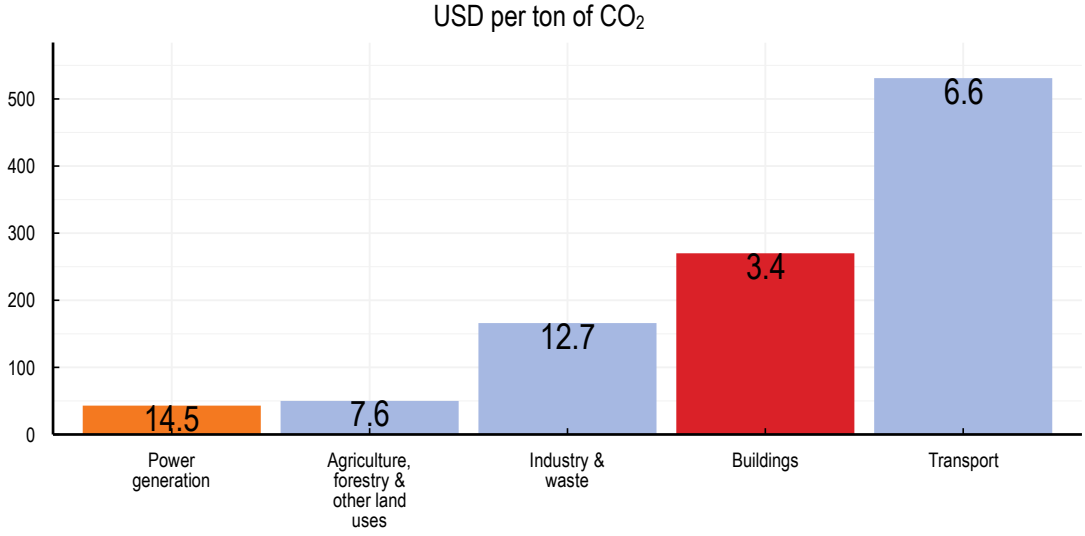
Source: Net-zero by 2050 – A roadmap for the global energy sector (IEA, 2020[11]).

StatLink https://stat.link/k79d0j

R&D investments in carbon-free technologies for the building sector not only make these technologies available but also help to make them more cost-efficient. An important benchmark for calibrating and evaluating policies that aim at reducing GHG emissions is to create standardised measures of the monetary costs of reducing a ton of CO_2 for the deployment of alternative technologies (Blanchard and Tirole, 2021[10]). While there is considerable uncertainty around estimates of abatement costs, some indicate that direct emissions from the building sector are costly to abate (Figure 2.12).

Innovation is also important from the vantage point of reducing the abatement costs associated with the decarbonisation of buildings. Abatement costs are assessed to be high in the sector because of needed electrification and the installation of equipment to improve energy use, consumption and storage (Figure 2.13). Indirect emissions from power generation, on the other hand, are less costly to abate under appropriate carbon pricing and available technologies.

Figure 2.12. Abatement costs are high in the buildings sector

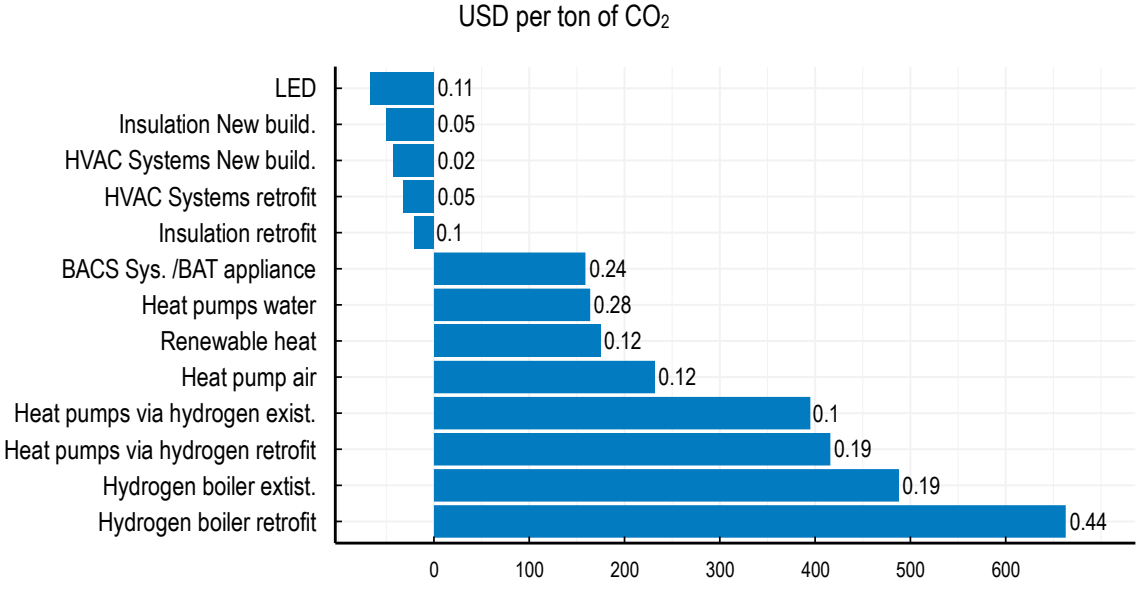


Note: The annotated numbers denote the abatement potential (in Giga tons of CO_2 equivalent) for each sector.
Source: Goldman Sachs International (2020[46]).

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Recent evidence shows the great potential of innovative solutions to reduce installation and maintenance costs. Goldman Sachs International (2020[46]) estimate that from 2019 to 2020 alone, the flattening of the CO_2 abatement cost curves reduced the costs of abating 50% of global CO_2 emissions by 20% and the costs of decreasing 70% of global CO_2 emissions even by 30%. The challenge for direct emissions in the building sector is even more significant as abating the bulk of the emissions would require a carbon tax higher than $150 per ton of CO_2, although recent developments have lowered that estimate (Figure 2.13).

Figure 2.13. There is little low-hanging fruit to reduce direct emissions from buildings



Note: The annotated numbers denote the abatement potential (in Giga tons of CO_2 equivalent) for each sector. Abatement cost curves are based on technology and price assumption from 2020.
Source: Goldman Sachs International (2020[46]).

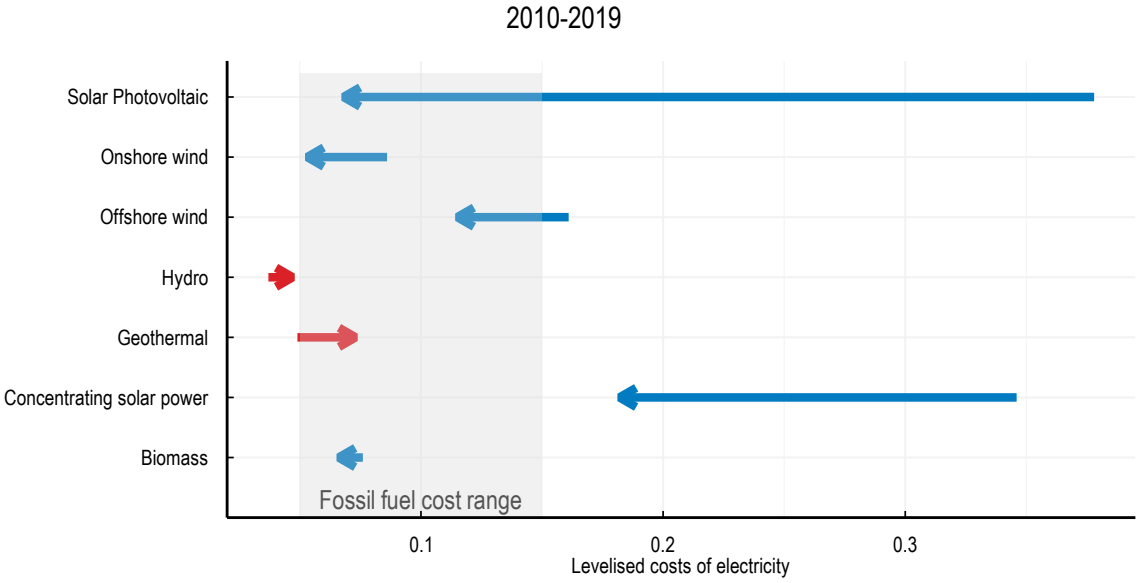
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High upfront costs remain an obstacle to the renovation of electricity and heating systems in residential buildings. Subsidies for research and installing heat pumps or hydrogen boilers would accelerate the switch to clean technologies, create economies of scale, and spur competition and innovation. The resulting reduction in installation costs for clean technologies would reduce the energy transition's social costs and flatten the required forward path of carbon taxes.

While not the most cost-efficient policy tool, feed-in tariffs and feed-in premia can encourage investment in low-carbon electricity generation technology and create positive externalities. Power generators receive a fixed price known in advance, reducing or eliminating uncertainty for investors. Reducing climate policy uncertainty can significantly increase firms' investment activity, in particular in capital-intensive sectors that require long and stable planning trajectories for their investments. Solar PV is an example of the cost-reduction effect of innovation and scalability (Figure 2.14).

Public support is also important in the area of vocational education to ensure that enough workers are equipped with the skills necessary for housing decarbonisation. Retrofits and low-carbon construction, two labour-intensive activities, require specific skills.

Figure 2.14. Innovation has cut installation costs for many renewables including rooftop photovoltaic



Note: The arrow signals a change in levelised costs of electricity from 2010 to 2019. Blue (red) lines denote energy sources which installation costs have declined (increased) during the period 2010-2019. The grey area represents the range of costs of fossil fuels.
Source: (IEA, 2020[47]).

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Design policies that limit adverse impacts on low-income households

Carbon taxes offer options to mitigate adverse distributional effects

Decarbonising housing involves costs, which can have adverse consequences for low-income households. Policy options are available to alleviate adverse distributional side effects from the taxation of housing CO_2 emissions. In terms of design, taxes can be levied on direct emissions, thus pricing the carbon content of heating fuels and leaving the pricing of CO_2 emissions from electricity to taxes or permit schemes applied to power generators. This has the advantage of reducing the regressive impact of electricity taxation while creating incentives to reduce CO_2 emissions at the power generation stage. At the same time, the revenue from taxation can be used to finance transfers to adversely affected households. This consideration, taken together with the observation that impacts differ along other dimensions than income, such as the type of housing, suggests allowing room for space-based differentiation in compensation strategies.

Tradeable permits have similar effects to taxes

If auctioned, tradeable emission permits for housing emissions would have very similar distributional effects as residential carbon taxation. As carbon taxes, auctioned permits would have regressive effects before factoring in their large revenue potential, which offers ample scope to compensate adversely affected low-income households. One difference with taxes is that the price volatility inherent to emission trading systems entails a degree of cost uncertainty which would be particularly harmful to low-income households whose economic conditions are particularly unstable (Cournède, Garda and Ziemann, 2015[48]).

Costs of energy-efficiency standards weigh particularly on low-income households

Strict energy-efficiency standards on buildings and appliances have implications for costs, which are likely to weigh particularly on low-income households. A case can therefore be made for providing bridging loans and subsidies, as the subsequent annual energy savings can be low compared with the cost of renovation. An ex-post assessment of a programme undertaken in France over 2000-13 shows annual energy-bill reductions of EUR 8 per EUR 1 000 invested (Blaise and Glachant, 2019[32]). Mandatory renovations can work against social inclusion by contributing to so-called "gentrification" if they effectively push out low-income renters as rents increase in response to the improvement work to levels that they cannot afford (Anguelovski et al., 2019[49]).

Subsidies require appropriate targeting

Subsidies for emission reductions, even if beneficial to low-income owners living in high-emission-per-square meter dwellings, can bring large benefits to high-income owners. Countries could consider income-based eligibility criteria as well as the provision of refundable tax credits to overcome such concerns. Low-income owners may also struggle to finance up-front investments and may be sensitive to the time delay between the investment and reception of the tax benefit as well as the practical difficulties of living in a house under heavy renovation. The *MaPrimeRénov* programme in France, for instance, offers higher grants for retrofitting projects performed by lower-income households (up to EUR 10 000 per project) and an advance payment to undertake the renovations for the lowest-income households (OECD, 2022[16]). A 64% share of the demand came from lower-income households, a major improvement in terms of targeting compared to the previous scheme (Cour des Comptes, 2021[50]).

Information provision through mandates to certify the energy performance of dwellings implies small direct effects stemming from the certification cost. These costs may raise liquidity issues for low-income owners if they are required outside transactions or inheritance, an adverse effect that can be offset with targeted subsidies. The more targeted subsidies are, however, the greater will be the degree of administrative complexity.

Mobilise all levels of government

Housing and environmental policies are highly decentralised

Well-functioning governance arrangements will be needed to align housing decarbonisation policies and implementation across all levels of government. Both environmental and housing policies are highly decentralised in OECD countries (Box 2.6). While emission goals are set by national governments in international (e.g., Paris Agreement) or supranational fora (e.g., European Green Deal), environmental policy is usually carried out on a shared basis between national, regional and local governments. This is also the case for housing policies, which have an even more prominent local component.

Table 2.4 illustrates some examples of responsibility attribution for relevant policy areas regarding three policy functions: regulation, implementation and financing.

Box 2.6. The importance of cities and regions for decarbonising buildings

The share of emissions from buildings in total emissions is highest in large metropolitan regions and lowest in remote regions (OECD, 2022[51]). In addition, this share increases dramatically in large cities. CO_2 emissions from buildings in London and New York account for 78% and 70% of total emissions, respectively (London City Hall, 2022[52]; NYC Mayor's office of Climate and Environmental Justice, 2022[53])

Buildings within a country differ across regions. Climatic conditions affect the energy performance of buildings and also the property owner's motivation for energy efficiency improvements. Also, the policy environment varies across cities and regions. Each local government has different capacities and policy priorities, including housing affordability, energy poverty and local employment (OECD, 2022[51]). Also, the building stock and locally available heating sources differ across cities and regions. For instance, cities that are close to data centres or industry sites can profit from residual heat and invest in district heating infrastructure.

Energy efficiency improvements in buildings bring benefits, including local job creation, better health outcomes because of improved indoor air quality, and lower energy bills. The OECD – EU Committee of the Regions (CoR) city survey revealed that 89% of cities and regions valued "Reduced cost of paying the energy bill for low-income households" as the most important benefit of energy efficiency improvements in buildings.

Collaboration across levels of government is fundamental in implementing effective measures. Policy tools such as the OECD checklist for Public Action to Decarbonise Buildings in Cities and Regions can help national and sub-national policymakers to align national and local actions towards building decarbonisation (OECD, 2022[51]).

Table 2.4. Responsibility allocation across government levels

	Spain	Canada	France	United States
Carbon pricing (tax, ETS)	Supranational and regional regulation and implementation	Provincial regulation and implementation, with federal backstop	Supranational and national regulation and implementation	State-level regulation and implementation
Housing planning and building standards	Supranational, national and regional regulation, regional and local implementation and funded by all the layers	Federal and provincial regulation, with local implementation	Supranational and national regulation, with regional and local implementation and funded by all the layers	Federal and state (some also local) regulation and state (or local) implementation, funded by all the layers
Energy efficiency (e.g. isolation, heating systems)		Federal, provincial and local regulation, implementation and finance	Central government	
Energy performance information (labelling)	Supranational and national legislation, with regional implementation	Federal and provincial regulation, with local implementation	Supranational and national legislation, with national implementation	State and/or local regulation and implementation

Source: National, regional and local institutions' online resources regarding law, planning and information.

Competencies in relevant fields are often shared vertically, even in unitary countries. While carbon pricing is usually centralised, with the exceptions of Canada, Spain and the United States, for housing planning and building standards (despite basic central regulation), legislation and implementation are usually in the hands of lower tiers of government. With respect to energy performance certification, regulation is often the responsibility of central governments, while sub-national entities usually carry out implementation. Finally, the largest contrast between federal (or heavily decentralised) and unitary countries is related to the governance of energy efficiency policies. While sub-national governments in decentralised countries can elaborate laws in this field, in unitary countries, lower tiers of government are limited to implementing centrally set legislation. A common practice is for sub-national governments to complement national policies with more ambitious targets or by adding additional funding.

Many policy instruments are under the purview of sub-national governments

Social housing is an important policy tool to address affordability and energy poverty challenges. Social housing comprises more than 28 million dwellings and about 6% of the total housing stock in OECD and non-OECD EU countries. There are significant differences across countries in the definition, size, scope, target population and type of provider of social housing. For instance, social rental housing makes up less than 10% of the total dwelling stock in most OECD and EU countries but more than 20% of the total stock in Austria, Denmark and the Netherlands. Social housing dwellings are often owned by sub-national governments, especially municipalities.

Regulation is often set centrally to ensure minimum standards among the different sub-national jurisdictions. In the absence of minimum nationwide standards, there is a risk of predatory competition among jurisdictions that could result in sub-optimal environmental outcomes, including in the housing sector. Carbon pricing in Canada is a clear example of the latter since the federal government established a minimum threshold (known as the federal backstop) that all provinces must reach (Snoddon and Tombe, 2019[54]). Provinces can still decide whether they use carbon taxes or emission trading systems to reach the yardstick and have room to determine the price of carbon emissions if it is higher than the federal backstop. Similar minimum standard-setting may be established (or strengthened in case it already exists) for buildings, electrification or energy savings. Importantly, the process to set them should consider sub-national governments' views to facilitate their engagement and minimise risks of politicisation of environmental policy.

In addition, financial incentives can be used to encourage sub-national governments to align their priorities with nationwide decarbonisation strategies. This is the case, for example, of Ecological Fiscal Transfers (Busch et al., 2021[55]), which the central government pays to sub-national entities based on a multi-variate index of environmental policies, such as enhanced air quality and/or higher shares of land covered by natural protection areas. By doing so, the incentives to improve local government environmental performance can be boosted (Dougherty and Montes, 2022[56]). Inter-governmental policy alignment can also be achieved by making inter-governmental grants conditional on targets set in national or sectoral decarbonisation strategies. Furthermore, financial support for sub-national entities in priority areas would help prevent the creation of unfunded mandates, which arise when the central government creates new responsibilities for the sub-national governments based on its own policy agenda without providing them with the financial support necessary to implement the policy.

Finally, alternative non-regulatory mechanisms, such as soft-power tools, may be useful. Central governments could use their coordination capacity to support experimentation and pilot programmes of new innovative projects and may help sub-national governments learn from best practices used in other jurisdictions. Such policy laboratory and yardstick competition dynamics are characteristic of federations and one of the traditionally used arguments to support decentralisation.

Targets and climate action plans can be set at the sub-central level

Many cities have introduced targets and climate action plans. Currently, 142 cities worldwide have introduced Climate Action Plans compatible with the Paris Agreement target, with 118 of these cities located in the OECD (C40, 2022[57]). Table 2.5 illustrates some of these city-level policies. In a survey of OECD cities, 80% stated that they have energy efficiency goals that are more ambitious than that of the central government (OECD, 2021[58]). For example, in 2012, the city of Copenhagen set the aim in its Climate Plan to achieve carbon neutrality by 2025, 25 years ahead of the Danish national commitment (City of Copenhagen, 2020[59]). Notably, the city aimed to foster the energy efficiency of the existing building stock by encouraging the retrofitting of private homes and maintaining the renovation programme for social housing. For newly constructed dwellings, energy efficiency certificates should ensure the construction of energy-efficient new buildings and provide quantitative indicators to track CO_2 emission reduction progress. Even if more ambitious than national strategies, city-level action plans can pose inter-governmental coordination challenges, especially when national and local targets differ and reflect different implementation strategies.

Table 2.5. Urban policies aimed at promoting energy efficiency in buildings

	Copenhagen	New York	Vienna	Paris	Tokyo
Taxes		Emission trading scheme for buildings planned			Emission trading scheme for buildings (industrial and commercial sectors only)
Subsidies and tax incentives	"One-stop-shop" energy-saving packages to commercial and service companies Tax deduction for retrofit program abandoned in 2022	Low- or no-interest loans to finance energy efficiency improvements (Green Housing and Preservation Program) Green Roof Tax Abatement program Property tax exemptions for green buildings (LEED-certified)	"Thewosan" support scheme: subsidies for new buildings achieving a low energy or passive-house-standard Additional subsidies for the installation of heat pumps, gas condensing boilers and access to district heating	Subsidies for retrofits provided by Anah (L'Agence nationale de l'habitat) Tax credit for retrofits No-interest Eco Loan (Éco-prêt à taux zéro) Reduced VAT of 5.5%	National and local subsidies for specific retrofits (e.g., Minato Ward, subsidy for window glazing)
Standards and regulations	Building regulations (revised in 2016) with mandatory energy efficiency requirements	Proposed mandatory energy use limits for existing buildings Performance-based stretch-energy codes for new construction	Low energy standards Passive-house-standards (voluntary)	Mandatory energy efficiency standards for all buildings	No strict standards; targets for zero emission house and zero emission buildings
Provision of information (labels)	Energy performance certificates	Building Energy Efficiency Rating Labels	Energy performance certificates	Energy performance certificates Effinergie (low energy) labels for new construction	Tenant Rating and Disclosure Program to reflect energy use (mandatory) Carbon Certification Program (voluntary)

Source: City climate action plans (City of Copenhagen, 2020[59]), (The City of New York, 2019[60]), (Magistrat der Stadt Wien, 2022[61]), (City of Paris, 2020[62]), (Tokyo Metropolitan Government, 2019[63]).

While usually better adapted to local specificities, city-level climate action plans rely mostly on higher administrative levels for implementation and financing and often lack the resources to implement their usually more ambitious commitments. For instance, in a survey of 21 OECD cities and regions, 76% of the cities and regions mentioned that the lack of resources was the biggest constraint to implementing energy efficiency measures (OECD, 2021[58]). In the case of Copenhagen, the city recognised in 2020 that the 2025 target could not be reached. The main constraint is the lack of resources to support energy retrofitting since only 15% of Copenhagen's housing stock can be directly influenced by the municipal government (5% are city-owned buildings, and 10% are social housing units). Another difficulty is the gap between the assumed and observed energy use of new buildings that frequently use more energy than anticipated by the building code (City of Copenhagen, 2020[59]).

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3 Gearing housing finance towards efficiency, resilience and decarbonisation

Financial markets and intermediaries are central to attaining public policy objectives in housing. This chapter documents the extent to which housing finance arrangements vary across OECD countries, with different implications, especially in terms of risk sharing between borrowers and lenders. It takes stock of trends in housing finance, especially the ascent of non-bank lenders. The chapter discusses policy options to create favourable conditions for housing finance markets that provide adequate funding, underpin efficient housing markets and contribute to the decarbonisation of homes.

Main policy lessons

Housing finance is one of the largest financial market segments. Well-functioning housing finance markets are essential to fund home buying and homebuilding as well as the large retrofitting expenses required to attain net-zero emissions. Another key policy objective is to ensure that the sector contributes to, rather than undermines, economic resilience in the face of shocks.

Policy options to improve housing finance include:

- Policy should shift the focus away from promoting homeownership, which is often achieved through tax breaks for borrowers, and instead provide support, where appropriate, across the tenure spectrum. This would imply ensuring inclusive access to good-quality housing through a combination of well-functioning private rental markets, and adequate social and affordable housing.
- To correct the bias towards homeownership, mortgage-interest deductibility should be gradually phased out, where it exists. Mortgage interest deductibility is both inefficient and inequitable, as it pushes up house prices. Other mortgage support measures, such as subsidised insurance or public guarantees, also have the undesirable effect of putting upward pressure on house prices and exacerbating default risk, with sizeable fiscal costs.
- The revenue foregone due to tax breaks for borrowers could instead be used to finance meritorious programmes, such as the provision of social and affordable housing; and improve the public finances.
- As regards financial resilience risks at a time of downward pressure on house prices, macroprudential policy should focus on avoiding adverse feedback loops triggered by asset repricing: key tools are capital requirements and leverage caps combined with close scrutiny of linkages between banks and leveraged holders of mortgage-backed securities.
- The effectiveness of the regulatory tools for mortgage real estate investment trusts and real estate mutual funds should be further assessed. There is merit in implementing more comprehensive, risk-based approaches to regulating non-bank mortgage lenders and servicers. The objective is to address nascent vulnerabilities without undermining the benefits of market-based finance. Non-bank financial institutions should have adequate incentives to internalise their liquidity and maturity-transformation risks to avoid unnecessary cyclical spillovers to the rest of the financial system and the real economy.
- There is a need to strengthen the resilience of real estate mutual funds to allow them to absorb outflows without resorting to redemption suspensions. These could include the imposition of capital buffers and additional liquidity requirements, adoption of swing pricing and use of liquidity management tools. The risks of mortgage real estate investment trusts are centred on maturity mismatch and debt rollover, and could be dealt with using risk management tools to strengthen their capacity to absorb losses and improve their liquidity positions.
- Prudential regulations on non-bank mortgage lenders and servicers could be further improved, including by adopting a risk-based approach in line with the regulatory framework for banks. Also, it is important to adjust liquidity surcharges in light of market conditions to avoid a pro-cyclical stance that would force some lenders to raise funds at times of financial stress.
- A central objective of green finance is to fund decarbonisation of the real estate sector. In that regard, policy needs to take a more active role in promoting transparency for the various green building rating systems to improve clarity and comparability to allow the various markets to merge and deepen across boundaries, thereby exploiting scale economies and overcoming the fragmentation that has slowed the low-carbon transition. Policymakers should likewise seek to strengthen green real estate bond and mortgage-loan frameworks. They should also support the development of green real estate finance instruments to underpin the expansion of green real estate finance markets needed to fund the transition to net zero carbon emissions.

Keep in mind country-specific features of mortgage markets

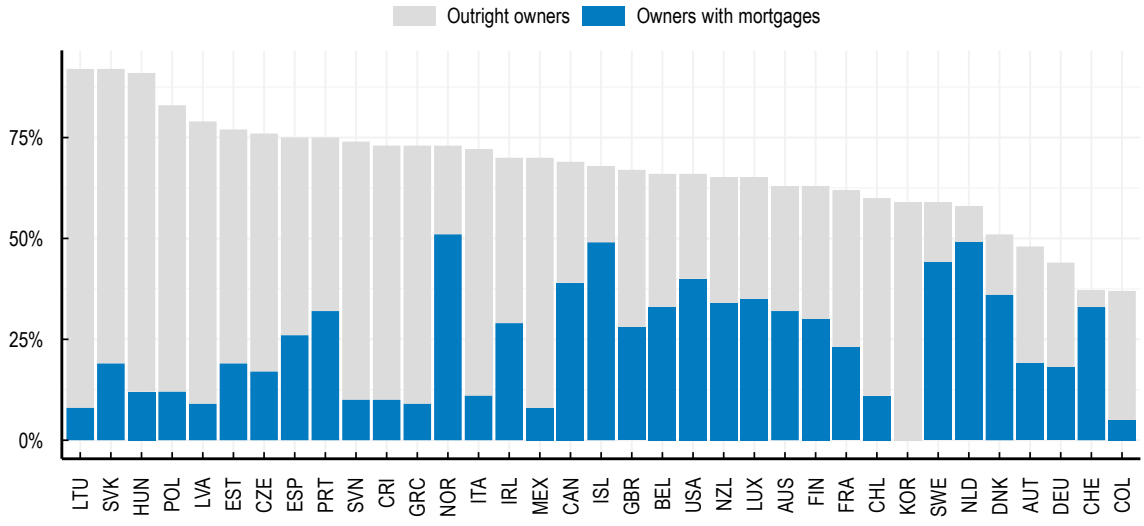
Housing-finance markets differ along many dimensions across OECD countries.[1] Mortgage market depth, the characteristics of the products (e.g., years of amortisation, availability of foreign currency borrowing, fixed versus variable-rate lending), tax treatment, policies supporting mortgage take-up, the macroprudential framework and foreclosure rules all vary across economies. These features structure access to and affordability of owner-occupied housing. Yet, ownership is only one route to ensuring good housing outcomes: private rentals are an alternative option, and social and co-operative forms can also provide good-quality housing for lower-income segments of the population.

Homeownership and mortgage holding rates vary considerably across OECD countries

Homeownership rates vary considerably across OECD countries and social groups. Homeownership is particularly high in central and eastern European countries (Figure 3.1). Among owner-occupiers, those with a mortgage are fewer than one in ten in Colombia but about one in two in Norway, Iceland and the Netherlands. Moreover, homeownership is lower for younger households, even though age gaps in homeownership rates vary considerably across countries (Figure 3.2, Panel A). Furthermore, homeownership is correlated with income: income gaps in homeownership are particularly high in the Netherlands, Norway and France (Panel B). Similar income gaps are found in mortgage holding (Panel C). Mortgage costs also tend to be higher in relation to disposable income for low-income households (Figure 3.3).

Figure 3.1. Homeownership rates vary considerably across OECD countries

Percentage of households, 2020 or latest available

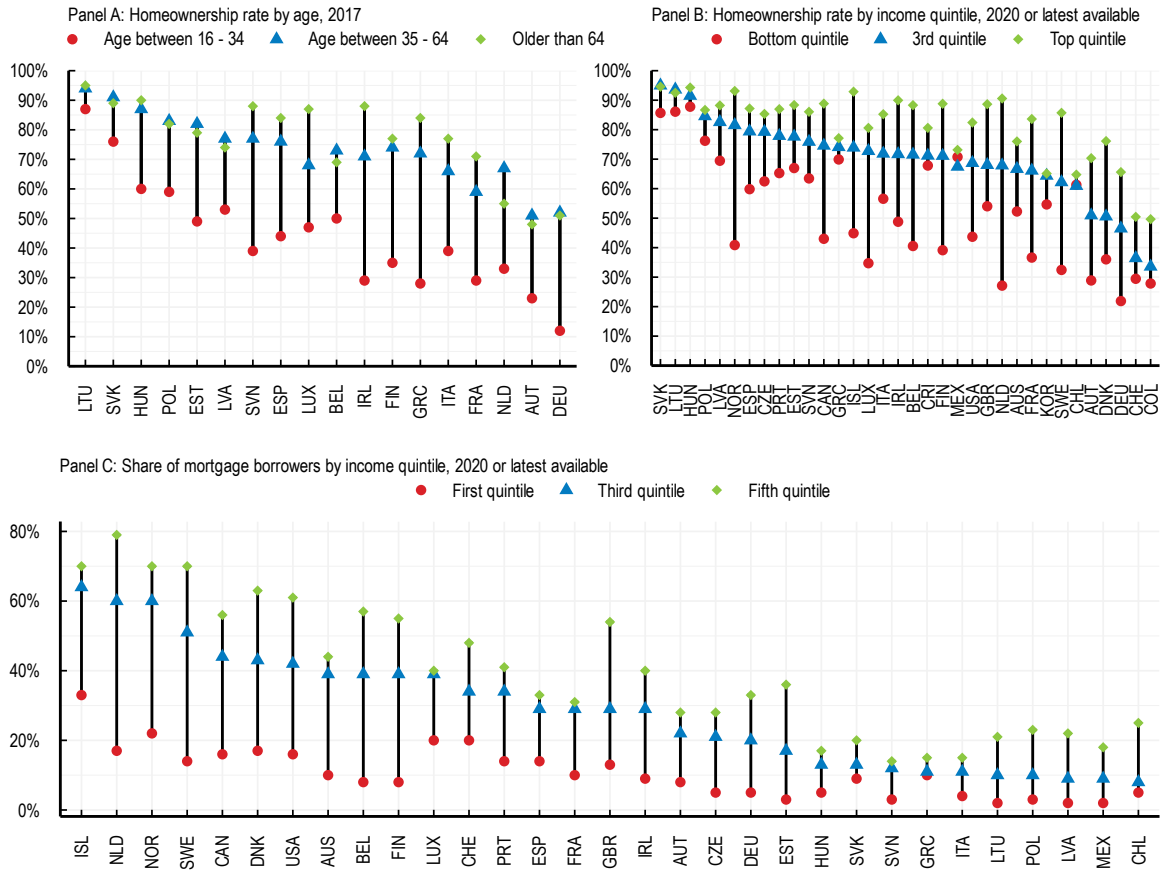


Note:Data on the share of owners with mortgages is missing for Korea.
Source: OECD Affordable Housing Database.

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[1] This chapter draws on three reports that provide more detail and additional references (OECD, 2021[25]; OECD, 2022[42]; Van Hoenselaar et al., 2021[1]).

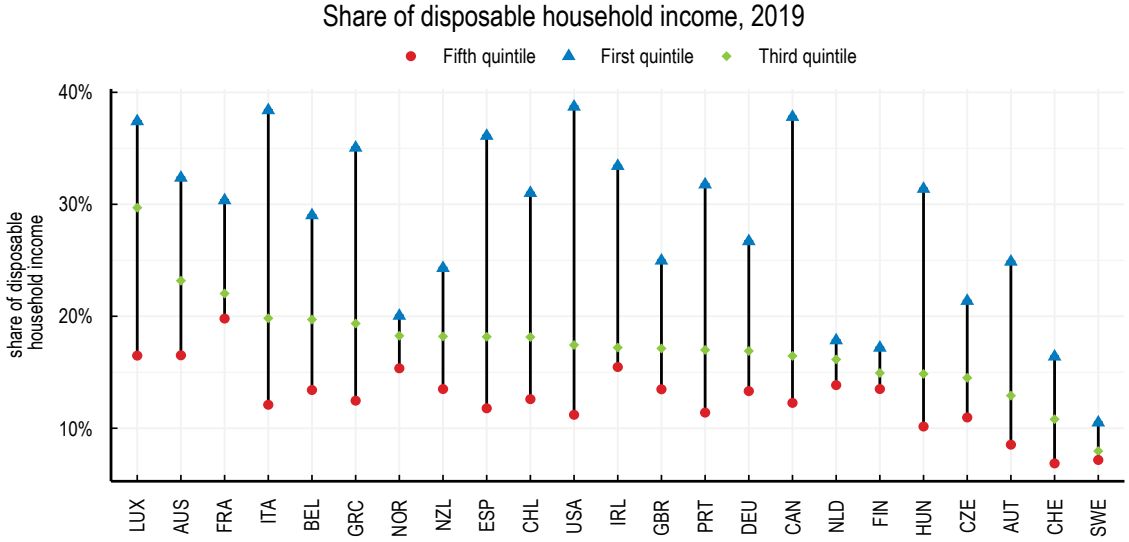
Figure 3.2. Homeownership and mortgage rates differ by age and income quintile



Source: ECB (2017), *Household Finance and Consumption Survey;* OECD Affordable Housing Database.

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Figure 3.3. Mortgage costs burden low-income households more

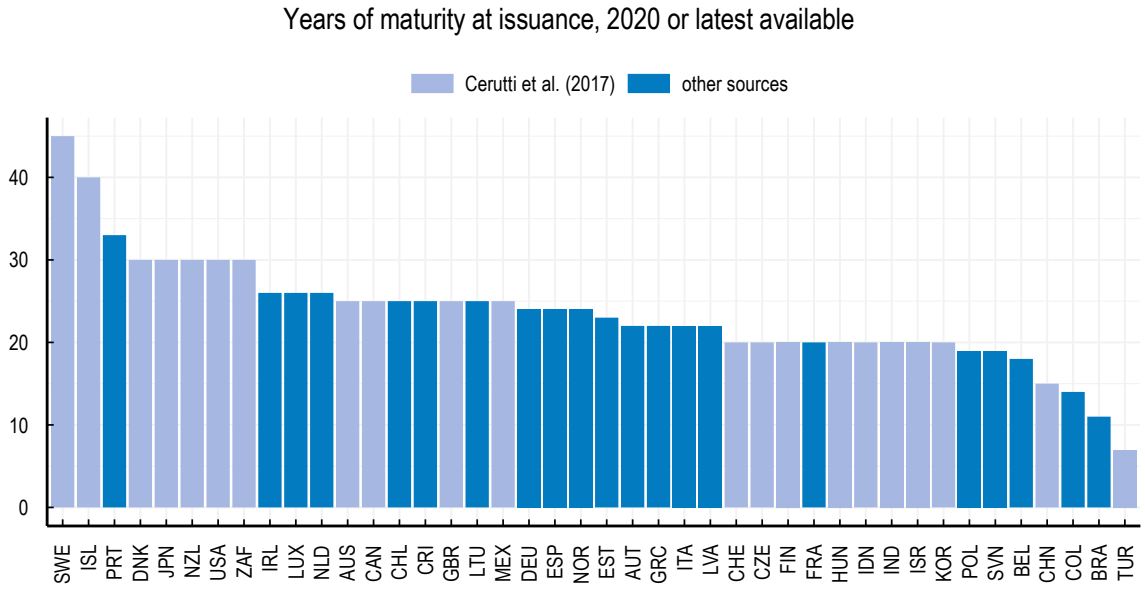


Note: 2019 or latest available year. The average is calculated only across households with a mortgage. For the United States and Chile, gross household income is used due to data limitations.
Source: OECD Affordable Housing Database.

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Mortgage markets also differ considerably across countries. The share of fixed-rate mortgages has increased substantially over the past decade, given the decline in interest rates in most countries, which makes floating-rate mortgages less attractive. Also the average maturity of new housing loans varies across countries (Figure 3.4), while the share of foreign-currency mortgage lending has shrunk.

Figure 3.4. The average maturity of mortgage loans varies considerably across countries



Note: Other sources refer to data from national sources from Van Hoenselaar et al. (2021[1]), when 2020 statistics from national sources are unavailable, the figure shows 2015 data from Cerutti, Dagher et Dell'Ariccia (2017[2]). The national sources give actual averages across loans at origination, while the data collected by Cerutti, Dagher et Dell'Ariccia (2017[2]) refer to the most typical maturity in the country.
Source: Cerutti, Dagher et Dell'Ariccia (2017[2])) and Van Hoenselaar et al. (2021[1]),.

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Recognise the tension between supporting mortgage borrowing and promoting financial resilience

Many tax systems include mortgage interest tax deductibility and other support measures

The tax system plays an important role in shaping housing demand (OECD, 2022[3]). The most important aspect is mortgage interest deductibility (MID). Mortgage interest on owner-occupied housing benefits from tax relief in 17 OECD countries via tax deductions or credits (Table 3.1). Marginal effective tax rates vary across countries and tend to be higher where household debt is high (Figure 3.5).

Table 3.1. Most countries support mortgage borrowers

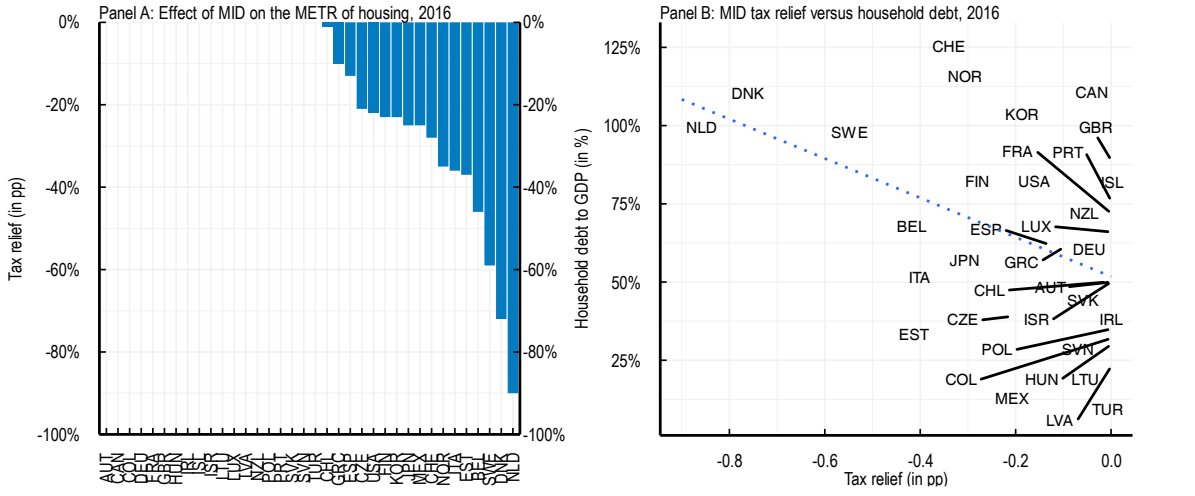
National programmes[1]

	Mortgage interest relief[2]	Mortgage guarantee schemes	Subsidised mortgages	Public mortgages
Belgium	X	X		
Canada		X	X	
Chile	X			
Costa Rica		X		
Czech Republic	X		X	X
Denmark	X			
Estonia	X	X		
Finland	X	X		X
France			X	
Greece	X			
Hungary			X	
Ireland				X
Israel			X	
Italy	X	X		
Japan	X		X	
Korea	X			
Latvia		X		
Lithuania			X	
Luxembourg		X	X	
Mexico	X		X	
Netherlands	X	X		
New Zealand		X		
Norway	X			X
Russia			X	
Spain	X			
Sweden	X	X		
Switzerland	X			
United Kingdom				X
United States	X	X	X	

Notes: (1) Only programmes at the central-government level are reported. Many local and regional governments also have programmes.
(2) This relates to mortgage interest relief for owner-occupied housing.

Source: OECD Affordable Housing Database.

Figure 3.5. Mortgage interest deductibility pushes up household debt



Note: Tax relief denotes the percentage point reduction of the marginal effective tax rate (METR) on residential property for debt-financed owner-occupied properties induced by mortgage interest relief (MID).

Source: Millar-Powell et al. (2022[4]) and OECD Household Accounts.

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Various types of mortgage support to facilitate access to housing loans are available in OECD countries. For example, the US Federal Housing Administration offers insurance to about 20% of all owners up to a ceiling (Box 3.1), and various Government-Sponsored Enterprises (GSEs) are active in the secondary mortgage market (see below). The Korean Housing Finance Corporation plays a similar role. New Zealand has a guarantee scheme that allows higher loan-to-value (LTV) ratios than what would otherwise be provided by financial markets. Eleven other countries also operate various guarantee schemes. Tax-favoured saving plans for savings directed towards the purchase of a home are also fairly widespread. Finally, subsidised or publicly provided mortgages exist in 14 countries.

There is a case for reassessing mortgage support measures

Governments would do well to phase out mortgage-interest deductibility (MID), where it exists. To the extent that housing supply is imperfectly elastic, the tax break is at least partially capitalised in prices, which benefits existing homeowners, who are usually more affluent than potential buyers, while reducing borrowing costs. The additional tax revenue from removing or capping tax relief on homeownership could be used to lower other distortionary taxes or to improve after-tax income equality, depending on social choices. Other instruments, such as subsidised insurance or mortgage loan guarantees, are less distortionary, but they may exacerbate default risks with non-negligible fiscal costs (Box 3.1). Support may also be capitalised in higher property prices, which is undesirable.

Box 3.1. Public finance risks from mortgage loan guarantees: the US FHA and Canada's CMHC

An important historical example of the materialisation of public finance risk is the 30 September 2013 budgetary transfer of USD 1.69 billion to recapitalise the US Federal Housing Administration (FHA).

This federal agency, established in 1934, insures mortgages for first-time and low-income buyers of single-family residences as well as the construction of affordable rental properties. It insured about 5% of all residential mortgages originated in 2006, a share that surged to about 40% in 2011 before falling back to 11.4% in 2019. Thanks to the unforeseen housing-market effects of the GFC the cumulative effects of its loan guarantees from 1992 to 2012 – a period during which the FHA insured USD 2.679 trillion in residential mortgages – fell short of predicted savings of USD 45 billion and became an estimated cost of USD 15 billion. According to the Congressional Budget Office, including the year 2013 as well, its cumulative loan guarantees would contribute only USD 3 billion to its capital reserves, USD 73 billion less than what would have resulted from the originally estimated subsidy rates.

Despite five increases in premium rates starting in 2009, tightened credit requirements and tougher enforcement actions, the General Accountability Office included the FHA as a high-risk entity in early 2013 because of its vulnerability to fraud, waste, abuse and mismanagement. With a negative net worth at the time of USD 16.3 billion and a capital ratio of -1.44% (compared to the legally mandated 2%, a level that it failed to reach each year from 2009 to 2014), along with the results of a Federal Reserve stress test that showed a potential need for USD 115 billion in extra funding in the event of a severe downturn, the FHA was forced to accept the "bailout".

Another interesting case is that of Canada, where the Canada Mortgage and Housing Corporation (CMHC) is the federal government's agency for its housing market interventions. It has never incurred a direct fiscal cost to taxpayers, though with almost CAD 401 billion in insurance in force and CAD 461 billion in guarantees in place (CAD 257 billion in Canada Mortgage Bonds and CAD 202 billion in MBS) and equity of only CAD 13.2 billion it is obviously highly leveraged. The federal government undertook a public consultation in 2017 ago to seek reactions to the idea of shifting more of the risks to mortgage originators by implementing a lender risk-sharing arrangement (Finance Canada, 2017[5]), but no major changes have been made since then.

For all these reasons, a case can be made to shift the focus of policy support away from promoting homeownership toward ensuring inclusive access to good-quality housing through a combination of social and affordable housing, private rental markets and well-functioning mortgage markets. The large amounts spent on tax breaks for mortgage borrowers provide opportunities for policy reforms that enhance financial stability, by reducing incentives to borrow, improve public finances and expand housing supply, through social and affordable housing construction. The capacity of private rental markets to provide affordable housing depends on the degree to which regulations allow homebuilding (Molloy, 2020[6]); without sufficiently flexible supply, there is a risk that financial investment into rental housing might contribute to high rent levels (Lima, 2020[7]).

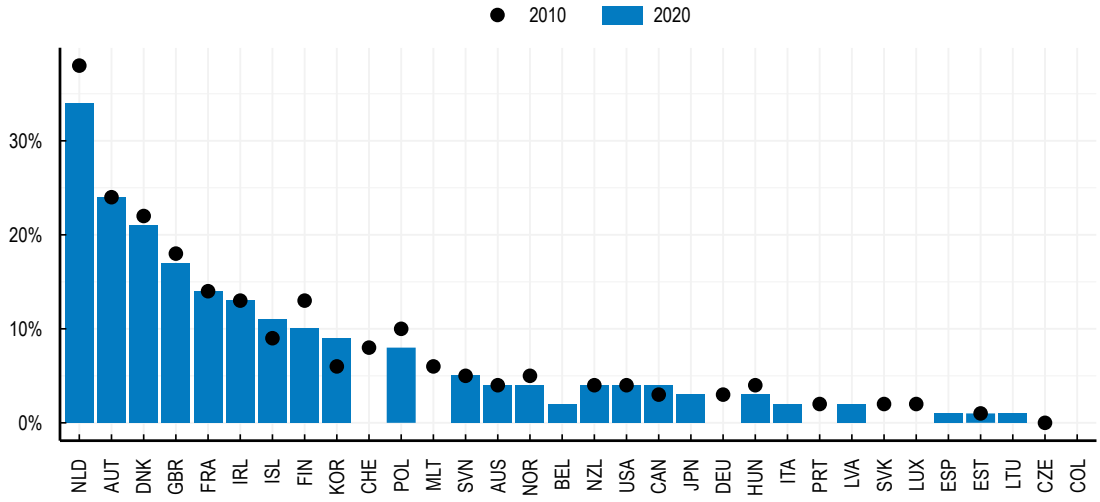
Social housing provision is a powerful tool to improve affordability

Affordability is a challenge everywhere in the OECD with important implications not just for well-being but also for local economic dynamism and competitiveness. Low-income households have been under increasing financial pressure from rising housing costs, despite very low borrowing costs until recently. Housing poverty is measured by the "overburden rate": the share of the population in the bottom quintile of the income distribution spending at least 40% of their disposable income on housing. It has afflicted one in four such households in the OECD on average. Overburden rates are lower among low-income renters, at about one-third among those in the private market and 10-15% for those in subsidised social housing.

Most OECD countries offer at least a certain amount of publicly-owned housing (Figure 3.6). However, at an average of about 7% of the dwelling stock, it is a smaller share than private rentals. The amount of government expenditure in support of rental social housing has generally been declining as a share of GDP (Adema, Plouin and Fluchtmann, 2020[8]).

Figure 3.6. The social rental dwelling stock is large in only a few countries

Social rental dwellings as per cent of the total housing stock



Source: OECD Affordable Housing Database (indicator PH4.2); Italy: Federcasa and the Tax Revenue Agency; Finland: national authorities.

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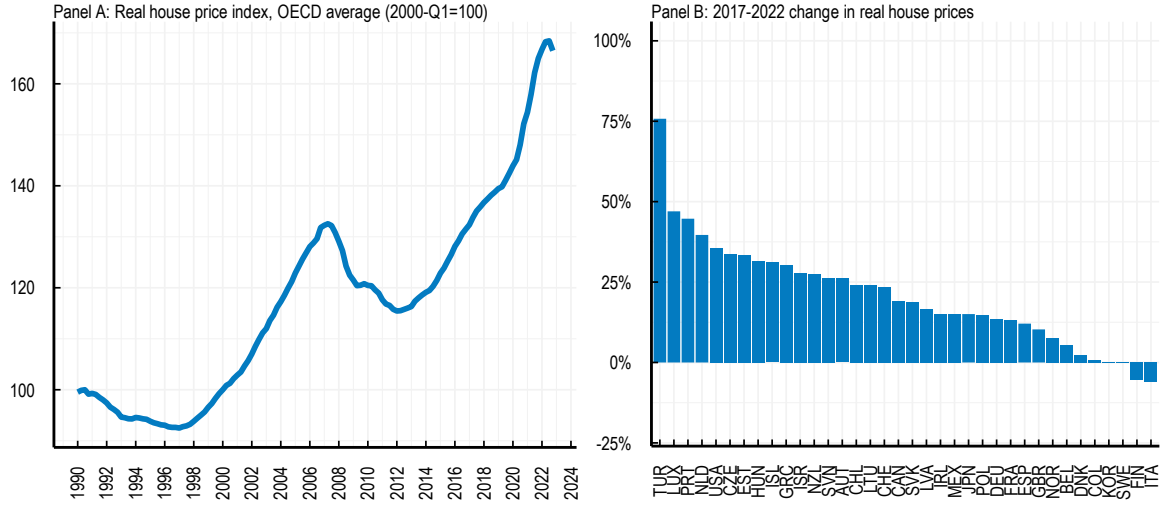
Compared to ownership, renting has the advantage of encouraging greater labour mobility, which helps to deepen the labour market. However, that benefit is lost when it comes to subsidised (social) housing due to lock-in effects, unless coupled with portable eligibility. Housing allowances are an alternative policy option, but they are to some extent capitalised in rental prices. Affordability is also influenced by land-use regulations and planning (OECD, 2021[9]), to the extent that the relaxation of restrictions unlocks

opportunities for housing developments more closely aligned with socio-economic and demographic trends (Phillips, 2020[10]).

Financial stability needs to be ensured against mortgage borrowing risks

Housing provides key consumption services while being a long-term investment, a store of wealth and a collateral. Its financing is an important driver of business cycles. With interest rates rising after a long and rapid house price expansion (Figure 3.7), high levels of household debt and highly leveraged financial institutions, the macroeconomic role of housing finance may prove particularly significant. In the past, similar imbalances have affected the stability and resilience of financial markets and generated financial crises. The onset of the global financial crisis of 2007-2009 is a prime example of such consequences. Experience shows that the economic cost of such crises can be very large and recalls that public authorities need to provide a particular attention to the risks associated to this sector.

Figure 3.7. Real estate prices have risen rapidly



Note: Nominal house prices deflated using the private consumption deflator from the national account statistics.
Source: OECD Analytical House Price Indicators.

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Measures to facilitate access to mortgage borrowing often come with adverse side-effects on house prices, and macroeconomic and financial stability, especially when they encourage excessive borrowing. Overall, household indebtedness varies substantially across OECD countries (Figure 3.8, Panel A) and is closely influenced by house price developments (Panel B). Many governments intervene in mortgage markets because of the associated financial risks, especially through macroprudential regulations (OECD (2021[9]) and Box 3.2 for the example of Italy). These can work on the side of borrowers, to keep indebtedness in check and reduce default risk, or lenders, to limit risk taking and excessive leverage.

Borrower-side macroprudential policy

Prudential regulations in this area include caps on individual borrowers' housing debt in relation to their income (DTI), debt service relative to income (DSTI) and the amount of borrowing relative to the value of the associated property (LTV). LTV ceilings at origination range from 50% in Israel to 95% in Finland, Canada, Denmark and Latvia (Figure 3.9). DSTI limits are in some cases only recommended, income definitions differ (i.e., gross versus net), and some countries allow a certain amount of lending to exceed the cap. They vary from 30% of income in Colombia to 80% in the Slovak Republic (Figure 3.10) and have empirically found to be more effective in curbing credit growth than those imposed on LTVs. DTI caps,

which present the advantage of being insensitive to changes in interest rates or house prices, have so far been more rarely used (Van Hoenselaar et al., 2021[1]).

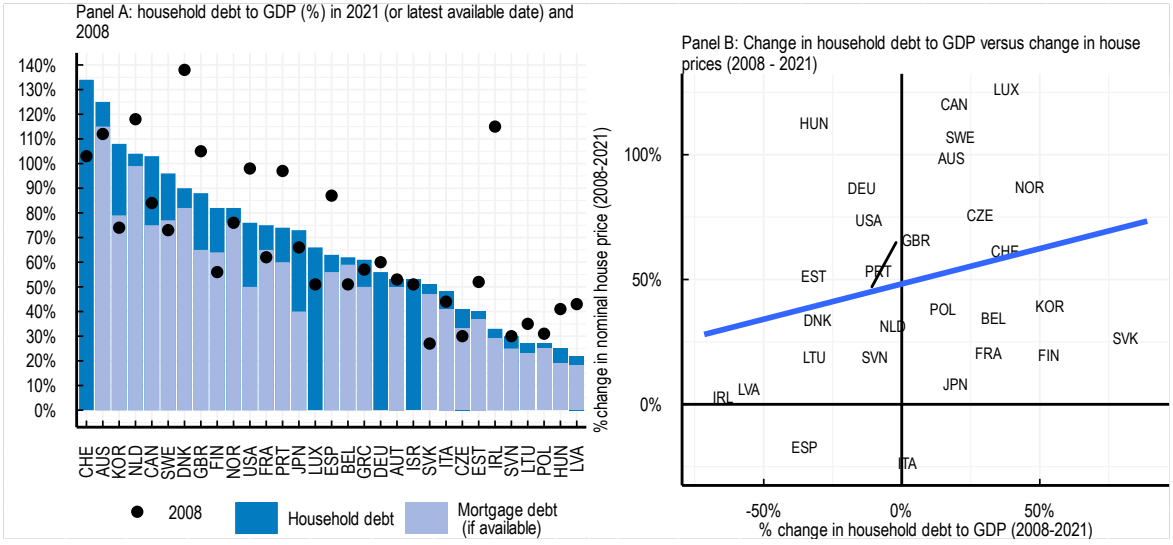
Box 3.2. Italy's macroprudential framework

A regulatory framework for borrower-based instruments allows Italy to face systemic risks that could stem from the real estate market and the indebtedness of households or non-financial firms. The Bank of Italy can impose a number of restrictions on new loans, including limits on the LTV ratio, DTI, LTI, DSTI, leverage, maximum maturity and amortisation requirements of loans. The definition of measures is flexible, and limits can be applied: (a) on loans to households and firms; (b) with or without exemption thresholds; (c) in the same way on all loans or differentiated based on borrower and loan characteristics; (d) at the national level or for specific geographical areas; and (e) alone or in combination, with other measures.

In addition to banks, the Bank of Italy may apply borrower-based measures also to other financial intermediaries who, like banks, carry out the activity of granting loans in any form to the public. As of end 2022, the macroprudential authorities were not applying restrictive policy settings, as they assessed risks from the Italian residential real estate sector as low.

Source: Communication by the national authorities to the OECD.

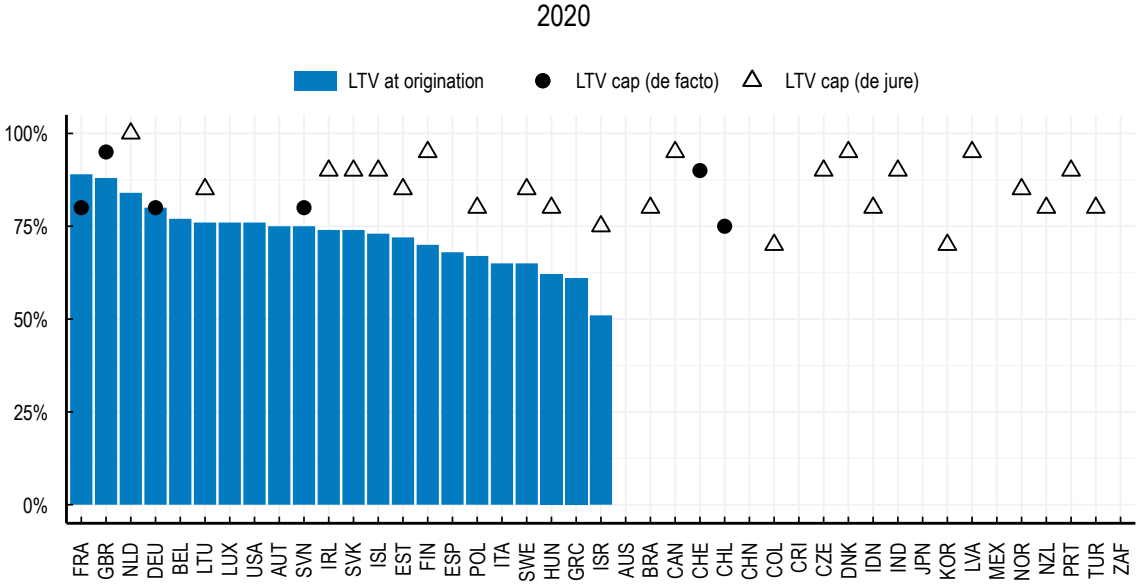
Figure 3.8. Household debt levels and dynamics have differed across countries



Source: OECD Analytical database.

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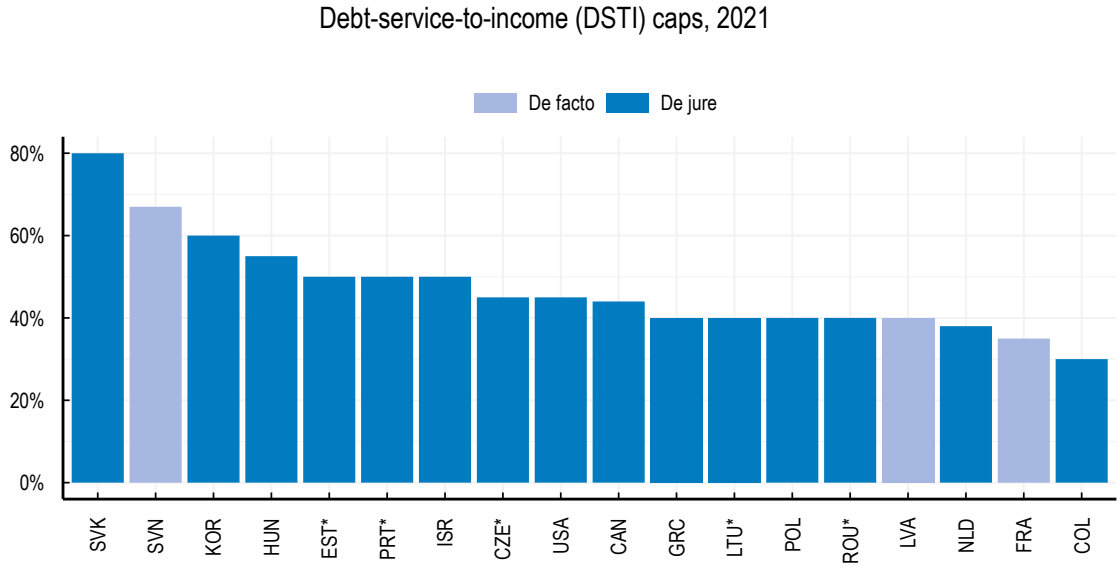
Figure 3.9. Average loan-to-value at origination is typically well below loan-to-value caps



Note: *De jure* LTV-caps refer to official regulation of government institutions. The *de facto* caps are caps that follow from self-imposed constraints by financial institutions or recommendations from public authorities.
Source: ESRB (2021) Macroprudential database; OECD QUASH 2019 survey; IMF Macroprudential database; (ECB, 2020[11]); Bank of England.

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Figure 3.10. Countries cap debt service relative to income at different levels



Note: The income used for the DSTI differs by country; some use gross income and some net income. In Estonia, Portugal, the Czech Republic, Lithuania and Romania, a certain percentage of loans are extended above the DSTI cap. In the Czech Republic, a higher DSTI cap (50%) applies to borrowers aged under 36 years.For the United States the DSTI cap applies only for qualified mortgages that are eligible for purchase or guarantee by either Fannie Mae or Freddie Mac.
Source: (ECB, 2020[11]); Bank of England; ESRB Macroprudential database; IMF Macroprudential database; OECD QUASH survey.

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Lender-side macroprudential policy

Mortgage indebtedness also creates risks for lenders and holders of repackaged housing loans. While household balance sheets are currently stronger than before the global financial crisis, aggregate numbers might conceal important heterogeneity. Risks remain that the repayment capacity of low-income borrowers could deteriorate, given the withdrawal of pandemic income support measures, higher inflation and rising financing costs (OECD, 2022[12]). These developments may test the adequacy of the macroprudential tools to counter mortgage default, such as DSTI or LTV caps, deployed at the time when housing markets expanded rapidly. Therefore, trends in new defaults should be carefully monitored as deteriorating credit quality of households could lead to substantial losses for mortgage lenders and holders of mortgage-backed securities, with negative impacts on the resilience of the financial system.

Higher interest rates in response to higher inflation reduce the value of mortgages and their derived securities on the balance sheets of financial institutions, making asset valuation a major risk for macroprudential policy to manage. Tools directly focussing on the health of financial institutions, such as risk-weighted capital requirements and non-risk-weighted leverage caps, are well suited to tackle the risk of adverse feedback loops that could be triggered by asset revaluation. They need to be combined with close scrutiny of linkages between banks and leveraged holders of mortgage-backed securities. As well, the risks associated with variable-rate and foreign-currency mortgage loans need to be appropriately accounted for.

Tailoring macroprudential policy to economic circumstances

The steering of macroprudential policy, which can build on a wide body of accumulated international experience (Box 3.3), needs to consider higher inflation and rising interest rates. Regulatory caps on DSTI ratios need to be forward-looking, incorporating the likelihood of higher interest-rate payments for variable-rate loans as interest rates increase. In an environment of rising inflation and interest rates, fixed-rate mortgage lending involves risks to financial stability through channels that differ from the recent low-inflation, low-interest-rate period. In as much as wages, capital income and disposable household income at least partly follow inflation, servicing fixed-rate loans should become easier for households over time, even if the squeeze from higher energy and food prices may temporarily complicate mortgage servicing and ultimately such loans will have to be rolled over at higher borrowing rates.

Box 3.3. Conducting macroprudential housing policies: the experiences of three countries

Lithuania

In Lithuania, the global financial crisis underlined the importance of macroprudential policy implementation to ensure sound financing of the housing sector and mitigate credit-fueled unsustainable housing price dynamics.

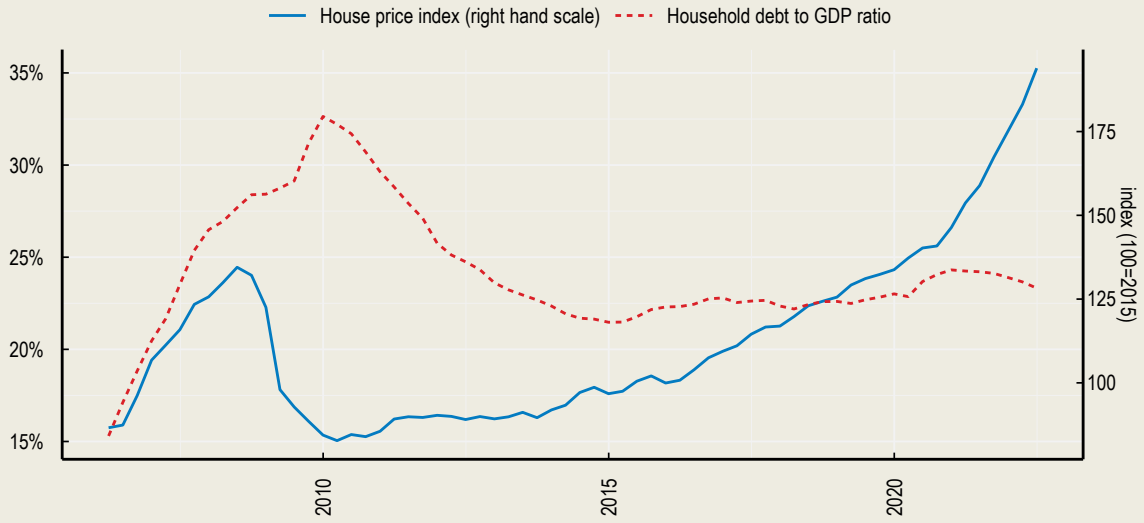
The Lithuanian housing market experienced a substantial boom-and-bust cycle over the period 2006-2009 amid easy lending conditions and an underestimation of credit risk. To encourage more responsible lending practices and to strengthen market discipline in the aftermath of the housing crisis, in 2011, the Bank of Lithuania issued a set of Responsible Lending Regulations. These regulations implemented a mix of borrower-based measures (BBMs) applying LTV, DSTI and maturity limits on newly issued housing loans. As the mortgage market remained depressed and lending standards set by credit institutions were extremely strict at that time, it allowed for a non-binding calibration of BBM limits with the aim of preventing a subsequent build-up of vulnerabilities.

The BBMs were successful in ensuring responsible lending practices, as after 2011 the share of loans with high LTV and DSTI at origination remained low and household debt declined to well below pre-

crisis levels, despite the significant recovery in the mortgage market since 2016 (Figure 3.11). In contrast to the 2006-2008 episode, the increase in house prices during the post-pandemic period has been fuelled by different factors including a sharp rise in construction costs, high consumer confidence and a significant increase in housing demand (Karmelavičius, Mikaliūnaitė-Jouvanceau and Petrokaitė, 2022[13]).

Figure 3.11. Lithuanian house prices have been rising while indebtedness has remained stable

Household-debt-to-GDP ratio and house price index in Lithuania



Source: Bank of Lithuania, Statistics Lithuania.

StatLink https://stat.link/ts6amx

The prolonged environment of low interest rates implied that DSTI limits became less binding. Lower interest rates allow borrowers to take on more debt without breaching the DSTI threshold. To safeguard borrowers from excessive borrowing when interest rates are low and to ensure their ability to service their loans under higher interest rates, the 40% DSTI requirement was supplemented in 2015 with the obligation to ensure that DSTI would not exceed 50% if calculated using a 5% interest rate. The implementation of this requirement indirectly implied a maximum debt-to income ratio of 7.8 and therefore reduced the effective DSTI limit to 35% for those close to the DTI limit. As of 2022, loans issued adhering to this requirement constitute 70% of the mortgage loan portfolio, a situation that contributes to resilience to increasing interest rates.

In 2017, with the transposition of the EU Mortgage Credit Directive into Lithuanian legislation, the scope of the Responsible Lending Regulations was expanded to ensure that BBMs would be applicable to all credit providers issuing housing loans in Lithuania. Such an activity-based application of BBMs treats all credit providers equally, reducing opportunities for regulatory arbitrage.

The increase in second and subsequent housing loans raised concerns regarding their impact on financial stability. Their share rose from 10% to 13% of new housing loans between 2019 and 2021 (Bank of Lithuania, 2022[14]). To reduce risks from such loans and discourage households from taking mortgages for housing other than their primary residence, the LTV requirement for second and subsequent housing loans was tightened from 85% to 70% as of 1 February 2022.

Growing risk in residential real estate markets also called for action to improve the resilience of credit providers. To enhance their capacity to absorb losses in the event of a housing market correction and

resulting inability of households to meet their obligations, a 2% systemic risk buffer became applicable on 1 July 2022 for domestic exposures to household debt secured by a residential property.

In Lithuania a significant share of housing transactions is financed by own funds: 50% of total acquisition costs on average over the period 2015-2021. Therefore, macroprudential policy measures can affect only a fraction of the housing market transactions, and additional policy measures with a broader reach, such as an immovable property tax, are needed. Currently only households whose real estate worth exceeds a relatively high threshold are subject to the immovable property tax. Such tax design does not sufficiently address housing market stability goals and could be adjusted imposing a recurring tax on a broader range of taxpayers while maintaining overall tax system progressivity (Bank of Lithuania, 2022[15]).

The Lithuanian housing market is affected by a wide range of factors, including by the stance of monetary policy. Challenges are best addressed by combining several macroprudential and tax policy tools with effective land-use planning and social housing development to ensure a flexible housing supply.

Norway

High household debt and house prices are important vulnerabilities in the Norwegian financial system. Since 2010, Norway has implemented a number of macroprudential measures to promote a more sustainable development in household debt and to address risks related to household indebtedness and other vulnerabilities.

Borrower-based measures

Borrower-based measures were first introduced in the form of non-binding guidelines on mortgages from the Financial Supervisory Authority in 2010. The guidelines were replaced by a mortgage regulation laid down by the Ministry of Finance in 2015. In 2019, the regulation was broadened to include consumer loans. The measure is evaluated regularly, and subject to public consultation.

The current regulation is set to expire at the end of 2024. The regulation caps the loan-to-value ratio (LTV) of new mortgages at 85%, and the debt-to-income (DTI) ratio at 500%. Furthermore, it requires the lender to assess the borrower's debt-serving ability, allowing for an interest rate increase of 3 percentage points or an interest rate of at least 7 per cent. To ensure that banks can make customer-specific assessments, a share of banks' loans can exceed the regulation's requirements.

Since the measure was introduced, fewer mortgages with a very high LTV and DTI ratios have been granted. However, the average DTI ratio has increased, and an increasing number of mortgages have been granted to borrowers with a DTI ratio close to 500%.

Capital requirements

Developments in residential and commercial property prices are important indicators for the assessment of cyclical vulnerabilities. Both indicators often rose substantially ahead of financial instability episodes. The counter-cyclical capital buffer requirement, which is intended to strengthen banks' ability to absorb loan losses, was decreased during the pandemic. Since then, it has been increased several times, and is set to increase to 2.5% as of March 2023. The central bank has the decision authority over the countercyclical buffer.

A systemic risk buffer for banks was implemented in Norway in 2013, and set at 3%. In 2020, the buffer was increased from 3 to 4.5 per cent and targeted towards domestic exposures. The systemic risk buffer is in large part calibrated based on structural vulnerabilities stemming from high household debt and substantial exposure towards commercial real estate among Norwegian banks.

To prevent large banks from using the Internal Ratings Based (IRB) approach to assign unjustifiably low risk weights on Norwegian residential and commercial real estate exposures, the Ministry of Finance adopted from year-end 2020 temporary floors for average risk weights for such exposures at 20 and 35 per cent, respectively. The floors are reviewed biennially, and were extended for two more years from year-end 2022.

Switzerland

To reduce risks in the Swiss mortgage and real estate markets, a series of measures were taken between 2012 and 2022. These measures include stricter capital requirements for high-LTV mortgage loans, several revisions to the self-regulation rules and the use of the sectoral counter-cyclical capital buffer.

- Self-regulation rules were tightened in 2012, 2014 and 2020. The revisions restricted the use of pension savings as down payment or as collateral for borrowers (10% own equity, not taking into account any pension assets, was required in 2012 and 2014; and 25% for investment properties in 2020). Moreover, they stipulated that mortgages must be paid down to two thirds of the collateral value within a maximum amortisation period (20 years in 2012, 15 years in 2014).
- The sectoral counter-cyclical buffer was activated and set at 1% of risk-weighted mortgage positions financing residential real estate located in Switzerland in early 2013. In 2014, it was increased to 2%. After the onset of COVID-19, the sectoral countercyclical buffer was deactivated in March 2020 to cushion the economic impact of the pandemic and give banks – together with other measures – more latitude for lending. The sectoral counter-cyclical buffer was reactivated in January 2022 (at 2.5%) in light of the persistent risks facing Swiss mortgage and real estate markets.

Overall, the combination of supply and demand-side measures coupled with repeated public warnings by authorities seems to have had an important impact on housing-related risks. In particular, the sectoral counter-cyclical buffer has contributed to the resilience of the banking system. Moreover, tightened down-payment requirements appear to have had an impact on the dynamics of the mortgage and residential real estate markets.

Legal systems need to balance the rights of borrowers and lenders in foreclosure proceedings

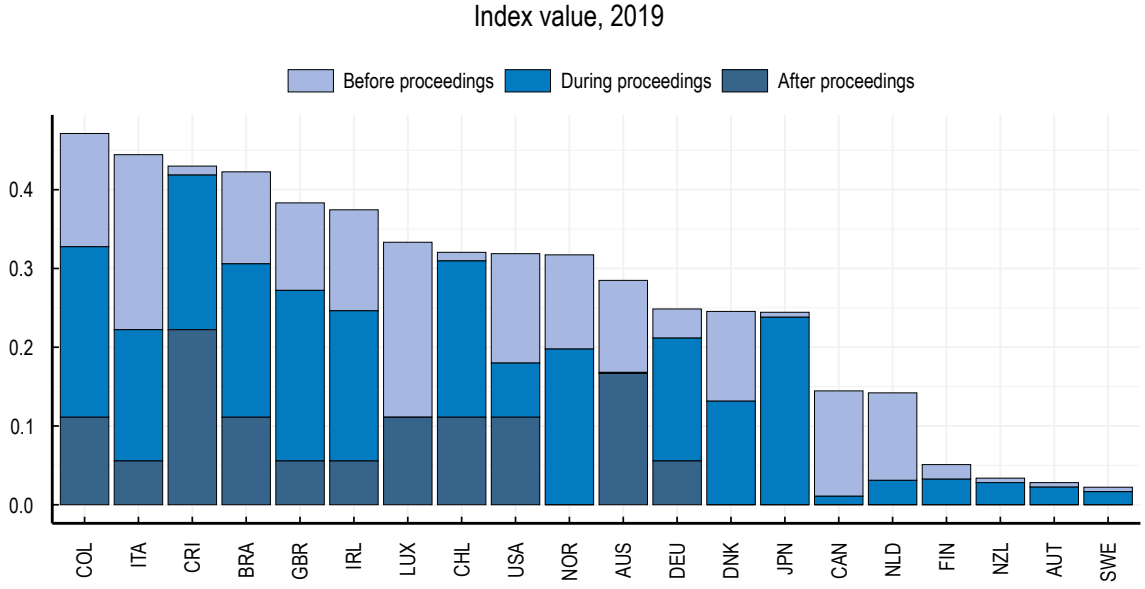
Foreclosure procedures vary considerably across OECD countries. The balance between the protection of borrower and lender rights determines how the default burden is shared between households and the loan-issuing institution. The OECD has recently developed a Foreclosure Regulation Index, which measures the balance between the protection of lenders and borrowers based on eight features of mortgage regulation (Van Hoenselaar et al., 2021[1]). The results for 20 OECD and partner countries show that Colombia and Italy have the most borrower-friendly regulations, whereas Sweden and Austria are the most lender-friendly jurisdictions (Figure 3.12).

In some countries foreclosure can begin immediately after the first missed payment, but in others the delay can run well above a year. The process takes anywhere from a few weeks in Austria and Luxembourg to an average of 120 weeks in Italy. This increases the risk facing lenders, as the quality of the underlying collateral might deteriorate in the interim.

Out-of-court procedures are available in about half of the countries considered. If in- and out-of-court procedures both co-exist, the latter are generally most used because they are faster and less costly. Specialised bankruptcy courts exist in only five of the countries considered. Liability for the unpaid part of the loan is clearly indicated in nine countries but can apply in another five.

Foreclosure rules need to be balanced between borrowers and lenders, as regulatory systems tilted to one or the other side tend to stifle the mortgage market. There are also benefits to having legal frameworks that allow the operation of credit information systems, which allow credit scoring. Jurisdictions with stronger legal rights and more extensive credit information systems generally have deeper mortgage markets.

Figure 3.12. The OECD Foreclosure Regulation Index illustrates differences in the balance of rights between borrowers and lenders



Note: A higher value of the index means greater borrower protection. Because countries can also have a score of zero for some questions, not all countries have a positive score on all three components of the index.
Source: Van Hoenselaar et al. (2021[1]).

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Monitor the rise of non-bank real estate finance

Since the global financial crisis the credit quality of structured real estate finance products has broadly improved. Typical mortgage-backed securities are no longer backed by riskier lower-quality subprime and Alt-A collateral. This situation results from the shift in market risk perceptions following the crisis, and the strengthening of regulation and oversight of securitisation activities. Overall, national authorities and international organisations have made considerable progress in identifying and better understanding activities and risks in financial intermediation. The result has been a clear improvement in credit quality for banks' mortgage supply, but at the cost of some reduction in supply and thus an increase in cost, at least at the margin. However, the low-rate environment that lasted until recently was the dominant factor together with weak supply of new housing, and in many locations real estate prices surged with associated jumps in debt levels of households and corporations.

In parallel, a profound structural shift in real estate finance from structured products to leveraged institutions and collective investment vehicles that perform liquidity transformation, has been occurring in the United States and in several other countries since the global financial crisis. The low-interest-rate environment of the past decade has increased investors' appetite for yield and supported the growth of collective investment vehicles, including mortgage real estate investment trusts (mREITs) and real estate mutual funds (REMFs). Concomitantly, more stringent capital requirements on mortgage lending activities

under the Basel III regulatory framework have weakened banks' incentives to lend for real estate purchases, opening space for the rise of non-bank mortgage originators and servicers as an alternative to traditional bank mortgage lending. In Europe and elsewhere, institutional investors (including insurance companies and pension funds) and investment funds have shown growing interest in real estate lending, all the while accepting the downside risks from various accompanying shocks.

Downside risks can emerge for some mortgage-backed security (MBS) markets

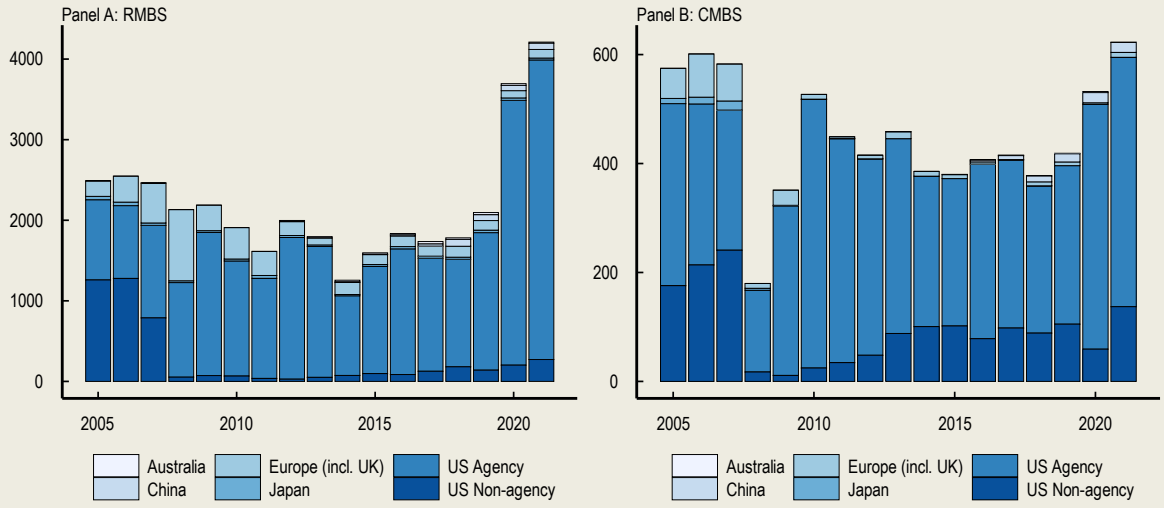
Real estate finance markets can be vulnerable to a turn in the housing cycle and fragile commercial real estate following the COVID-19 pandemic. The monetary and fiscal support and loan forbearance measures that followed the pandemic alleviated the problems that would otherwise have manifested themselves, especially in the residential sector, which benefited from strong protection (OECD, 2020[16]). For its part, commercial real estate price performance has been much weaker since the outbreak of the pandemic because of both the office space surplus that resulted from the surge in remote working and reduced shopping footfall due to social distancing rules and stay-at-home behaviour. In addition, real estate assets and subsequently real estate finance markets are exposed to medium-term challenges from physical and climate change-related risks, which may lead to credit quality deterioration of non-financial corporations and a declining value of real estate collateral.

Furthermore, mortgages originated by non-bank financial institutions (NBFIs), which at least in the United States are generally of lower quality than those coming from banks, are likely to be particularly vulnerable to sharp increases in investor risk aversion. Therefore, a decline in real estate prices, or a shock that implies a substantial deterioration in the credit quality of mortgage borrowers or a significant depreciation of real estate collateral value, may cause mortgage-based security (MBS) prices to decline, implying losses, share redemptions and margin calls for a wide range of financial intermediaries and investors. While international, the MBS market is dominated by U.S. issuance (Box 3.4). Rising investor risk aversion may trigger feedback loops from desired deleveraging to MBS market turbulence and defaults and ultimately lower mortgage availability, real estate prices and overall economic growth.

Box 3.4. MBS markets: the experience of the United States

Real estate MBS markets have recovered well in the United States from the global financial crisis, while issuance has remained subdued in other major markets (Figure 3.13). Another notable development is the dominance of MBS issuance by US GSEs. After US MBS markets, Europe and China are the two next largest. While the Chinese real estate MBS market remains small in nominal terms, RMBS and CMBS issuance both recorded their highest growth rates there over recent years.

Figure 3.13. The US real estate MBS market has recovered from the global financial crisis



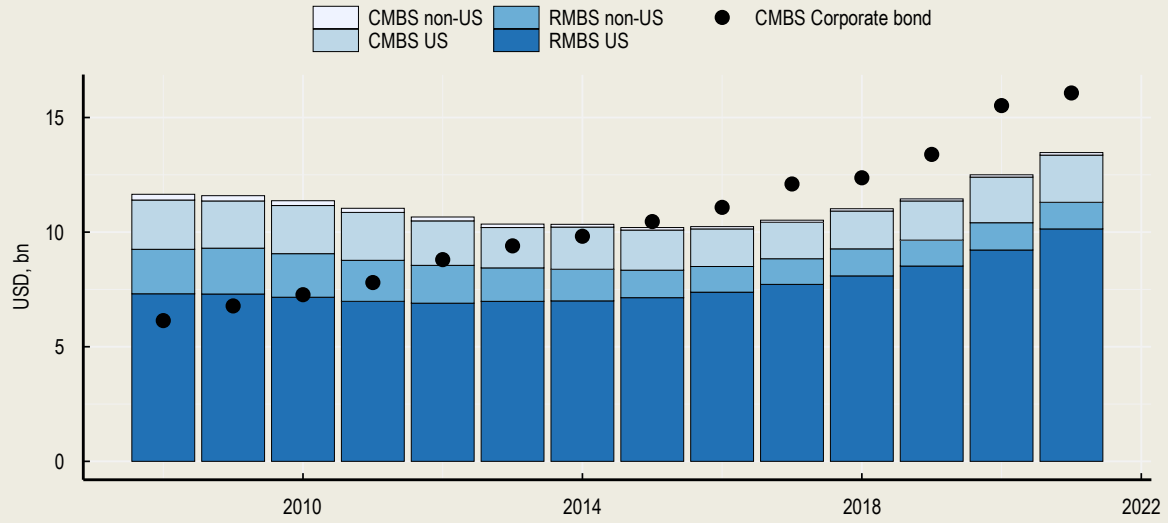
Note: These figures show the nominal amount of RMBS and CMBS issuance in major MBS markets. US agency issuance includes both agency and residential and multifamily securitisations by Fannie Mae, Freddie Mac or Ginnie Mae excluding risk transfer deals. All other government agency or GSE securitisations or guarantees and GSE risk transfer deals are part of non-agency ABS or MBS. Other selected RMBS markets include Australia, China, the European Union (including the United Kingdom) and Japan.

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The effect of the pandemic on MBS issuance has been diverse across major MBS markets. For instance, agency CMBS and agency MBS purchasing programmes implemented by the Federal Reserve since March 2020 supported record high US agency RMBS and CMBS issuance in 2020 and 2021. However, RMBS and CMBS issuance has declined sharply in most other major markets (except CMBS issuance in Australia and China). Despite the severity of the COVID-19 crisis, residential mortgage delinquencies generally increased only moderately in 2020 in major real estate finance markets, as guarantees and moratoria, which were implemented in many jurisdictions, avoided defaults on many loan exposures that might otherwise have gone sour (Green, 2022[17]).

At USD 10 trillion outstanding, US RMBS remain by far the largest segment of the global ABS market of USD 13 trillion in 2021 (Figure 3.14). The US Federal Reserve held about USD 2.6 trillion worth of MBS as of end-December 2021. In comparison, in 2008 global real estate MBS markets were twice as large as corporate bond markets in major real estate finance markets. However, in 2021 the relative size of global real estate MBS markets represented 84% of total outstanding corporate bonds. While global real estate MBS markets have expanded substantially over the last decade, other market-based finance markets have experienced even stronger growth.

Figure 3.14. The US MBS and corporate bond markets are by far the largest



Note: The aggregate amount of corporate bonds outstanding is calculated including data from the United States, the European Union (including the United Kingdom), Japan, Australia and China.
Source: SIFMA, AFME, JSDA, Australian Securitisation Forum, CNABS, BIS Debt securities statistics database, OECD calculations.

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The strengthening of the US government-sponsored-entity (GSE or agency) regulatory framework and oversight following the global financial crisis has helped improve US credit standards, with agency MBS being safer than they were a decade ago. Nonetheless, financial innovations continue to flourish in CMBS markets as reflected by the rising market share of commercial real estate collateralised loan obligations (CRE CLOs). These developments recall the innovation-fragility view that identified financial innovations as the root cause of the GFC. It was characterised by the creation of securities perceived to be safe, but exposed to neglected risks. They underscore the need to monitor associated risks and adapt regulation.

Hedging activities on MBS markets, which are fixed-income products sensitive to changes in interest rates, may have substantial spillover effects on US Treasury markets. However, very large Federal Reserve holdings of MBS reduce the impact of interest-rate fluctuations. When interest rates increase, the price of an MBS tends to fall at an increasing rate and much faster than a comparable Treasury security due to mortgage duration extension. To mitigate interest rate fluctuation risk MBS holders use either interest-rate swaps or Treasury sales, which can potentially lead to volatility in the Treasury market.

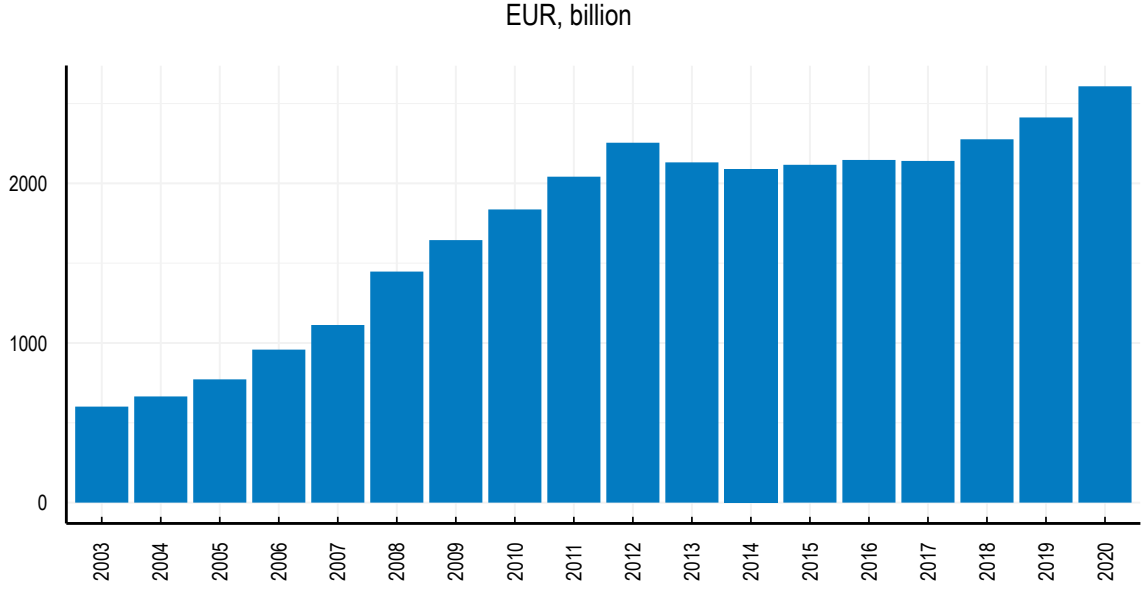
Concerns have increased following the widespread rise in interest rates in the context of higher inflation and tapering of asset purchases of major central banks, two developments that imply a substantial repricing of Treasury securities. Nevertheless, Federal Reserve holdings of MBS may help to mitigate the impact of hedging activities on the volatility of MBS and Treasury markets. For instance, unlike many institutional investors, the Federal Reserve does not hedge pre-payment risk, because it does not target the duration of its portfolio.

Covered bonds remain key instruments in European mortgage finance

Covered bonds are debt instruments issued by a bank or a mortgage institution that are backed by collateral, a so-called cover pool, which includes real estate mortgage loans and public-sector debt instruments. While covered bonds are a source of secured and low-cost funding, they may increase the refinancing risks that the issuer bank faces on unsecured wholesale funding sources. By contrast with MBS, where a given set of underlying mortgages are transferred to a special purpose entity, covered bonds require the issuer bank to maintain a cover pool of high-quality assets backing the bonds. Since the asset pool backing the covered bonds needs to be replenished, accumulated losses on mortgages that surpass the bank's capital are concentrated on unsecured debt holders. Therefore, the more covered bonds a bank issues, the higher the risk that its unsecured obligors incur, which exposes the bank to higher rollover risk on its unsecured debt. This differs from MBS, where the mortgage risk is transferred to the buyers of MBS. Greater covered bond funding may thereby exacerbate bank-liquidity risk and increase pressures on unsecured wholesale funding markets. Unprecedented monetary and fiscal support combined with loan forbearance measures following the pandemic have helped to contain mortgage defaults and preserve the resilience of covered bond markets. Notably, the negative credit impact on residential mortgage loans in the cover pool of assets backing the bond has been small. In addition, the impact of the pandemic on the performance of commercial real estate assets may be more severe, but cover pools' exposures to such assets are limited.

The global covered bond market has expanded substantially over the last decade (Figure 3.15) .Covered bonds backed by mortgages account for the largest share of outstanding covered bonds. Covered bond markets are dominated by European markets but have expanded globally over the last decade, including in the Asia Pacific region, North America and in several emerging economies. Still, top issuers in 2020 remained European banks. However, issuance dried up during the pandemic, because so much policy support was unspent and ended up in higher household savings in the form of bank deposits, which are a particularly low-cost source of bank funding. Little impact on prime residential mortgage markets is expected as policy and regulatory support is withdrawn, but the same cannot be said for commercial real estate assets.

Figure 3.15. The covered bond market has expanded substantially



Source: European Covered Bond Council, OECD calculations

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The role of REITS and REMFs is rising

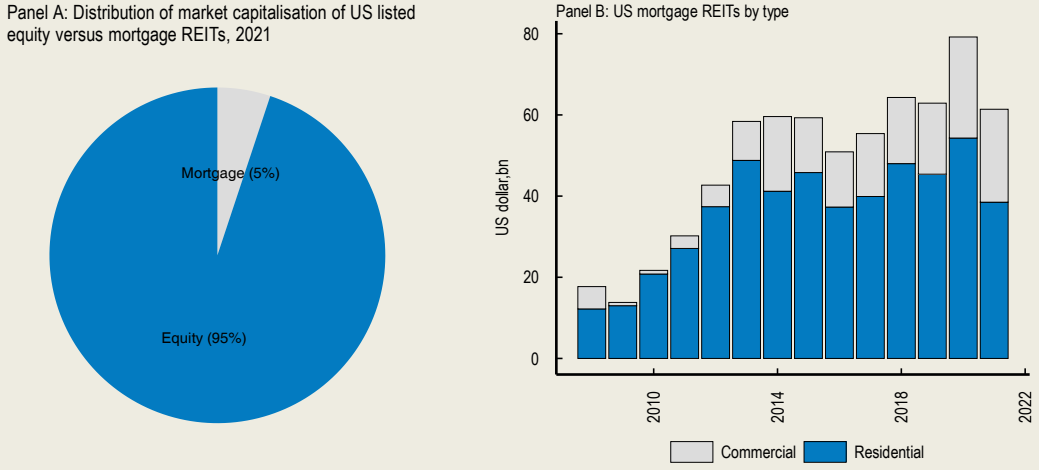
Real estate investment trusts (REITs) are specialised investment vehicles that derive most of their income from real estate-related assets. REITs generally specialise in either owning physical real estate assets or providing debt financing to real estate investors or developers. REITs issue share-like securities that give investors access to more liquid real estate investments than holding physical real estate assets. During the prolonged low-interest-rate environment since the global financial crisis, REITs have provided attractive investment opportunities, because in many jurisdictions they benefit from favourable legal treatment,[2] offer relatively higher dividend pay-out ratios compared to equities, and/or provide diversified and liquid real estate investments. Over the past decade, the equity market capitalisation of the REIT industry globally has tripled (from USD 430 billion in 2010 to over USD 1.3 trillion in 2021), some 65% of which is in the United States, though rapid growth has also been recorded in the Asia-Pacific region (Box 3.5).

Box 3.5. Trends and challenges in the REIT industry

Within the REIT industry, there are two broad types of REITs: equity REITs and mortgage REITs (mREITs) with very distinct characteristics. Whereas equity REITs invest in physical properties, mREITs invest in mortgages and MBS, making them real estate debt owners. Within mREITs, these entities tend to focus either on residential mortgages and RMBS or commercial mortgages and CMBS.

Most residential mREITs focus their investments on MBS issued by GSEs and are often called agency mREITs. Following the global financial crisis, several mREITs developed business models that buy distressed mortgage assets (both residential and commercial) from banks and other lenders, helping to recapitalise the banking sector, and restructure and service these debts. Most US publicly traded REITs are equity REITs (Figure 3.16, Panel A), but mREITs issuance has grown significantly since the global financial crisis (Panel B). Notably, the market capitalisation of US mREITs has more than tripled over the past decade (from USD 18 billion in 2008 to USD 61 billion in 2021). Though US residential mREITs are still the largest market segment, accounting for 63% of the capitalisation of US mREITs in 2021, commercial mREITs have also been expanding.

Figure 3.16. Mortgage REITs remain small relative to equity REITs despite expanding



Note: These figures show aggregate market capitalisation of US equity versus mortgage REITs from the NAREIT REIT Market Database that includes all US REITs listed in several sectoral indices.
Source: REIT.com, Refinitiv, OECD calculations.

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[2] For instance, US REITs are exempt from federal corporate income tax if they distribute at least 90% of their taxable net income annually to their investors.

Downside risks surround mREITs, which use short-term financing and leverage. They typically derive their returns from the income generated by underlying mortgages as well as changes in the mortgages' net present value. Short-term secured financing – notably through revolving credit facilities from banks and other financial institutions, and also borrowing from short-term secured funding (i.e., also known as repo) and bond markets – provides mREITs with funding at low interest rates to purchase long-term assets that provide higher returns. A common practice for mREITs is to multiply the difference between their short-term borrowing rates and long-term lending rates by adding leverage. In this process the mREIT initially uses the cash it raises from investors to purchase MBS. Then it uses those MBS as collateral to borrow money to purchase more MBS, a process that it repeats multiple times. However, the number of rounds is limited, as the repo lender requires a collateral margin on each loan (a gap that serves as a buffer for the repo lender's protection) or may impose covenants limiting leverage.

Leveraged mREITs are typically vulnerable to substantial rises in interest rates, which hurt their profitability and complicate their refinancing. Maturing short-term funding would have to be rolled over at higher interest rates, which would contribute to an erosion of their profit margin. More importantly, a substantial rise in interest rates would reduce the market prices and net present values of outstanding MBS and mortgages, in turn lowering the value of mREIT assets. If mREIT assets used as collateral for short-term secured funding see their value diminish, they may trigger margin calls and subsequent deleveraging, implying further MBS sales and price declines. A deleveraging spiral could entail substantial losses for a wide range of financial intermediaries and investors.

The onset of the pandemic saw a breakdown in heretofore stable relationships between different mortgage pools due to the bout of extreme risk aversion and heightened volatility. But the Federal Reserve intervened directly by purchasing agency MBS and allowing temporary capital relief to banks so they could keep lending. Together with loan forbearance this action succeeded in stabilising the MBS market as well as short-term markets for repos and commercial paper. However, long after the first wave of COVID-19, some types of US property were still suffering, notably office buildings, lodging and resorts, and health care. More recently, as the financial markets became afraid of a surge in inflation, exacerbated by the Russian invasion of Ukraine, participants have been comforted by the fact that, historically, real estate and REITs have performed comparatively well in eras of higher inflation during which rents usually kept up with overall prices and property values appreciated.

Closely related to mREITS are real estate mutual funds (REMFs), which are akin to funds of funds. About a sixth of REMFs are exchange listed (including through real estate-focused exchange-traded funds, ETFs). REMFs have expanded sharply from USD 650 billion in 2005 to USD 4.1 trillion in 2021 (ANREV / INREV / NCREIF, 2022[18]). Real estate-focused ETFs are performing liquidity transformation, which renders them vulnerable to share redemptions by investors when market conditions deteriorate. Real estate-focused ETFs provide liquid investments by offering redemptions at higher frequency. As with mREITs the materialisation of redemption risk can force sales, further adding to volatility. REMF net asset values are often subject to particularly high levels of uncertainty, prompting their regulatory overseers to encourage them to cease trading, as for example occurred in the United Kingdom during some periods of the Brexit negotiations. In 2020, REMFs recorded significant outflows following the weakening of mREITs (SEC, 2020[19]). The deterioration in the market liquidity of REMF assets was particularly severe for funds facing larger share redemptions from investors. Notably, REMFs attempted to use a liquidity waterfall strategy, to initially meet increased redemption demand using cash and cash equivalents. However, some REMFs ran out of cash and cash equivalents forcing them to sell real estate assets into increasingly illiquid markets. Developments since the onset of the pandemic have shown that structural vulnerabilities remain in mREIT and REMF products, which are contributing to the price volatility in MBS markets.

Non-bank mortgage lending entails risks

Since the global financial crisis, low interest rates and more stringent bank regulation[3] have contributed to the rise of leveraged non-bank mortgage originators and servicers, mainly in the United States (Box 3.6). These non-bank mortgage firms perform liquidity and maturity transformation. Their development has brought several benefits: heightened competition; longer maturity horizons (from insurance companies and pension funds), which lessen the need for maturity transformation; and likely less pro-cyclicality of supply (as no money is created), even if the limited empirical evidence may point in the opposite direction (BIS, 2020[20]). However, as mentioned above, the average credit quality of NBFI mortgages is generally lower than that of banks.

Box 3.6. Trends and international experience in non-bank housing finance

The rise of non-bank mortgage origination and servicing since the global financial crisis has occurred at very different speeds across countries.

- Housing mortgages issued by non-bank mortgage lenders have risen substantially in the United States over the past decade, from 30% in 2010 to 55% of total origination in 2020. The market share of banks went below 50% in 2014. Like banks, non-bank mortgage lenders use the originate-to-distribute business model[4] and sell a substantial share of their mortgages to government agencies (including Fannie Mae, Freddie Mac and Ginnie Mae), which held about two-thirds of all residential mortgages in 2020. Fannie Mae and Freddie Mac, which have been under the conservatorship of the US Treasury since 2008, hedge their credit risk though private mortgage insurance (PMI) and the issuance of Credit Risk Transfer securities (CRTs).[5]
- In China, sources of funding for real estate developers mainly comprise non-banks. Notably, self-raised financing (i.e., equity IPOs, corporate bond issuance and loans from trust companies) represented 70% of total sources of funding for real estate developers in 2020. Nevertheless, the COVID-19 crisis has accelerated the decline in trust loans that already started at end-2017. In 2019, the China Banking and Insurance Regulatory Commission introduced more explicit caps on real estate financing for trust companies to prevent them financing property developers that do not have all necessary licenses or meet requirements on shareholders and capital.
- In other major real estate finance markets the shares of non-bank residential mortgages have remained roughly stable at moderate levels (i.e., under 10% in Japan, the United Kingdom and the European Union).

As for commercial mortgages available data for major real estate finance markets show moderate non-bank lending ranging from under 5% in Australia to 16% on average in the European Union at end-

[3] In January 2020, Basel III requirements were loosened, however (OECD, 2021[25]).

[4] In July 2021, US state financial regulators approved measures to improve the financial soundness of their non-bank mortgage servicers.

[5] CRTs came into existence following the 2013 Federal Housing Finance Agency guidelines to lower risks to GSEs and ultimately to US taxpayers. CRTs' principal is not guaranteed, and lower rated tranches are highly subordinated. Although CRTs are held by a variety of players, including hedge funds, mREITS, REMFs, banks, insurance companies and investment companies, ownership is concentrated. Fannie Mae and Freddie Mac had issued CRTs on USD 3.5 trillion of single-family mortgages by end-2019 and had purchased private mortgage insurance on another USD 1.6 trillion. In early March 2020, the CRT market shut down due to investors' fears of an imminent serious loss event. Nevertheless, Freddie Mac restarted issuing CRTs in July and Fannie Mae in early 2021.

2020. Nevertheless, there is considerable heterogeneity across European economies, characterised by substantial financing shares from insurance companies (i.e., Belgium, Croatia and Germany,), pension funds and investment funds (i.e., Belgium, Ireland, Italy, Latvia, Malta and the Netherlands).

Fintech lending has expanded in major real estate finance markets, bringing efficiency gains, while raising potential concerns for financial resilience. The origination process has been streamlined and automated by new entrants, resulting in faster approvals and lower costs, fraud and errors, albeit at the expense of greater vulnerability to cyber attacks (Fuster et al., 2019[21]). Fintech lending promises convenience for borrowers and a more accurate assessment of risks for lenders. Traditional lenders have adopted some of their innovations, blurring the distinction between fintech and traditional lenders. Furthermore, some cooperation has occurred; for example, a bank might contract with a fintech to provide the digital infrastructure for its mortgage originations. By 2020, the two largest fintech firms had between them 30% of all residential originations of the top 25 firms in the United States (which represented two-thirds of the market).

Other forms of non-bank real estate lending include peer-to-peer (P2P) or marketplace lending, balance sheet property lending and real estate crowdfunding. Originations of all these forms of loans were suspended or scaled back during the first half of 2020 following the COVID-19 shock but seem to have recovered since then. New lending technologies have the potential to increase efficiency by reducing operating costs, enhancing the accuracy of mortgage transactions and reducing fraud. Yet fintech digital platforms are also vulnerable to external threats and risks of cyber-attacks, which can expose consumers to higher risks of loss and other harms, including from third-party fraud.

Non-bank financial institutions' high leverage and considerable liquidity transformation involves risks (Box 3.7). Furthermore, the performance of these institutions also depends on real estate prices, the quality and diversification of their assets, their reliance on the occasionally volatile wholesale funding market, periodic redemption surges and links to other financial markets.

Box 3.7. Non-bank housing finance: leverage, liquidity and other main risks

United States

Non-bank mortgage lenders are exposed to liquidity risk because of their business model, which includes a combination of various funding sources[6] and equity. The reliance of these institutions on short-term warehouse lines of credit to fund long-term mortgages may expose them to liquidity mismatch. They can face liquidity shortages following an unexpected shock that leads to less liquid securitisation markets. In the event of a shock that negatively affects the credit quality of mortgages and raises investor concerns over non-bank mortgage lenders, these institutions are likely to experience reduced access to funding at a higher cost. Unlike banks, which can rely on deposits as a fairly stable funding source, non-bank mortgage lenders lack such a largely captive deposit base and can be subject to sharp changes in funding costs.

Non-bank mortgage lenders are increasingly exposed to volatility through the rising share of mortgage servicing rights (MSRs) on their balance sheets. For instance, non-bank mortgage lenders serviced 60% of mortgages in 2021, up from 6% in 2011 (CSBS, 2021[22]). They have also expanded their mortgage servicing market share largely through bulk purchases of MSRs of non-performing loan

[6] Non-bank mortgage lenders fund their business through the combination of retail notes, whole loan sales, securitisation, warehouse lines of credit and firms' own balance sheets, i.e. supported by debt and equity investors. Non-bank mortgage lenders have a range of funding structures with a diverse set of investors, such as banks, traditional asset managers, hedge funds, family offices and high net worth individuals. While some firms have publicly traded equity, most are still privately held.

portfolios originally held by banks. Non-bank mortgage servicers are exposed to liquidity risk because when a mortgage defaults, the servicer not only loses servicing income but must also keep settling payments to investors, tax authorities and insurers using its own funds, as well as incurring the high cost of servicing delinquent mortgages.[7] In particular, Ginnie Mae servicers are exposed to greater liquidity risk, as they are likely to face higher impaired or defaulted loan servicing (Ginnie Mae, 2016[23]). For loans in both GSE (including Fannie Mae and Freddie Mac) and Ginnie Mae pools, the mortgage borrower takes the initial credit loss. Then, the private mortgage insurance company or the government entity that guarantees the loan takes second-round losses. However, Ginnie Mae servicers are expected to bear any credit losses that the government or the insurer does not cover.

A collapse of some non-bank US mortgage lenders and servicers could amplify negative shocks, but regulators have recognised the risk and strengthened regulatory oversight. Subsequently, the authorities must assess the risk that stresses in the non-bank sector will be transmitted to the regulated banking system, especially because the relationships between them are complex and opaque.[8] If non-bank mortgage lenders and servicers were to default in large numbers, then overall mortgage supply would shrink and real estate prices decline. Accordingly, early in the COVID-19 crisis the US Federal Reserve supported the MBS market, and mortgage forbearance, the Coronavirus Aid, Relief, and Economic Security (CARES) Act of March 2020 and higher unemployment assistance all helped to underpin the financial sector and the real economy (GAO, 2021[24]). The Federal Housing Finance Agency (FHFA) and Ginnie Mae have announced several measures to facilitate liquidity by making it easier for mortgage lenders and servicers to make various forms of short-term cash advances.

Europe

In a number of European countries, insurance companies and investment funds have some exposure to solvency or redemption risks from their commercial real estate investments (i.e., Belgium, Bulgaria, Estonia, Germany, Latvia, Lithuania, the Netherlands, Portugal and Slovenia). Yet pension funds in most European jurisdictions face moderate exposure to the real estate sector. Valuation losses from commercial real estate exposures could make affected insurance companies and investment funds less willing or able to provide new financing in several European jurisdictions. On the whole, however, the relatively small direct exposure of pension funds and insurance companies to the real estate sector in most jurisdictions and the fact that indirect investments in real estate are often internationally diversified and covered by risk management frameworks should reduce the risks of financial distress

Source: (OECD, 2021[25])

There is a need to manage risks from non-bank mortgage finance

The efficacy of regulatory tools for mREITS and REMFs also needs to be assessed to ascertain whether or not a more comprehensive risk-based approach is required to regulating non-bank mortgage lenders and servicers. Nascent vulnerabilities should be addressed, without undermining the benefits of market-based finance. The key challenge is to determine whether sufficient tools are available to incentivise leveraged real estate non-bank financial institutions to take heed of liquidity and maturity transformation risks to avoid unnecessary cyclical spillovers to the rest of the financial system and the real economy (Box 3.8). Beyond policies mitigating poorly coordinated redemptions, significant liquidity mismatch suggests a need to expand liquidity management tools so that REMFs can absorb outflows without

[7] In particular, it must continue to service loans that are under foreclosure or forbearance.

[8] Principle 1B of the OECD Policy Framework for Effective and Efficient Regulation emphasises the importance of Transparency of the Financial Landscape for all stakeholders.

resorting to the option of redemption suspensions (IMF, 2021[26]). Ireland provides an example of reforms to regulate property funds with a view to enhancing financial stability (Box 3.9).

Box 3.8. Open-ended funds: vulnerabilities and reform options

In 2017-18, the Financial Stability Board (FSB) and International Organisation of Securities Commissions (IOSCO) made considerable efforts to articulate key structural vulnerabilities from open-ended funds (OEFs) and detailed recommendations were developed by IOSCO.[9] In October 2021, the FSB issued policy proposals to enhance money market fund (MMF) resilience, including with respect to the appropriate structure of the sector and of underlying short-term funding markets (Financial Stability Board, 2021[27]). Like open-ended investment funds, REMFs are prone to share redemptions. Therefore, among the key policy proposals by the FSB for MMFs, some measures could also be relevant for REMFs, including:

- *A capital buffer* of sufficient size or a leverage limit would mitigate the risk of losses by investors, and thus reduce their incentives to rush to redeem shares. Imposing criteria for eligible assets would mitigate the impact of large redemptions by reducing the liquidity transformation performed by REMFs. REMFs would have to invest a higher portion of their assets in shorter dated and/or more liquid instruments, making them less dependent on liquidity conditions in the markets for the assets they hold, and reducing the first-mover advantage for redeeming investors. For example, the Central Bank of Ireland is introducing a 60% leverage limit on the ratio of property funds' total debt to their total assets and guidance limiting liquidity mismatches for property funds (Box 3.9).
- *Swing pricing*[10] could help mitigate redemption risk and first-mover advantages arising from mutualised liquidity, if it is implemented in a manner that is likely to pass the costs they impose on the fund on to redeeming investors. In addition, basing redemption values on minimum balance at risk could reduce the first-mover advantage from potential losses in a REMF because investors remaining in the fund would no longer bear losses disproportionately.
- *Additional liquidity requirements and the use of liquidity-management tools* could make REMFs more liquid on the asset side and provide funds with flexible risk-management solutions. While these policy measures could be beneficial to strengthen the resilience of REMFs, further consideration should be given to the prioritisation and combination of policy measures into a reform package to address identified REMF vulnerabilities by jurisdiction.

[9] In 2017, the Financial Stability Board (FSB) issued Policy Recommendations to Address Structural Vulnerabilities from Asset Management Activities. In 2018, IOSCO and its members issued two reports: 1) Recommendations for Liquidity Risk Management for Collective Investment Schemes; and 2) OEF Liquidity and Risk Management: Good Practices and Issues for Consideration (Good Practices).

[10] Swing pricing is a mechanism that allows fund managers to reduce the fund's net asset value (NAV) when outflows exceed a "swing threshold". Fund managers would be able to allocate transaction costs in the best interest of all investors and achieve a more equitable treatment because transaction costs are otherwise borne by investors selling the shares rather than those remaining in the fund.

Box 3.9. Measures to limit leverage and liquidity mismatches for property funds in Ireland

Funds investing in property have become key participants in the Irish commercial real estate (CRE) market, holding some EUR 22 billion of property as of 2022.[11] This growing form of financial intermediation offers potential benefits for macroeconomic and financial stability. Often established and funded by overseas investors, property funds provide an alternative channel of financial intermediation for investment in the commercial real estate market, reducing reliance on domestic sources of capital.

This changing nature of financial intermediation also raises the potential that new vulnerabilities could emerge, so it is important that the macroprudential framework adapts accordingly. Given the growth in the property fund sector, the resilience of this form of financial intermediation matters more today for the functioning of the overall commercial real estate market than a decade ago. In turn, dislocations in the market have the potential to cause and/or amplify adverse macroeconomic consequences, through various channels. These include potential losses on lenders' exposures, funding constraints for borrowers using commercial real estate as collateral and potential adverse implications for construction sector activity.

To make this growing form of financial intermediation more resilient to shocks, in November 2022, the Central Bank of Ireland introduced macroprudential measures for property funds. These were the first policy measures to be introduced under the third pillar of the Central Bank's macroprudential framework, covering non-bank financial intermediaries. In particular, it introduced a 60% leverage limit on the ratio of property funds' total debt to their total assets (the "leverage limit") and Central Bank Guidance (the "Guidance") to limit liquidity mismatch for property funds.

The main risk targeted by the Central Bank relates to the potential that financial vulnerabilities in the property fund sector lead to forced selling in times of stress. Excessive leverage and liquidity mismatch are potential sources of vulnerability in property funds.[12] The presence of high leverage and liquidity mismatch increase the risk that – in response to adverse shocks – some property funds may need to sell property assets over a relatively short period of time, causing and/or amplifying price pressures in the commercial real estate market.

The Central Bank of Ireland provides a five-year implementation period to allow for the gradual and orderly adjustment of leverage in existing property funds and an eighteen month implementation period for existing funds to take appropriate actions in response to the Guidance. The Central Bank authorises new funds only if they meet the 60% leverage limit, while it expects that property funds authorised on or after 24 November 2022 to adhere to the Guidance from their inception.

The proposed measures aim to safeguard the resilience of this growing form of financial intermediation, so that property funds are better able to absorb – rather than amplify – future adverse shocks. In turn, this should better equip the sector to continue to serve as a sustainable source of investment in economic activity.

[11] CRE includes any income-producing real estate, either existing or under development, including rental housing; or real estate used by the owners of the property for conducting their business, purpose or activity, either existing or under construction.

[12] Central Bank analysis for such funds is largely based on a bespoke survey of Irish property funds carried out in 2020 (i.e. the Deep Dive Survey) together with regulatory and statistical data collected regularly by the Central Bank.

For mREITs liquidity management challenges are related to maturity mismatch and debt rollover risk, which result from the use of short-term secured funding and/or bank warehouse credit lines to finance longer-term MBS and mortgages. Notably, risk-management tools aimed at strengthening the ability of mREITs to absorb losses and strengthen their liquidity positions would help to mitigate their sensitivity to margin calls.

In the United States, non-bank mortgage lenders and servicers are regulated for safety-and-soundness purposes and are subject to capital and liquidity requirements. While non-bank mortgage lenders and servicers do not pose the risk of a claim on the deposit insurance fund, financial distress in that sector may be a substantial threat to financial system resilience, both directly and through its interconnectedness with the regular banking system. In 2019, the US Conference of State Bank Supervisors and the American Association of Residential Mortgage Regulators jointly published procedures for examining the safety and soundness of all financial institutions that have since been adopted in whole or in part by most states (CSBS, 2019[28]; CSBS, 2021[22]).

While these prudential standards are welcome, the Final Model Standards could be further enhanced. In particular, the capital regulatory standards are not defined using a risk-based approach for non-bank mortgage lenders' assets, in contrast with the bank regulatory framework that takes many factors into account. Also, neither the maturity and capacity of its debt facilities, nor the effectiveness of its hedging strategies, nor the idiosyncratic aspects of the lender's business model are considered for liquidity requirements. In addition, the GSE liquidity surcharge of 200 basis points when delinquencies reach a certain level may require non-bank servicers to raise more funds at a time when they may already be under financial stress. A counter-cyclical requirement would be a more suitable approach. Therefore, regulatory requirements for non-bank mortgage lenders and servicers may not be completely adequate relative to the risks posed by these firms. Further consideration should be given to additional relevant risk factors to define capital and liquidity requirements for non-bank mortgage lenders and servicers. However, if regulators detect rising vulnerabilities at a particular firm, they may decide to impose more stringent capital and liquidity requirements on a firm-by-firm basis to mitigate idiosyncratic risk and spillovers that may threaten the resilience of the sector and possibly beyond. This suggests that more work is needed to further develop and implement various tools to address vulnerabilities of mortgage lenders and servicers. Also, an assessment of the use and efficacy of these tools would ensure that they help to mitigate excessive risk taking with respect to liquidity and leverage, and improve resilience during periods of stress.

Harness mortgage finance for housing decarbonisation

Housing finance has a key contribution to bring to cutting emissions from the residential sector, an effort that is going to require costly investment (Chapter 2). Mortgage lenders can support housing decarbonisation at different stages:

- For new construction, mortgage lenders can recognise that homes built in accordance with standards compatible with the net-zero target will imply lower recurring energy costs and avoid the risk of expensive later retrofitting by their owners. These two characteristics respectively improve the cash flow and collateral value of borrowers, both enhancing the credit quality of the loan. Transparent, reliable energy certification would facilitate the take-up of building loans that can recognise the lower risk associated with a strong environmental quality of construction.
- For existing homes, similarly, reliable certification would make it easier for banks to recognise the credit enhancement, also in terms of both collateral value and borrower cash flow, from greater energy efficiency.
- Retrofitting is currently missing a lending market. For an individual dwelling, the amount is much smaller than a mortgage, complicating the coverage of administrative and other issuance costs. The consumer credit market is also ill suited to the funding of retrofitting: the payback period of

retrofits is typically longer than the maturity of consumer loans, and the higher risk associated with a consumer credit results in elevated interest rates that can make retrofitting investment unprofitable. Again, reliable, transparent information on the energy quality of the retrofitted homes would help lenders to recognise the specific benefits of energy-efficiency renovation loans, by comparison for instance with consumer loans, such as reducing future energy bills and raising the value of the home. Such an advance would create more favourable conditions for deep markets to develop for the funding of retrofitting.

Green building rating systems have proliferated

A variety of green building rating systems (GBRSs) have been developed to provide the information required to facilitate the incorporation of environmental objectives in the buildings sector. GBRSs are typically third-party, voluntary and market-driven standards, which provide information to real estate investors and bondholders about an existing building or a construction project's performance from a sustainability and environmental perspective. Favourable energy ratings tend to be reflected in higher property prices (Taruttis and Weber, 2022[29]; Copiello and Donati, 2021[30]; Fuerst et al., 2015[31]; Hyland, Lyons and Lyons, 2013[32]). However, evidence on their effect on housing loans is scarcer, although analysis of Dutch residential mortgage data linked greater energy efficiency with a lower probability of default (Billio et al., 2021[33]). Furthermore, studies of commercial mortgages in the United States (which fund both office and multi-family residential buildings) found that default risk is higher for borrowers facing higher energy costs (Mathew, Issler and Wallace, 2021[34]) and significantly diminishes after the funded buildings became energy certified (An and Pivo, 2018[35])).

Box 3.10. The rise of green building rating systems: Types and international experience

Green building rating systems (GBRSs) may be either single-attribute, focusing solely on water and/or energy, or multi-attribute, which address emissions, toxicity and overall environmental performance in addition to water and energy. Their common objective is that certified projects reduce the overall impact of the built environment on natural, environmental and human health throughout their lifetimes.

Among the several existing single-attribute GBRSs, the ENERGY STAR certification programme, introduced in the United States in 1992, and Energy Performance Certificates (EPCs), introduced in Europe in 2002, are the most widely recognised labels for energy-efficient products, including real estate assets (Whole Building Design Guide, 2022[36]).

These certifications are benchmarking methodologies to assess energy performance gaps between actual and estimated energy performance for EPCs or against a national building energy consumption benchmark in the case of the ENERGY STAR rating system.[13] In both cases there is no guarantee that they are consistent with the achievement of global climate-change objectives. Energy criteria and cut-offs considered in single-attribute GBRSs are defined using benchmarking methodologies for energy-efficiency performance. Yet, such criteria are not fully aligned with international climate-transition objectives, which could limit the relevance of existing instruments to provide sufficient mechanisms to achieving agreed carbon-reduction targets and pathways to decarbonising buildings, and promoting the construction of green buildings.

[13] An EPC rating is valid for a period of 10 years, and buildings are ENERGY STAR-certified for a period of 12 months. After this period, if property owners want to retain its certification, they must go through the scoring and application process again so as to demonstrate that they have sustained their top performance.

Hundreds of multi-attribute GBRSs are now available worldwide, varying in approach, application processes and evaluation metrics (Antonini, Marchi and Politi, 2021[37]). BREEAM, CASBEE, Green Star and LEED are among the most widely applied.

Energy is used in all major GBRSs and is the most important category for all four major multi-attribute GBRSs. The average weight of energy (27%) is much higher than the average weight for all the identified criteria (11%), which suggests that energy plays a crucial role in GBRSs. Although multi-attribute GBRSs consider alignment with international objectives for climate transition, their main current focus on energy performance rather than renewable and decarbonised energy sources limits the scope of their benefits.

Standards and principles for green real estate finance are still some distance from full alignment with the net zero target

Given the wide impact of real estate on the environment and climate, green bond classification standards use several categories to define eligible green real estate projects (Box 3.11). Notably, environmental impacts of the real estate industry can be identified throughout the entire economic value chain, including land use, materials sourcing, supply chain scope and scale, demands on transportation and infrastructure, energy and water pollution and biodiversity, occupant health and well-being, and community impact. Eligible green real estate projects should contribute to one or more of the following five high-level environmental objectives: (i) climate change mitigation, (ii) climate change adaptation, (iii) natural resource conservation, (iv) biodiversity conservation, and (v) pollution prevention and control (ICMA, 2021[38]). While two of these objectives would provide direct climate-related benefits, others may do so as a side benefit.

High-level environmental objectives should be complemented by a set of relevant qualitative criteria and quantitative metrics to assess the accurate impact of green building projects on achieving environmental and climate-transition objectives. The International Capital Market Association (ICMA) has developed specific high-level guidance and definitions to capture and illustrate the environmental and sustainability benefits of green building projects according to seven core dimensions that include: (i) new buildings, (ii) retrofitted buildings, (iii) energy use, (iv) primary energy use, (v) final energy use, (vi) gross building area and (vii) certification schemes (ICMA, 2020[39]).

Nevertheless, the wide range of GBRSs and existing, published methodologies for building project GHG accounting and carbon-emission reductions make complete consistency of reporting metrics challenging. Overall, the lack of a robust methodology aligned with the Paris Climate Agreement objectives could limit the effectiveness of these frameworks for achieving climate-transition goals. Also, the lack of a comprehensive set of quantitative metrics that focus on carbon emission reduction targets may represent a substantial challenge for real estate assets and underlying real estate finance products to support an effective and orderly climate transition.

Box 3.11. Green mortgage loan standards for the decarbonisation of real estate assets

The Global Alliance of Buildings and Construction, the International Energy Agency and the United Nations Environment Programme have developed a roadmap to full decarbonisation by 2050 with the goals of enhancing green-bond market efficiency and redirecting capital flows to decarbonisation-compatible projects (GlobalABC/IEA/UNEP, 2020[40]). They distinguish buildings that are net zero in operating efficiency terms, in operating carbon terms and in whole-life emission terms.

Progress in setting up the required assessment infrastructure has also been made by the International Capital Market Association and the Climate Bonds Initiative, who have established green bond standards, and by the Loan Market Association, the Loan Syndication and Trading Association and the

Asia Pacific Loan Market Association, who have established green mortgage loan (GML) principles that are similar to those for green bonds.

A decade after the inception of green real estate financing products there exist numerous certifications for them, but few are targeted to achieving the climate transition for carbon-neutral real estate assets. Various organisations, including the International Capital Market Association (ICMA) and the non-profit organisation Climate Bonds Initiative, have developed green bond standards. Also, the Loan Market Association (LMA),[14] together with the Loan Syndications and Trading Association (LSTA) in the United States and the Asia Pacific Loan Market Association (APLMA), has developed green loan principles.

Environmental impacts of green bond or loan principles for green real estate projects are addressed within the frameworks of energy performance certificates (EPCs) and Green Building Rating Systems (GBRSs) that indicate adherence to particular definitions of green real estate assets. In so doing, green debt instruments help align the incentives of borrowers and lenders and make it easier for asset managers to satisfy increasing investor demand for ESG-labelled investment. There is evidence that investors are willing to accept lower financial returns in exchange for the satisfaction of holding ESG investments and that this willingness enables ESG asset providers to receive higher mark-ups (Baker, Egan and Sarkar, 2022[41]).

Standards for Green Mortgage Loans (GMLs) have been set mainly in Europe, the United Kingdom and the United States. GMLs have been issued consistent with the green loans principles that include similar key components as the green bond principles and climate bond standards developed by ICMA and the Climate Bonds Initiative. With three-quarters of Europe's building stock having poor energy performance, the European Union in 2015 agreed to the Energy Efficient Mortgages Initiative funded by its Horizon 2020 programme. It provides lower borrowing rates for energy-efficient buildings or extra lines of credit or cash back on existing loans for homeowners that improve the energy efficiency of their dwellings. It pursued faster decarbonisation under its Renewable Energy Directive in 2018 (which promoted efficient district heating and cooling), its European Green Deal in 2019 and Renovation Wave Strategy of 2020 by speeding up the use of renewables and of waste heat. In 2021 it followed up with an Energy Efficiency Directive and an Energy Efficient Mortgage label. The target is to raise the share of renewables in buildings' energy use to 49% by 2030.

In the United Kingdom, GMLs began on a small scale when offered in 2006 by the Ecology Building Society. Over time much larger financial institutions have joined the fray, such as Barclays Bank in 2018. The Bank of England has just started climate-change stress testing the commercial banks under its regulatory purview.

In the United States, Freddie Mac is active in both certification and refinancing of investments to allow homeowners to use renewables. Fannie Mae recognises 40 different green building certifications provided by 13 different GBRSs, but only eight require the achievement of zero emissions. Japan implemented its Flat 35S programme in 2005.[15] Finally, Mexico's National Housing Fund for Workers issues green mortgages that allow households to get extra loans for energy performance improvements.

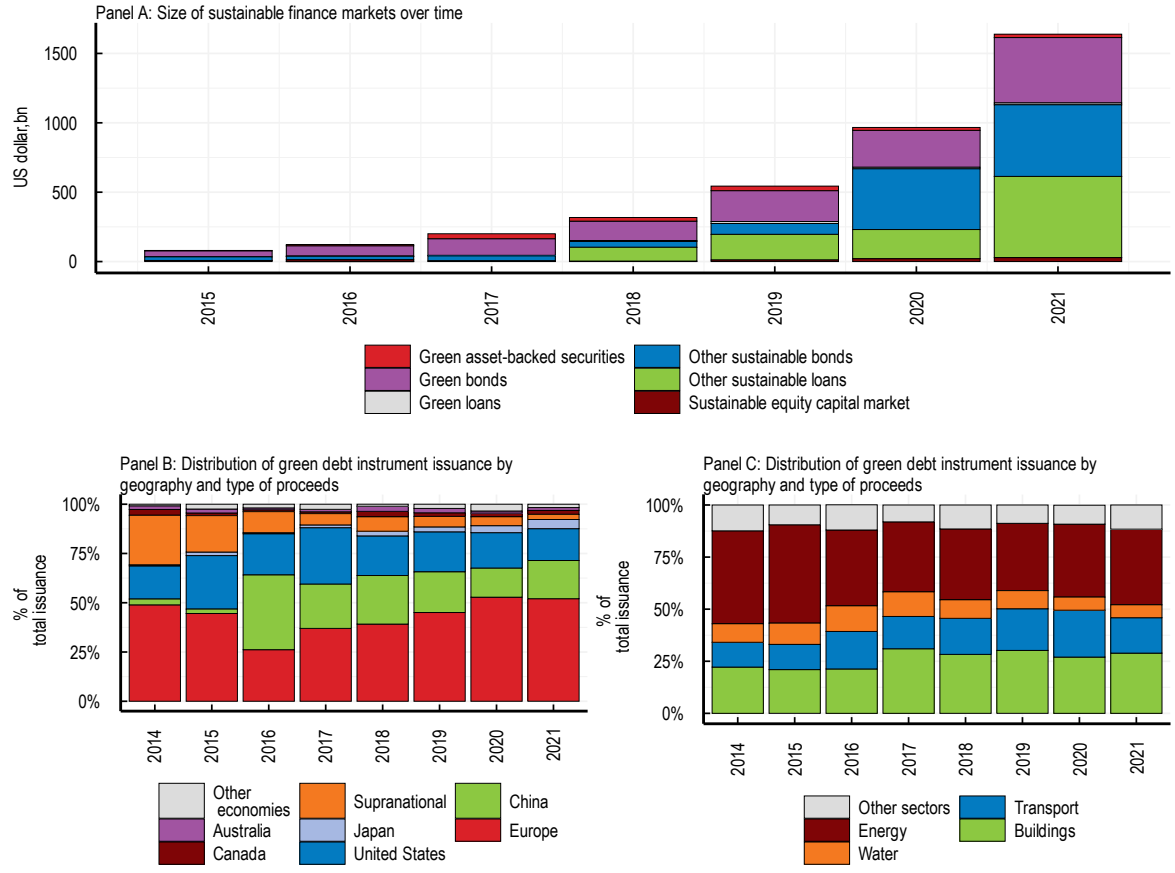
[14] LMA represents the syndicated loan market in Europe, the Middle East and Africa.

[15] Borrowers under the Flat 35S programme (a special type of Flat 35) who purchase houses that meet energy-efficiency criteria set by the Japan Housing Finance Agency also enjoy an interest rate reduction. The reduction depends on the budgetary support and, as of August 2015, the reduction was 0.6% for the initial five years (0.6% is exceptional; under previous economic stimulus packages it was 0.3%).

Market-based finance has been a powerful force behind green real estate debt developments

Sustainable finance markets have expanded significantly worldwide in recent years. The issuance of sustainable debt reached USD 1.6 trillion in 2021, eight times its 2017 level. Green bonds alone accounted for USD 450 billion, but their growth has been lagging that of other forms of sustainable debt (Figure 3.17, Panel A). Green debt markets are dominated by European markets, with China and the United States accounting for most of the remainder (Figure 3.17, Panel B). Also, a significant share (nearly 30% in 2021) of green debt proceeds is allocated to green buildings (OECD, 2022[42]).

Figure 3.17. Sustainable and green debt finance markets have expanded significantly



Note: In Panel A, other sustainable debt instruments include elements of social (S) and governance (G) of the ESG investment framework.
Source: Climate Bonds Initiative, Refinitiv, OECD calculations.

StatLink https://stat.link/e6t1n3

Such amounts may look impressive at first glance, but they pale when set against: 1) the fact that global urbanisation trends point to a need to construct some 13 000 buildings per day to keep up with population growth through 2050; 2) the latest (2019) estimates of the global value of building construction and renovation, less than 3% of which could be labelled as green (USD 152 billion out of USD 5.8 trillion); and 3) global real estate assets worth USD 310 trillion (0.05%). Green real estate bonds and MBS represented only 1.5% of total conventional bond and new mortgage loans granted in 2021.

Among the several types of green credit assets, green asset-based securities (ABS) include real estate MBS. In the last five years green MBS markets have expanded significantly, particularly in the United

States and to a lesser extent in other major MBS markets, including Europe, China and Australia. In the United States, green MBS markets are dominated by issuance of GSEs and municipalities, initially for multi-family housing but lately for single-family units as well. However, their growth has been far slower than that of the overall MBS market, and their share has shrunk from a peak of 1.4% in 2017 to just 0.3% in 2021. Activity in the rest of the world has been even more limited. REITs have issued green bonds as well, initially mostly in Europe, but recently North America has seen rapid growth, mainly for commercial buildings.

Many bond trading platforms have implemented dedicated green bond sections, notably in Europe and Asia, but also in Latin America. Some rating agencies have established green bond benchmarks starting with Standard and Poor's in 2014, even though none are dedicated to those for real estate issuers. As standards to promote carbon neutrality of real estate assets improve, and as the market expands, benchmarks will play an important role in breaking down some major barriers facing institutional investors. Specifically, these benchmarks will enable investors to better evaluate performance and assess the risk of green real estate financial products and help fund managers to report on the comparative performance of their green bond real estate investments.

After a decade of growth, green real estate finance markets remain small compared with conventional real estate finance markets. There are several challenges in aligning green real estate finance market practices with sustainability goals, including the lack of common definitions, standards, quality data and financial products that hinder the ability of market participants and regulators to identify, monitor and manage risks and opportunities. Therefore, more efforts are needed to promote investments in green real estate projects to transition to a low-carbon building stock and meet the climate objectives of the Paris Agreement.

Reforms can accelerate the contribution of housing finance to the climate transition

For green finance to contribute to decarbonisation and other environmental goals in the real estate sector – notably energy conservation, air pollution reduction, water use limitation and appropriate wastewater treatment – the most important role for public policy is to ensure good conditions for the rapid development of this growing market. So far, a patchwork of mainly private-sector green building rating initiatives has got the market off the ground but has failed to achieve the global standardisation and market integration that would allow the various markets to merge and deepen across boundaries to exploit all the available scale economies and overcome the fragmentation that has restricted progress. Failing rapid advancement, it seems unlikely that the Paris Agreement's objective of net zero emissions by 2050 will be achieved either in this sector or in the overall economy.

Policy measures may be warranted to strengthen the alignment of green real estate assets with the low-carbon transition. Policies could focus on strengthening green real estate bond and mortgage loan frameworks to improve the existing tools, methodologies and products, to avoid real estate finance market fragmentation and to support an orderly climate transition. Notably, industry-wide principles and good practices could contribute significantly to the development of a level playing field for these markets, and to strengthen their consistency and integrity in support of the decarbonisation of real estate assets.

Creating and sharing best practices would also support the development of green real estate finance instruments, particularly for the classification, pricing and securitisation of financial instruments. This would help investors identify the benefits of these products for the climate transition and enhance their ability to identify, monitor and manage risks and opportunities. Given the increasing appetite for green real estate finance assets, such policy guidance and incentives for green real estate bond and MBS issuance could contribute significantly to the liquidity needs of the domestic financial sector and support the expansion of green real estate finance markets. Furthermore, they could provide the right incentives to investors and facilitate market access, which would likewise contribute importantly to their development.

Greater international co-operation is also needed among market regulators, central banks, international organisations and market participants to promote international comparability and the alignment of green real estate assets with the low-carbon transition, enhance market efficiency, reduce market fragmentation and strengthen market integrity. Comparability across all GBRSs is an absolute pre-requisite to support efficient and effective risk management frameworks that will help to level the playing field and provide investors with the confidence they need to participate fully in such burgeoning global markets. Well-functioning green real estate finance markets will be essential to satisfy the substantial funding needed to meet the climate-transition challenge and support resilient intermediation for the real economy.

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4 Tailoring urban policies to the new geography of housing demand

The COVID-19 pandemic and the on-going digital transformation of economies and societies have influenced preferences over housing types and locations. People have been spending more time at home, which has created demand for more space and better local amenities. Greater uptake of working-from-home practices has allowed workers to live further away from their place of work. This chapter deals with the evolving geography of housing demand, its drivers and policy implications.

Main policy lessons

With widespread lockdowns and working-from-home mandates, the COVID-19 pandemic has profoundly affected housing markets. In particular, the increased recourse to remote work, at least in sectors of the economy and activities with limited regular need for person-to-person interactions, is likely to have accelerated a long-lasting change in work practices that digitalisation has made possible but might otherwise have taken longer to materialise. These changes are influencing location choices and preferences that have been reshaping housing demand in several OECD countries since the onset of the pandemic, with policy implications that might differ across and within countries depending on local conditions and social preferences.

The main insights for the design of housing policy are:

- In most large cities, house prices decline sharply with the increase in distance to city centres: they exhibit a negative "house price gradient". These gradients became steeper before the pandemic but have flattened since due to increasing demand for housing in peripheral areas.
- This flattening of the house price gradient has been stronger where the take-up of working from home has been more widespread, corroborating the view that digitalisation is a key driver of the new geography of housing. It has also been stronger where local amenities are better.
- House price increases have been more muted where supply has responded more swiftly to changes in demand.
- Environmental amenities and disamenities strongly influence housing demand.
- Demand for housing has also risen in locations adjacent to metropolitan areas, especially in secondary cities rather than towns or rural areas.
- Priorities for housing policy reform include:
  - Harnessing digital technologies to better match housing demand and supply;
  - Developing digital government solutions and closing the digital skill divide by providing easily accessible lifelong learning and training opportunities;
  - Applying flexible land-use regulations that allow supply to respond to demand within urban strategies incorporating environmental, transport and public-service-delivery objectives;
  - Implementing split-rate housing taxes with higher rates for land than structures to unlock supply and densify urban and suburban areas;
  - Removing obstacles to residential mobility by shifting property taxation away from transaction-based to recurrent taxes;
  - Using land-value capture mechanisms to provide amenities inclusively and fund compensatory measures for low-income households in areas affected by environmental disamenities;
  - Implementing rental-market regulations that, while protecting tenants, include sufficient flexibility to maintain incentives to supply rental housing.

Housing demand varies considerably within metropolitan areas. Following the seminal work by Alonso (1964[1]), Mills (1967[2]) and Muth (1969[3]), a large body of the economic literature has studied the equilibrium between distance to labour markets and residential real estate prices. Jobs and urban amenities are concentrated in the central business district, where space for residential structures is scarce. As workers seek to reduce commuting costs, demand declines with distance to the centre. As a result, house prices and rents generally fall with distance from central business districts in a pattern that is usually called a negative "house price gradient" consistent with the modelling assumption for "monocentric cities".

The COVID-19 pandemic has affected housing markets by influencing housing preferences and location choices, with implications for the design of housing policy. These changes have been facilitated by digitalisation, which has enabled a rapid increase in remote working, at least in those sectors of the economy and activities with limited need for regular person-to-person interactions. Changing spatial housing demand patterns affect house prices and rents, especially where supply is rigid, with the potential of aggravating affordability challenges in urban spaces. Against this background, this chapter assesses recent trends in the spatial distribution of residential real estate and identifies areas for policy reform to make housing markets operate efficiently and in a manner that addresses affordability and sustainability objectives.

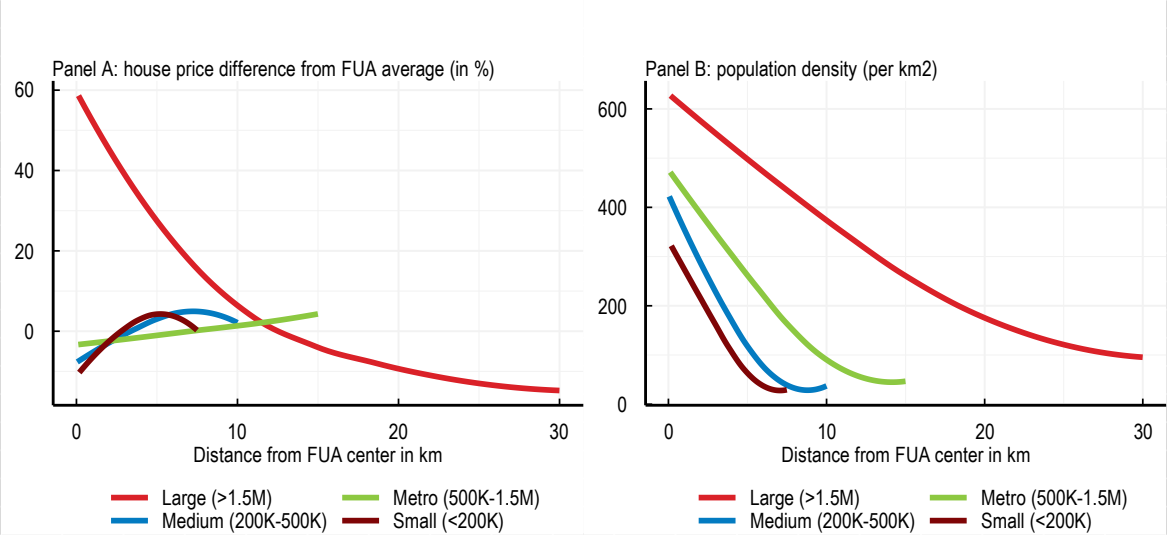
Monitor spatial trends in house prices and residential construction with new data

With more than three years since the pandemic started, there is a growing body of evidence that seems to confirm initial anecdotes of flattening intra-city house price gradients in large metropolitan areas (Figure 4.1).[1] The OECD has contributed to this debate by collecting cross-country data on disaggregated house prices (Annex A). The negative house price gradient is stronger for large cities, where commuting costs tend to be higher (Figure 4.2). Major cities are among the functional urban areas (FUA) with the steepest negative gradients, including London, New York, Washington, Mexico City, Paris, Berlin, Hamburg, Brussels, Barcelona and Madrid. However, a few large cities have no significant negative gradient, such as several sprawled metropolitan areas in the United States, Germany's Ruhr area and England's West Midlands. Negative house price gradients are seldom observed in smaller and medium-sized FUAs.[2]

[1] Gupta et al. (2022[36]) show that house and rent prices decline with increasing distance to the city centre in most US metropolitan areas. The extent to which gradients decline depends on the intensity of working from home and the supply responsiveness in cities to accommodate changing housing preferences. Huang, Pang and Yang (2022[37]) show that the onset of COVID has reduced the gradient in Chinese cities as preferences have shifted towards low-density areas associated with lower infection risks. Gokan et al. (2022[35]) found a significant reduction in the house price gradient in the London area. See Ziemann et al (2023[6]) for additional bibliographic references.

[2] The house price gradient could be underestimated because transacted house prices do not take into account the lower average quality of city houses. While the analysis controls for difference in the average size of the houses by using square meter prices, it does not correct for the older age, possible lower energy performance and the larger prevalence of terraced houses in cities (Reusens, Vastmans and Damen, 2022[38]).

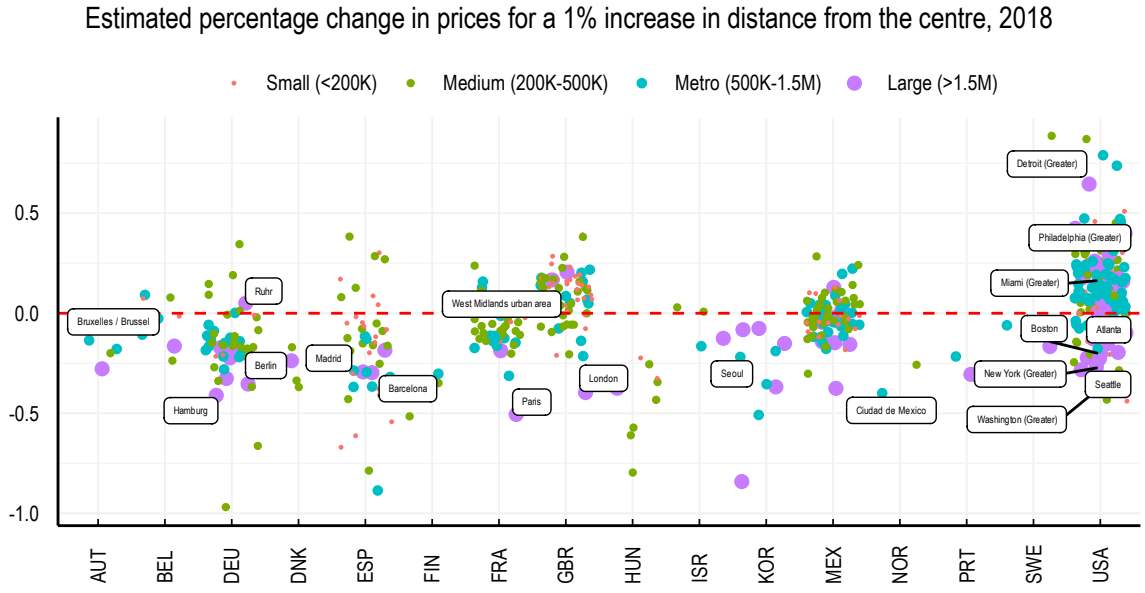
Figure 4.1. House prices decline with distance from the centre in large metropolitan areas



Note: The figure shows average values using local projection (loess filter) across more than 10 000 local area units from more than 500 functional urban areas (FUA) from 16 countries.
Source: OECD Geography of Housing Demand database and OECD calculations.

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Figure 4.2. House price gradients vary considerably within and across urban areas



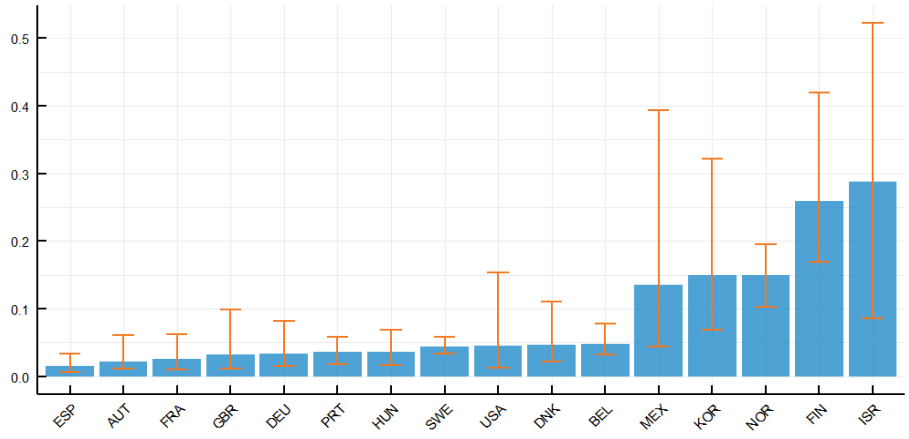
Note: House prices for 2018 are demeaned by population-weighted functional urban areas (FUA) average house prices and regressed on the distance to the largest high-density cluster within the FUA (prices and distances in logarithms). The elasticity estimated with this regression is the estimated change in prices for 1% increase in distance from the city centre reported on the vertical axis. Only FUAs with coefficients significant at the 95% level are shown. Colour and size of circles illustrate the population size class of the respective FUA: Small (<200K), Medium (200K-500K), Metro (500K-1.5m), Large (>1.5m).
Source: OECD calculation based on the Geography of Housing Demand database.

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The evolution of house prices reflects changes in both demand and supply. While supply can be assumed fixed over short horizons, adjustments cannot be ignored over the medium-to-longer term, even considering long construction delays and general scarcity of constructible land in dense urban areas.[3] The extent to which supply responds to demand shifts nevertheless varies across countries, as reflected in observable changes in built-up residential areas in OECD countries during 2019-21 (Figure 4.4).

Figure 4.3. The dynamism of residential supply differs across countries

Percentage point increase from 2019-2021 in the share of residential land use by local unit



Note: Blue bars denote the median expansion of the residential footprint across each country's local units. Error bars indicate respectively the 25th and the 75th percentile of the increase in residential land use across units.
Source: "Monitoring land use in cities using satellite imagery and deep learning", (Banquet et al., 2022[4]).

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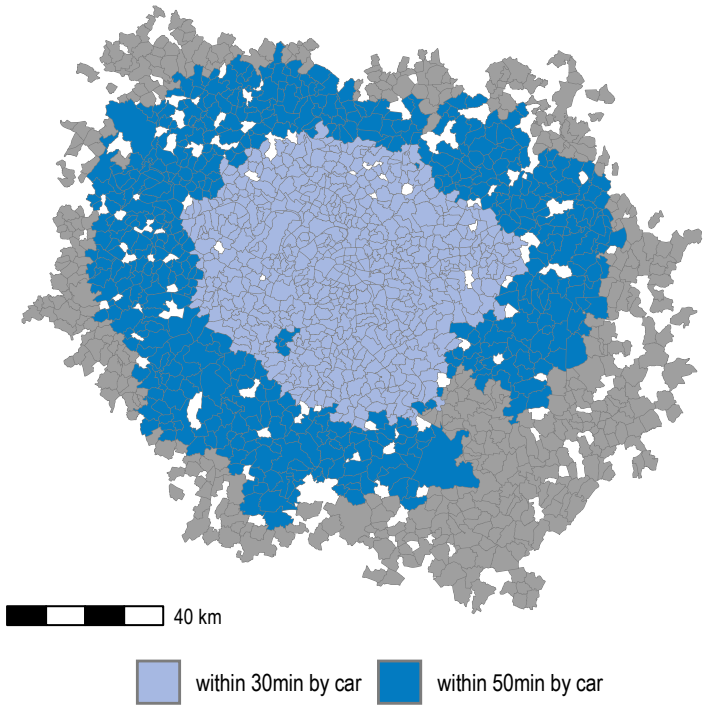
Explore the effects of working from home on the spatial distribution of housing demand

The adoption of working from home since the start of the pandemic reduces commuting costs, which influences the intra-city allocation of jobs. Indeed, less frequent commuting makes residential areas far from the urban core more attractive, broadening the range of location choices (Figure 4.4). For instance, a worker who used to commute five times a week for thirty minutes might accept commuting three times a week for fifty minutes. Workers have been working from home to varying degrees across cities and countries (Figure 4.5).

[3] New geospatial data sources and state-of-the-art machine-learning algorithms open the door to tracking construction activity in almost real time. Recent OECD work has trained an image segmentation model on Sentinel satellite imagery data using the Copernicus Urban Atlas to identify and track different forms of land use, notably including "residential", "commercial and industrial", "transport infrastructure", "open space" and "water and wetlands" (Banquet et al., 2022[4]).

Figure 4.4. 5x30=3x50 minutes: working-from-home widens the potential residential area

Acces to social and economic activities, Paris area, 2018

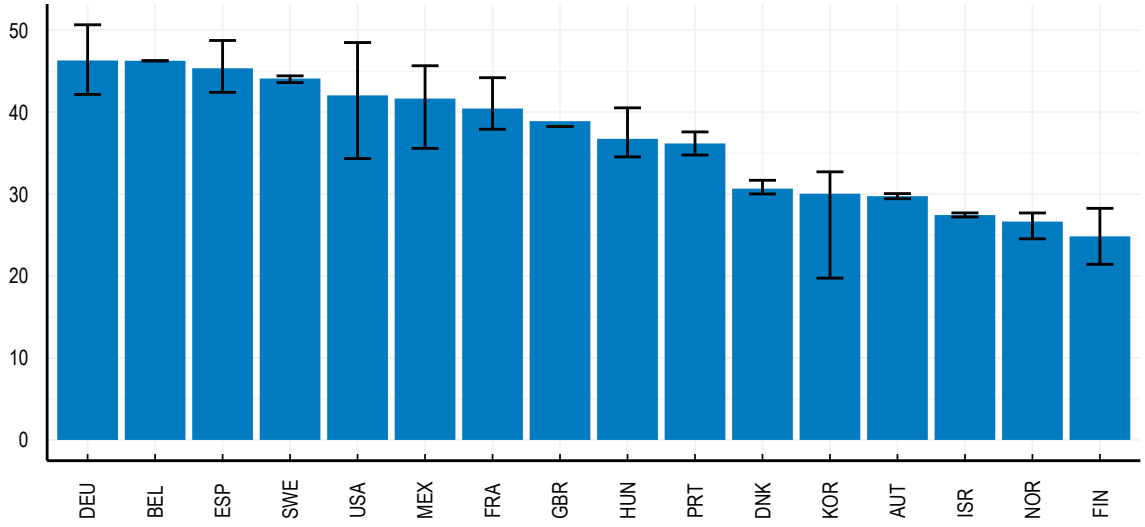


Note: Access to economic and social activity proxied by accessibility of 500 restaurants within 30 (50) minutes by car.
Source: OECD Urban Access Framework (OECD/ITF, 2019[5]).

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Figure 4.5. Working from home has taken off to varying degrees across the world

Percentage point change in working from home proxy between February 2020 and February 2022

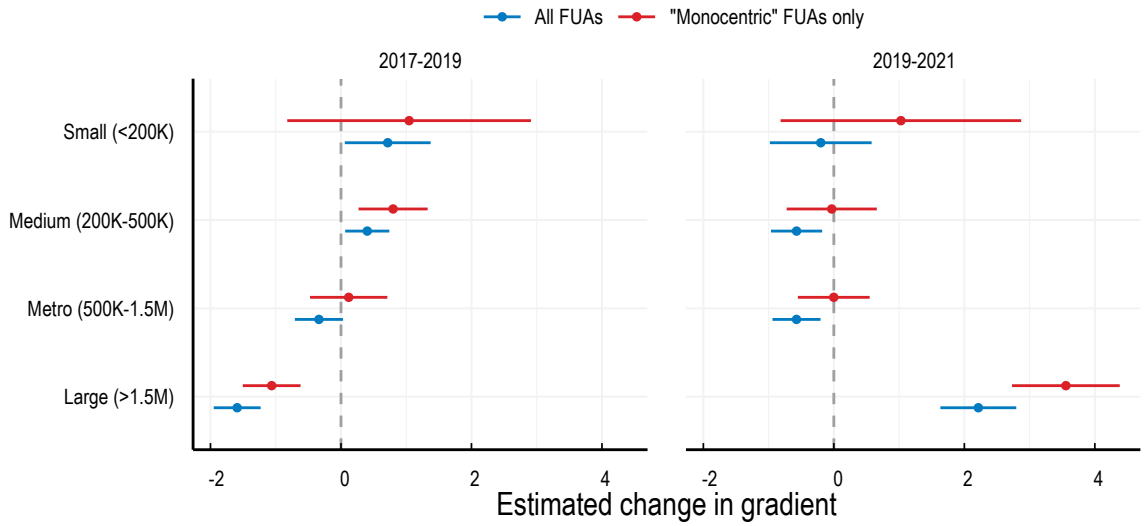


Note: Working from home proxied by Google Trend subject "Microsoft Teams". Percentage point changes between early 2020 and early 2022 by region are shown. Green bars denote the median change in working from home across a country's functional urban areas. Error bars indicate the 25th and the 75th percentiles of that change across regions, respectively. This Google Trend variable is correlated with the share of the total workforce reporting to usually work from home according to the regional module of the 2022 Eurostat Labour Force Survey.
Source: Google Trends and OECD calculations.

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Urban house price gradients have flattened since the onset of the pandemic, but only in large FUAs (Figure 4.6).[4] The shift is stronger for those FUAs where house price gradients were steeper before the pandemic, reflecting higher commuting costs. In zones experiencing strong demand for housing, additional supply is expected to attenuate the pressure on house prices.

Figure 4.6. The urban house price gradient has flattened in large urban areas



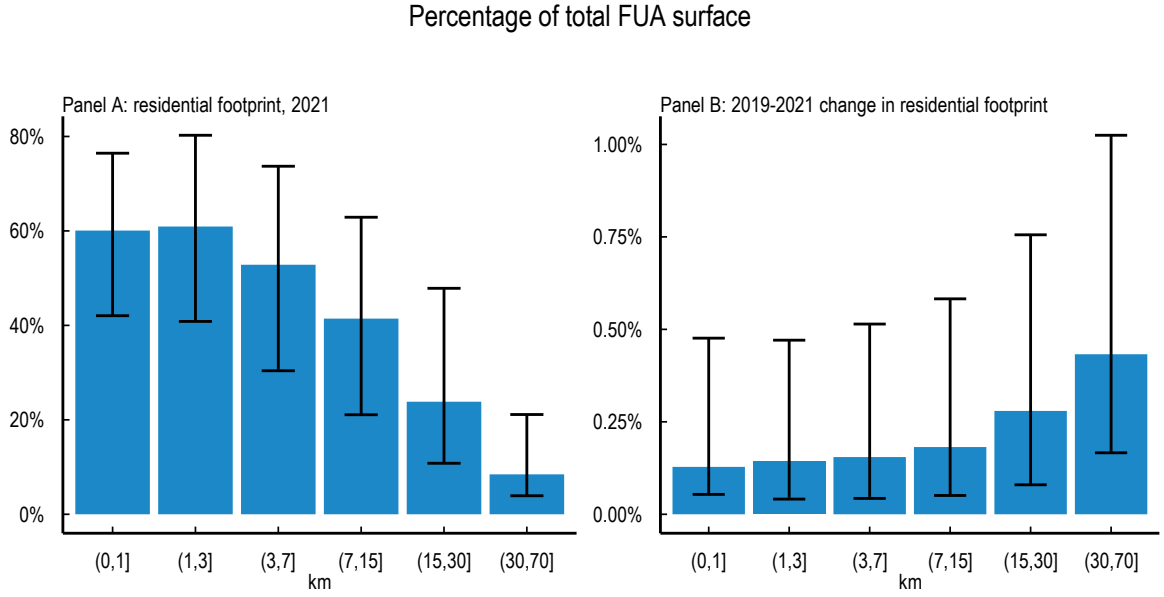
Note: Error bars reflect two standard deviations around the estimated coefficient. "Monocentric" functional urban areas (FUA) exhibit a negative price-distance gradient (see Figure 4.2). FUA population size classes are defined as follows: Small (<200K inhabitants), Medium (200K-500K), Metro (500K-1.5m), Large (>1.5m).
Source: OECD calculation based on the Geography of Housing Demand database.

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Accounting for local residential construction activity thus allows for better identifying changes in housing demand. Indeed, rising house prices could reflect scarce supply, buoyant demand, or both. Disentangling these effects is essential to assess the new geography of housing demand. The distribution of land use within FUAs corroborates stylised facts for population densities as the share of residential land declines with distance to the FUA centre (Figure 4.7, Panel A). But, from 2019 to 2021, satellite images suggest that residential construction activity was more buoyant in peripheral districts of large metropolitan areas (Figure 4.7, Panel B).

[4] The econometric assessment of the impact of working-from-home practices on urban house price gradients builds on earlier explorations by the OECD (Ahrend et al., 2022[34]). The novel dataset includes house transaction prices and transaction volumes from more than 600 FUAs across 16 countries. Annex B describes the methodology to investigate a flattening of urban house price gradients. The results are presented by sub-sample according to the FUAs' size and the degree to which it is consistent with the monocentric model: FUAs with a significantly negative house price gradient are labelled "monocentric FUAs".

Figure 4.7. Residential construction activity increases with distance to the centre



Note: The figures illustrate the distribution of the share of residential land use and its changes across all local area units (districts) as a function of the distance in km to the centre of the functional urban area. The error bars denote the 25th and 75th percentiles, respectively.
Source: "Monitoring land use in cities using satellite imagery and deep learning" (Banquet et al., 2022[4]) and OECD calculations.

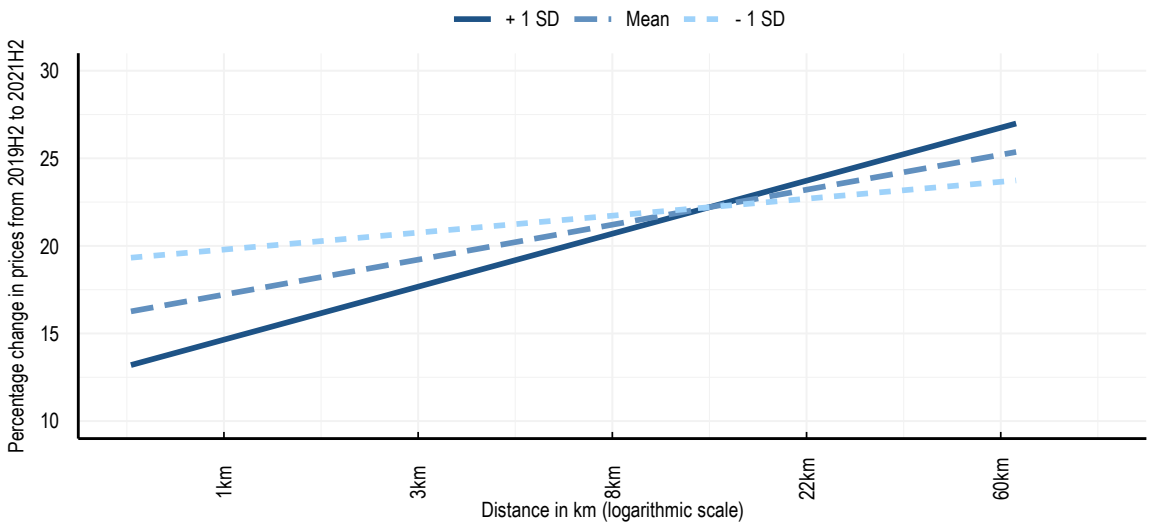
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Including these proxies for area-by-area residential construction in the analysis allows for isolating supply effects in the evolution of house prices resulting in a more precise identification of demand pressures.[5] The results indicate that accounting for supply effects increases the magnitude and significance of estimated correlations, strengthening the narrative that the observed flattening of urban house price gradients in the wake of the pandemic is related to changing demand patterns (Ziemann et al., 2023[6]).

Furthermore, incorporating the estimated take-up of remote work (Figure 4.5) into the model corroborates indications of a causal link from greater use of remote work, which facilitates living further away from city centres, to flattening house price gradients. Indeed, the flattening was more pronounced in areas with higher take-up of working-from-home practices (continuous dark-blue line in Figure 4.8). By contrast, urban areas with below-average take-up of remote work witnessed hardly any change in the gradient as the change in house prices from 2019 to 2021 barely depended on the distance to the city centre (short-dashed light-blue line in Figure 4.8).

[5] See Specification 3 in Annex B.

Figure 4.8. More remote work implies weaker price pressure in the centres and stronger pressure in the peripheries of large urban areas

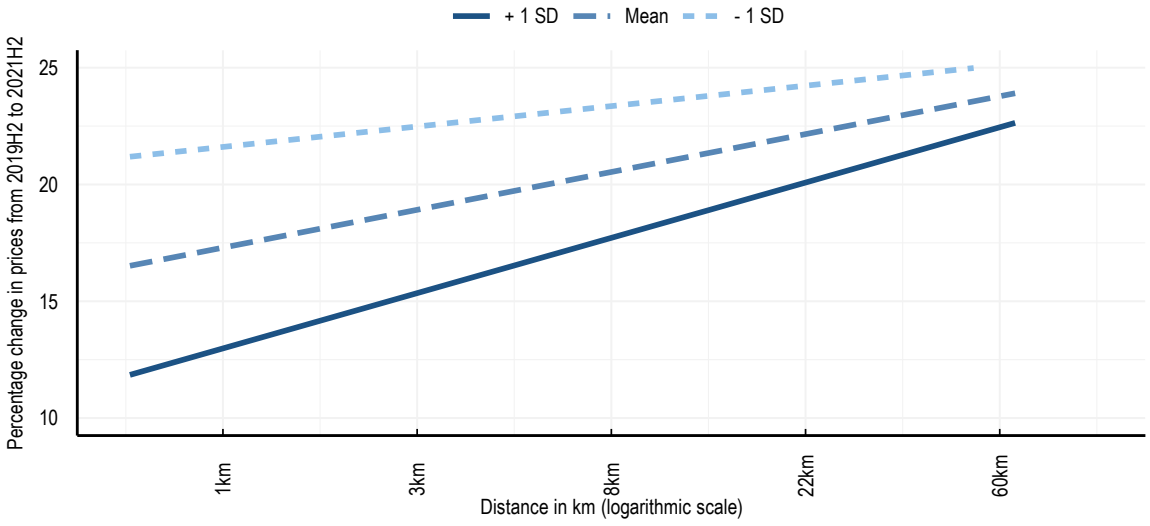


Note: The plots illustrate how the relationship between distance and price changes depends on the level of remote work (specification 4 in Annex B) proxied by the variable gt_teams, which denotes the change in the Google Trend Index topic "Microsoft Teams" from 2019 to 2021: this variable is tightly correlated with a direct measure of working from home while offering the benefit of much wider coverage. For illustrative purposes, three levels of the interacted variables are shown: "Mean" (the average value for remote work, equivalent to the price-distance slope without interaction), "+ 1 SD" (remote work one standard deviation above its average value) and "- 1 SD" (remote work one standard deviation below its average value).
Source: Geography of Housing Database, Google Trends and OECD calculations

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Price pressures in suburban areas have been weaker, where supply has been more responsive to stronger demand. In contrast, price gradients have flattened less in more densely populated urban areas where construction activity has been less pronounced (Ziemann et al., 2023[6]). Gradients have also flattened less depending on the availability of urban amenities, such as access to open space and the quality of transport infrastructure, which influences location choices. Price gradients have flattened less in lower-valued areas (Figure 4.9) This finding suggests that the move to the suburbs does not occur homogeneously. Local amenities seem to be valued more strongly in remote areas than near the city centre. Indeed, the loss of amenities is typically seen as one of the opportunity costs incurred when moving to the suburbs.

Figure 4.9. Local amenities have a stronger price impact in peripheral areas



Note: The plot illustrates how the relationship between distance and price changes depends on the level of the interacted variable (here: "P_amenity"; see Annex B for details). For illustrative purposes, three levels of the interacted variables are shown: "Mean" (the average value for the respective interacted variable, equivalent to the price-distance slope without interaction), "+ 1 SD" (the value of the interacted variable one standard deviation above its average value) and "- 1 SD" (the value of the interacted variable one standard deviation below its average value). "P_amenity" is a proxy for the value of non-distance-related average characteristics obtained as the residuals from a regression of the logarithm of house price levels on the logarithm of the distance to the FUA centre.
Source: OECD calculations.

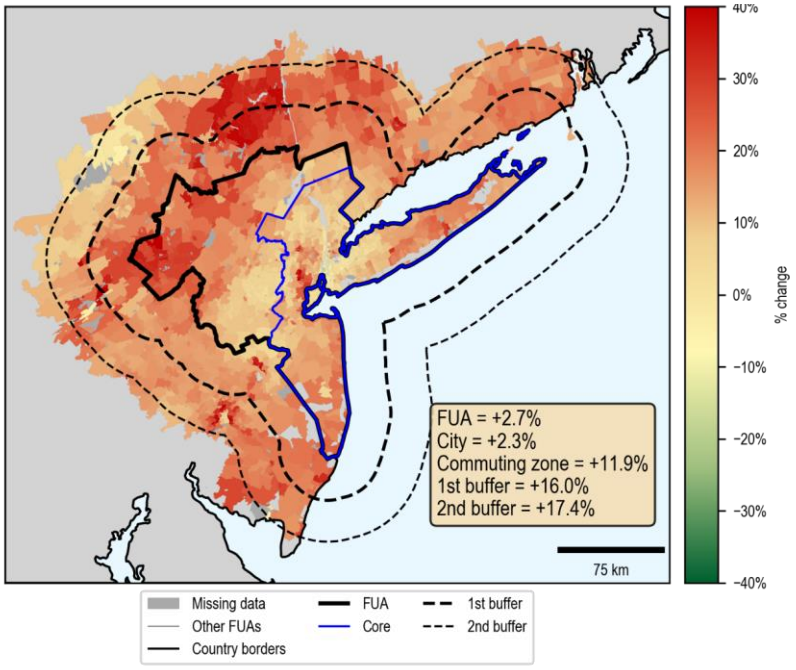
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There is growing evidence that the value of local environmental amenities and disamenities is reflected in house prices. Insofar as higher house prices raise household wealth, the provision of environmental amenities raises the welfare of homeowners. Conversely, would-be owners or renters can face trade-offs between environmental quality and housing affordability. From a welfare perspective, amenity provision is socially desirable as long as the economic value it creates exceeds the costs it entails.

Housing demand has also changed beyond metropolitan areas. When most pandemic-related mobility restrictions were lifted during 2020-21, house prices picked up outside metropolitan centres as well, even beyond their commuting zones [Figure 4.10 and OECD et al. (2021[7])]. Before the pandemic, house price growth was lower in commuting zones and adjacent areas. This pattern suggests that people moving outside the metropolitan boundaries require a certain degree of density that ensures access to key services and amenities. In contrast, rural areas only benefit from the pandemic's repercussions when located near the urban core.

Figure 4.10. House prices have been rising fast also outside large metropolitan areas: the example of New York City

House price change, 2019H1-2021H1



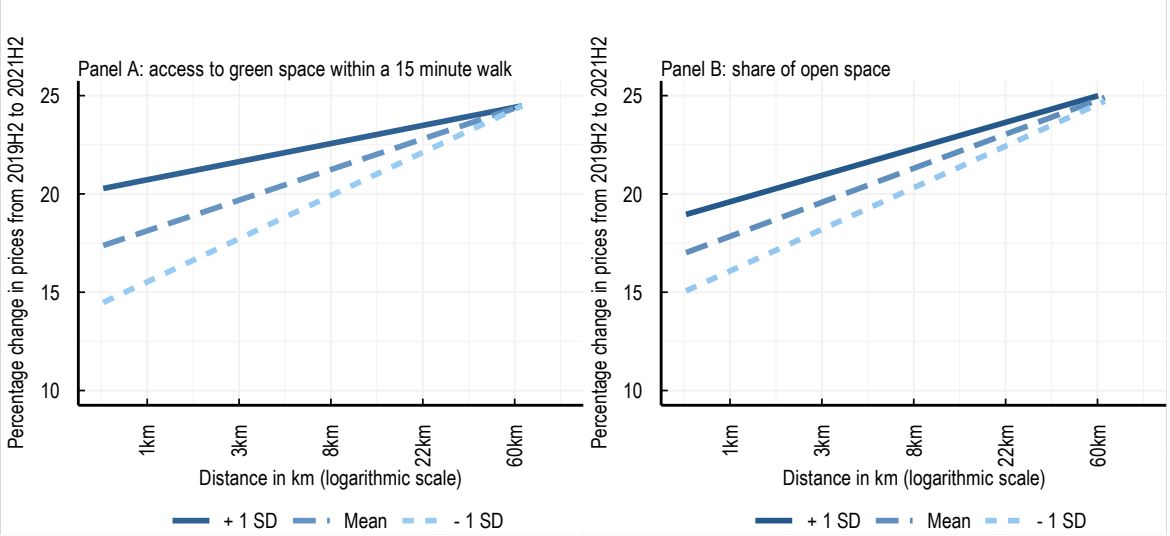
Source: "The geography of housing demand in times of COVID-19: Are housing markets changing beyond the metropolitan boundaries?", (Ahrend et al., 2023[8]).

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Factor in the impact of environmental amenities on housing demand

Much of the amenity value associated with locational choices comes from environmental quality. Open space and access to green spaces played a particular role in location choices during the pandemic. Such amenities provide not only health benefits due to reduced congestion and better air quality, but they also promote social cohesion and improve the quality of life in urban areas, values increasingly demanded since the pandemic outbreak. Places with scarce open space and difficult access to greenery experienced a sharper shift in demand from the city centre to the periphery (Figure 4.11).

Figure 4.11. Environmental quality is a major driver of price shifts away from city centres



Note: The plots illustrate how the relationship between distance and price changes depends on the level of the interacted variable (here, "green_15_walk" and "Open.space"; see Annex B for details). For illustrative purposes, three levels of the interacted variables are shown: "Mean" (the average value for the respective interacted variable, equivalent to the price-distance slope without interaction), "+ 1 SD" (the value of the interacted variable one standard deviation above its average value) and "- 1 SD" (the value of the interacted variable one standard deviation below its average value). "green_15_walk" measures the surface of green space accessible by a 15 minute walk. "Open.space" refers to the local area's share of open space in land use as inferred from satellite images. "log distance" denotes the demeaned logarithm of the distance to the respective FUA centre.

Source: "Benchmarking Accessibility in Cities - Measuring the Impact of Proximity and Transport Performance" (OECD/ITF, 2019[5]); "Monitoring land use in cities using satellite imagery and deep learning" (Banquet et al., 2022[4]); Geography of Housing Demand database and OECD calculations.

StatLink https://stat.link/b58jv4

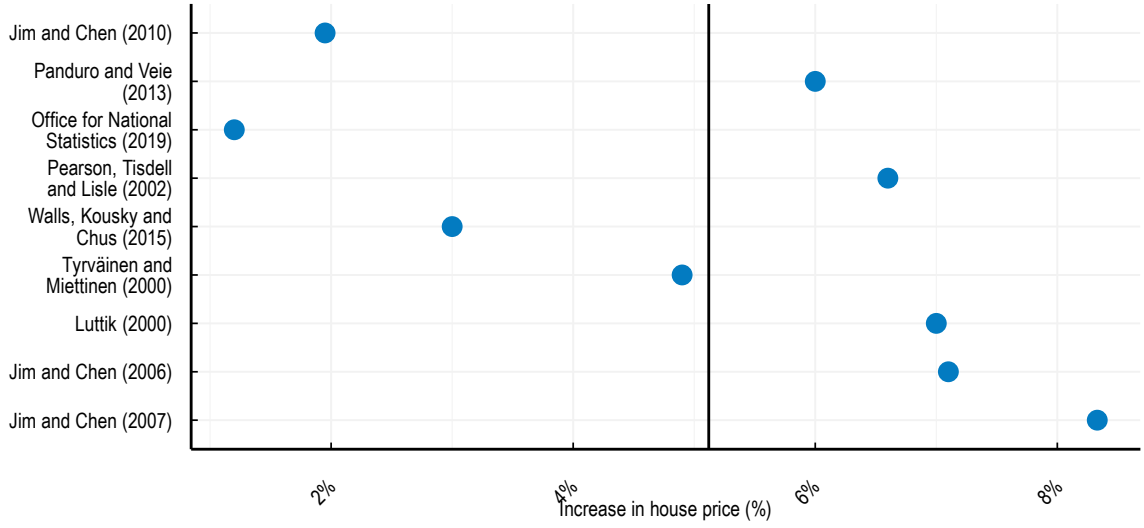
The link between environmental quality and house prices

The positive link between environmental quality and house prices is well established. House prices are affected by environmental amenities, ranging from proximity to open spaces and water bodies, which tend to make residential locations more pleasant, as well as disamenities, such as air and water pollution, noise and proximity to industrial sites and landfills, which have the opposite effect. There is large body of national and international evidence on these effects that provides useful insights for policy.[6]

Proximity to open spaces and water bodies is associated with higher house prices. This is the case of parks, and to a lesser extent forests and greenbelts (Farrow et al., 2022[9]). Empirical evidence suggests that the positive impact of park views on housing prices ranges between 4% and 8% (Figure 4.12). In addition, proximity to, and views of, water bodies, such as lakes, rivers, streams and oceans, also tend to be associated with higher house prices (Figure 4.13). In some cases, however, there is a negative premium related to proximity to large wetlands, suggesting that they can be seen as both amenities and disamenities depending on contextual and risk factors such as flooding.

[6] In order to better compare the results obtained across studies, which can use different metrics, reported results are harmonised where possible to marginal effects in terms of the percentage change in housing prices. For example, For studies assessing the impact of distance to open space, monetary values were converted to percentage changes where possible by using the average house price in the study sample. Nevertheless, direct comparisons remain impossible for some studies, the results of which are therefore generally excluded from the figures in this chapter.

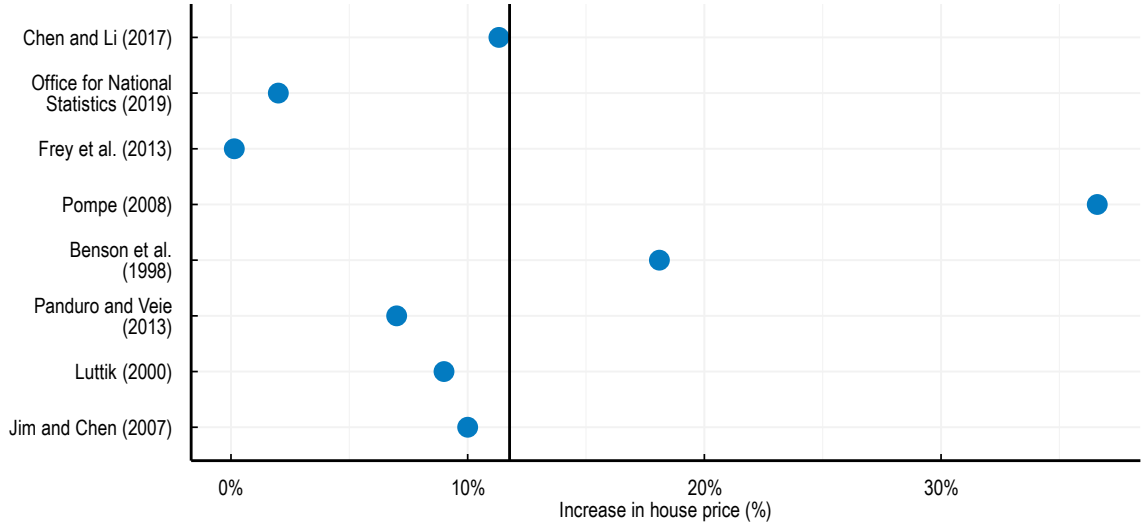
Figure 4.12. Effect of a view of open space on house prices



Note: Average impact line is calculated as the average of the results excluding Black and Richards (2020[10]), which is an outlier, reporting an estimate of 35.5%. The outlier could be due to the fact that the amenity in question was the New York High Line, which is a tourist attraction and is arguably more than an environmental amenity. Further, the High Line is located in an area with a particularly high level of real estate development. The source provides bibliographical information on the studies providing the reported estimates.
Source: "Provision of urban environmental amenities: A policy toolkit for inclusiveness", (Farrow et al., 2022[9]).

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Figure 4.13. Effect of water body view on house prices



Note: Average impact line is calculated as the average of the results excluding Pompe (2008[11]), which is an outlier due to a particular sample of houses with above-average prices. The source provides bibliographical information on the studies providing the reported estimates
Source: "Provision of urban environmental amenities: A policy toolkit for inclusiveness", (Farrow et al., 2022[9]).

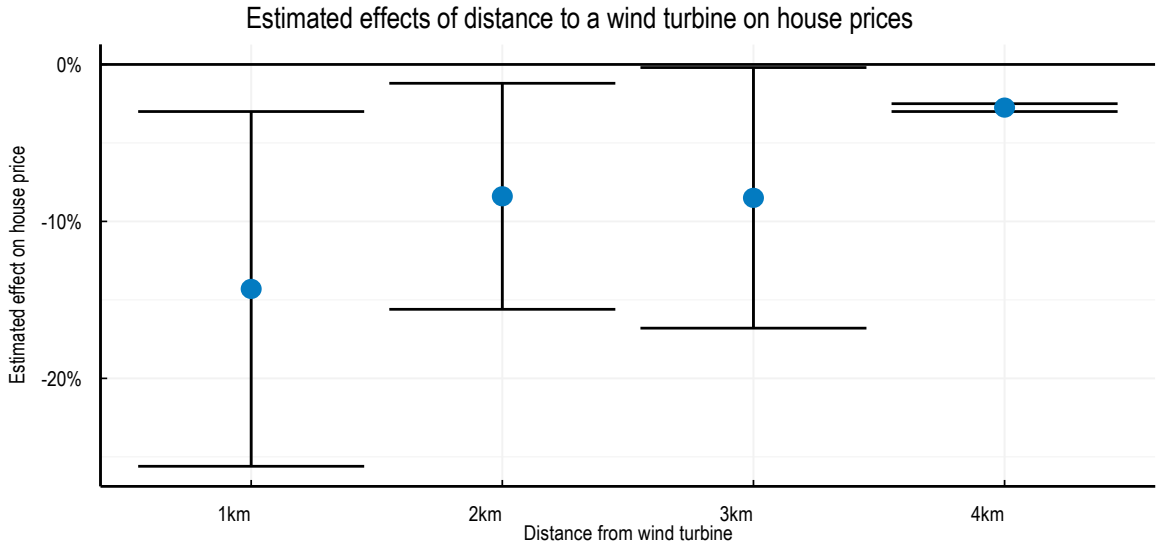
StatLink https://stat.link/4m761j

Proximity to industrial infrastructure has mixed, even if by and large negative, effects on house prices. These infrastructures include non-residential sites developed to provide services, such as generating power, disposing of waste or manufacturing products. In the case of power facilities, for example, international experience seems to suggest that wind farms have varied effects on house prices, depending on distance to the facility and the size of turbines (Figure 4.14). A nearby wind farm tends to depress house

prices, especially when it is located closer to a residential site and when turbines are taller (Dröes and Koster, 2021[12]). Conventional power plants also have an adverse house price effect, even though this impact subsides with the distance from the site of the plant. Evidence is less clear-cut for nuclear power stations.

Other industrial infrastructures, such as factories, brownfields and landfills, have heterogeneous but generally negative impacts on house prices. In contrast, the clean-up of brownfield sites, where hazardous pollutants may have been disposed of, tends to increase house prices, particularly in areas that had previously been significantly degraded. Landfills have been associated with significant negative impacts on house prices.

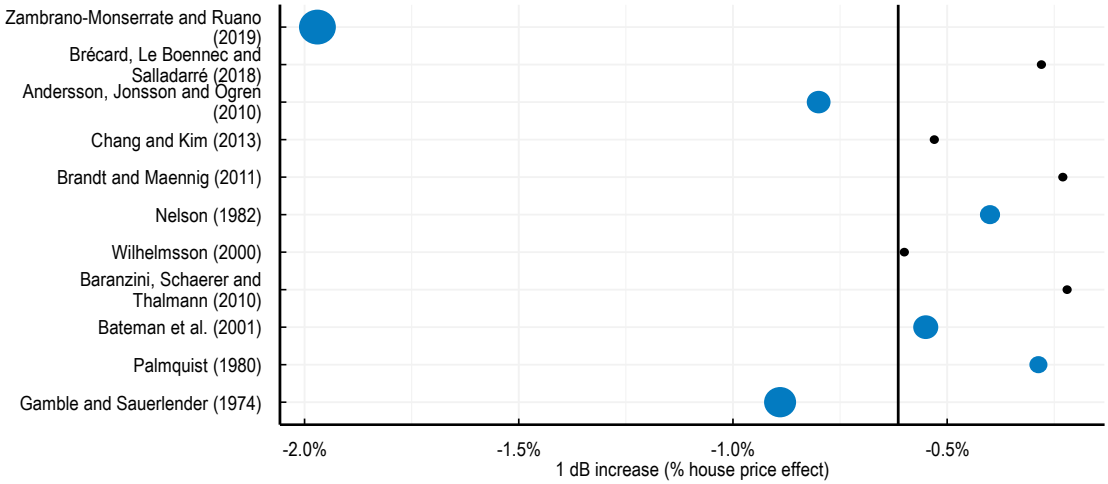
Figure 4.14. Decarbonisation efforts can have adverse effects on house prices



Note: The intervals depict the range of estimates in the studies surveyed by the source. The points represent median estimates.
Source: "Provision of urban environmental amenities: A policy toolkit for inclusiveness", (Farrow et al., 2022[9]).

StatLink https://stat.link/wd8qie

Figure 4.15. Effect on house prices of a one-decibel increase in noise



Note: The size of the blue circles represents the standard deviation of the impact reported in the corresponding article. Articles represented by black dots did not report the standard deviation. The source provides bibliographical information on the studies providing the reported estimates.
Source: "Provision of urban environmental amenities: A policy toolkit for inclusiveness", (Farrow et al., 2022[9]).

StatLink https://stat.link/lt2b7g

Air and noise pollution tend to depress house prices. The negative price premium reflects the umpleasantness associated with a degraded environment. Homes in areas with poor water quality also tend to be less sought after than those located in areas with better quality (Young, 1984[13]; Gibbs et al., 2002[14]).

Contextual factors may dampen or enhance the impacts of environmental amenities on house prices. For instance, greater awareness of the presence of local parks and the benefits of green spaces to residents tends to increase the impact of such amenities on local house prices. By the same token, information on flood risk and awareness of the risks of a local river also influence house prices (Chen, Li and Hua, 2019[15]; OECD, 2018[16]).

Population density affects the benefits associated with urban environmental amenities. Higher density tends to be associated with greater willingness to pay for open space, while fostering awareness about the benefits of amenities, which can enhance their impact on house prices. On the other hand, density may reduce the benefits of environmental amenities to the extent that crowding makes an amenity less enjoyable (Neuts, Nijkamp and Leeuwen, 2012[17]).

Willingness to pay for an amenity is only a partial measure of the total benefits the amenity generates for society. For example, improved long-term health outcomes resulting from better air quality are a benefit of urban forest creation that is not necessarily reflected in house prices. If environmental amenities create indirect costs or benefits, they create a wedge between house prices and the true social value of the amenities. Changes in house prices associated with a change in environmental amenity provision can therefore be thought of as only a partial reflection of potential welfare changes.

Behavioural biases and incomplete information may also cause willingness to pay to be an incomplete welfare measure. Home buyers often have at least some missing information regarding purchased properties. Other biases, for example, overvaluation fuelled by social contagion or disproportional aversion to losses compared to equivalent gains, can contribute to inaccurate individual valuations of environmental amenities (Salzman and Zwinkels, 2017[18]). These inaccuracies in valuations can eventually be reflected in house prices.

Distributional impacts of amenity provision

Access to environmental amenities is unequally distributed among social groups. Disadvantaged populations are disproportionately exposed to disamenities, such as pollution, poor water quality, and proximity to hazardous waste facilities and brownfield sites (Farrow et al., 2022[9]), OECD (2006[19]). Inequalities in the initial distribution of environmental disamenities imply that policies to improve environmental quality will be progressive insofar as those closest to disamenities experience the greatest benefits from their remediation (Banzhaf, Ma and Timmins, 2019[20]). As a result, the clean-up of brownfield sites can deliver disproportionate benefits across groups. Whether environmental amenity provision exacerbates or reduces inequality depends on the factors driving any existing inequities in amenity or disamenity provision across socio-economic status, as well as any effects beyond house price changes that their provision may entail (e.g., changes in transport times or quality of life).

Homeownership also plays a vital role in the impact of local amenity provisions on housing affordability. Rises in house prices resulting from amenity provision may decrease affordability for renters. Unlike homeowners, renters do not receive capital gains from housing price increases. They may also be more vulnerable to increases in housing costs, as they typically spend a larger part of their budget on housing-related expenses. Among renters, low-income households have a higher housing cost burden, compared with higher-income households.

Households that use a large share of their income to cover housing-related costs are particularly exposed to the distributional impacts of amenity provision. The displacement of renters and low-income households due to environmental amenity provision can occur via two mechanisms.

- First, as amenity provision in an area increases, the area attracts higher-income households that can pay more for the locally provided amenity. For instance, converting empty space into an urban park will attract potential buyers and renters who value public open space and related recreational facilities. Renters with a low amenity valuation may then be effectively forced to relocate.
- Second, inelastic housing supply, i.e., housing supply that is relatively unresponsive to rising prices, exacerbates the displacement of low-income renters over time in areas with weak rent control. Preventing exclusionary housing patterns near environmental amenities entails accompanying environmental amenity provision with measures that address supply and demand-side aspects. Accordingly, policy measures would do well to maintain an adequate supply of affordable housing in amenity-rich areas and support low-income households that face rent increases due to amenity-induced increases in house values.

Monetary, financial and tax policies determine the relative access to loans and the borrowing cost at which renters can become owners. Falling interest rates temporarily facilitate home ownership, allowing buyers who enter the market at the right time to collect the social value of amenity provision that capitalises into property prices. However, low interest rates also increase house prices by boosting the demand for housing. Mortgage interest relief also reduces the cost of borrowing, temporarily facilitating house purchases before the worth of the relief becomes capitalised into house prices (Chapter 3). Moreover, changes in demand and property values will not be uniform over space, with the provision of local amenities and building-rights scarcity playing a central role in the asymmetric distribution of capital gains.

Adapt policies

The changing patterns in housing demand arising from digitalisation require policy action to unlock supply and avoid the build-up of new inequalities. Policymakers can consider several options depending on local conditions, social preferences and policy settings.

Digital transformation

Digitalisation offers several options for technological change and innovation in the construction and "smart" management of buildings, not least through artificial intelligence and the internet of things. Innovations in urban planning and management are already taking place and can improve the management of traffic, urban amenities and infrastructure, as well as the energy efficiency of buildings and cities at large. Digital platforms can enhance competition and improve the matching of supply and demand for dwellings. Housing fintech can broaden access to finance and reduce borrowing costs to the extent that these activities are regulated appropriately to avoid new sources of financial risk (Chapter 3).

Effective digital infrastructure is a prerequisite for digitisation and remote work. Tackling the digital divide between urban and rural areas is particularly important in the context of spatial shifts in the demand for housing. Governments would do well to ensure widespread access to high-speed internet, upgrade technical and managerial skills, and implement product and labour market reforms to facilitate the uptake of digital technologies by firms (Sorbe et al., 2019[21]). The "OECD Going Digital" project aims to help policymakers better understand the digital transformation and develop appropriate policies to help shape a positive digital future (OECD, 2020[22]).[7]

[7] The "Going Digital Toolkit" provides a roadmap to policymakers by identifying policies and regulations to reduce connectivity divides. Such policies include promoting competition, fostering investment, and removing barriers to broadband deployment, as well as a set of approaches to extend connectivity in rural and remote areas. The development of digital government services can ensure a better and more inclusive response to citizens' needs and improve access to public services in disadvantaged communities. Closing the digital skills divide by providing all

Urban planning

Land-use regulations are important policy tools to respond to the new geography of housing demand within urban strategies compatible with environmental, transport and public service provision objectives. Shifts in the geography of housing demand magnify the benefits of regularly revising geographic boundaries for urban development to accommodate city growth while ensuring forms of expansion compatible with environmental objectives. Where regulations allow it, flexibility to convert commercial property and office space for residential use would facilitate the reallocation of housing capital to evolving demand for different uses, potentially making housing more affordable. However, there is a risk that disaffection for city centres gives rise to housing segregation as the better-off move away. These trends pose challenges for urban planning, land-use design and zoning regulations.

The governance of urban planning is often fragmented across government levels and sometimes across ministries or government agencies (OECD, 2021[23]). This situation can complicate reforms if public bodies with responsibility over one area, for instance, land regulation, do not have authority in other areas, such as taxation or social housing, that would allow them to design integrated reform packages. Responsibilities and decision-making should be delegated to the metropolitan rather than the local level to avoid not-in-my-backyard dynamics and foster inter-municipal co-operation, including in the provision of public services and transport. In other cases, there is a merit in enhancing tax and spending autonomy at the local level to boost housing supply responsiveness, especially where policymaking functions are overly centralised at higher levels of administration (Dougherty, Cournède and van Hoenselaar, 2023[24]).

The new geography of housing demand entails increasing distances between workplaces and residences. Fewer but also longer commutes might require rethinking urban passenger transport systems, notably in light of continuing efforts to decarbonise transport. Compact and transit-oriented development, commonly defined as mixed-use urban development with mass-transit facilities within walking distance of residential buildings, can make public transport more convenient, encourage ridership and decrease car dependency (ITF, 2019[25]).

Amenity provision

Environmental policies should support the provision of environmental amenities when net welfare benefits exceed net costs. Despite their myriad benefits, environmental amenities remain undersupplied in many urban areas. Public investments with strong spatial dimensions, such as the provision of open space, can increase house prices and burden residents who do not benefit from the associated gains, leading to an unequal distribution of the net benefits of the provided goods. Such effects should be anticipated by environmental policies to support amenity provision, and particular attention should be paid to the distributional effects that occur between renters and owners in affected areas. Additional attention should be given to displacement effects, whereby residents can face pressure over time to relocate out of the area due to amenity-induced increases in housing costs.

Amenity provision may need to be accompanied by complementary measures designed to mitigate economy-wide effects (OECD, 2018[26]) and negative distributional impacts that can occur via housing markets. Examples of policy measures that address both environmental issues and equity include subsidising the retrofitting of the existing housing stock (Chapter 2) and investments in green social housing, i.e., social housing that incorporates environmental amenities (OECD, 2021[23]). Enabling portable eligibility with respect to social housing could also be included in the toolkit of feasible interventions (OECD, 2021[27]). Relaxing building height restrictions can also improve access to environmental amenities.

citizens with ICT, literacy and numeracy skills requires equal opportunities for training, education, re-skilling and upskilling for the jobs and societies of the future.

Low-income areas tend to be overlooked in green renewal project planning (Haase et al., 2017[28]; Anguelovski et al., 2016[29]). There is scope to introduce greater equity into the urban planning process at the earliest stages of such projects. One means of doing so is to facilitate the inclusion of residents of all socio-economic status in participatory planning processes. Enhancing amenity provision in amenity-scarce areas would generate greater marginal benefits than their provision in areas with substantial existing supply. Policymakers should aim for a more uniform distribution of amenities, which may involve targeting areas with little supply.

Existing local fiscal and land-use policies, public finance mechanisms, as well as the spatial profile of amenities, tenure status and income, determine the potential for distributional impacts. As a result, these conditions should be taken into account when evaluating the appropriateness of potential compensation mechanisms. For example, successful implementation of land value capture mechanisms should take into account factors such as the maturity of land markets, land use regulations, investment policies, legal frameworks, fiscal and governance structures, as well as local circumstances and conventions regarding land rights (OECD, 2021[27]). The welfare impact of property taxes, for example, will depend not only on their magnitude but also on the relation between the tax rate on land and differences in rates across different land use categories (Brandt, 2014[30]).

Land value capture

Land value capture measures, including infrastructure levies or developer obligations, as well as smart ways to manage and re-adjust land use, can incentivise development and help densify existing residential areas (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[31]). Such measures can also contribute to financing the infrastructure and amenities needed to improve the accessibility of economic and social facilities in remote areas. Numerous land value capture strategies exist. These include betterment contributions and special assessments, impact fees, land readjustment, and inclusionary zoning (OECD, 2021[27]; Farrow et al., 2022[9]):

- Betterment contributions and special assessments require owners of properties benefitting from a public investment to pay the municipality a fee. The fee is assessed based on the added property value that the owners' profit from due to the public investment.
- Impact fees are similar to betterment contributions and special assessments, except that they are charged in the form of a one-time fee.
- Land readjustment occurs when landowners collaborate with a municipality to pool land that will be devoted to amenity development. Following the development of the pooled land, each landowner receives a smaller parcel that has greater value due to the provision of the created amenity.
- Inclusionary zoning involves setting minimum thresholds for the proportion of low- or moderate-income housing that developers should provide in exchange for the right to construct residential properties, and could be used in conjunction with amenity provision to ensure affordable housing supply in areas close to an environmental amenity.

Potential uses of these revenues vary according to the specific context and can include investment in social housing and the provision of housing subsidies for low-income households. Pricing mechanisms can also be used to recover the costs generated by environmental disamenities. The revenues generated by these pricing mechanisms can serve to compensate households that may disproportionately suffer from the impacts of disamenities.

Housing taxation

The design of housing taxes influences residential mobility. The use of transaction taxes is generally assessed as generating efficiency losses mainly through lock-in effects that hold back residential mobility

(OECD, 2022[32]). In addition, reliance on transaction taxes may strengthen incentives to buy less expensive land, which generally lies far from city centres and transport infrastructure, while deterring transactions that might help put land to more efficient uses, including residential ones. They also encourage the purchase of undeveloped land for new development rather than upgrading developed areas (Blöchliger and Kim, 2016[33]). Substituting at least partly recurrent property taxes for transaction taxes would make tax systems and housing markets more efficient with benefits for residential and labour mobility (OECD, 2022[32]).

Despite their efficiency, there is significant scope to improve the design and functioning of recurrent taxes on immovable property (OECD, 2022[32]). While all OECD countries levy recurrent taxes on immovable property, they are in many instances based on outdated property values, significantly reducing the associated revenue potential, while harming equity and economic efficiency. Opting for a split-rate design, whereby land is taxed at a higher rate than structures, would encourage the development of vacant or underused land in suburban areas, thereby fostering compact development and attenuating urban sprawl.

Property taxes provide local governments with stable revenue to finance the provision of local public goods and services, which in turn is a key determinant of residential settlement decisions, particularly for residents planning to relocate from amenity- and service-rich urban centres. In areas where housing supply shortages coincide with an abundance of vacant homes, recurrent taxes on these vacant homes can help increase housing supply. Such taxes should be flanked by credible measures to monitor compliance and avoid loopholes for short-term rentals (OECD, 2022[32]).

Rental market policies

Rental-market regulation can hinder supply when they involve overly tight rent controls (OECD, 2021[23]). Strict tenant-landlord regulation resulting in high tenure security and rent control can lower the expected returns from the residential rental supply, thereby reducing residential investment or encouraging alternative uses of the existing stock by owners.

Tight rental contract restrictions also adversely affect vulnerable renters, posing obstacles to residential and labour mobility. Excessive protection of tenants implies that renters with uncertain labour market prospects find it difficult to sign a lease. Strict regulations in rental markets further reduce residential mobility, as tenants in rent-controlled dwellings will be reluctant to move if rents are below market levels. As there is also a case for providing tenants with reasonable security over tenure and rent levels, a balanced system can involve a degree of rent stabilisation, whereby rents can be adjusted for new contracts (and potentially renewals) but regulated in line with market developments during the duration of a contract.

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Annex 4.A. The OECD Geography of Housing Demand Database

The OECD, supported by a network of public and private data providers, has assembled the Geography of Housing Demand (GHD) database of housing transaction prices for 16 countries at the smallest administrative unit available (Ziemann et al., 2023[6]; Ahrend et al., 2022[34]). In most cases, the data are made available by national statistical agencies that collect them to compile HPIs. France and the United Kingdom publish open-source data for every single transaction. Finally, private data operators from Germany ("vdpResearch") and Portugal ("Confidencial Imobiliário") agreed to share granular house price data computed from their proprietary databases.

Annex Table 4.A.1. Data sources and coverage by country

	Coverage			Number of FUAs (districts)				Source	Local house price variable
	Period	Population (%)	Area (%)	Small (<200K)	Medium (200K – 500K)	Metro (500K – 1.5m)	Large (> 1.5m)		
AUT	2017Q1 - 2022Q1	62	24	-	3 (67)	2 (70)	1 (123)	Statistik Austria	Median transacted price per m^2
BEL	2017Q1 - 2021Q4	94	77	5 (16)	4 (35)	4 (105)	1 (125)	STATBEL	Average transacted price per m^2
DEU	2018Q1 - 2021Q4	74	60	12 (76)	54 (751)	17 (698)	8 (1293)	vdpResearch	Average transacted price per m^2
DNK	2017Q4 - 2022Q1	46	25	-	3 (67)	-	1 (68)	Statistics Denmark	Average transacted price per m^2
ESP	2017Q1 - 2021Q3	92	51	46 (277)	22 (225)	8 (222)	3 (383)	INE	Average transacted price per m^2
FIN	2017Q1 - 2021Q4	81	37	3 (15)	3 (31)	1 (15)	-	Statistics Finland	Average transacted price per m^2
FRA	2017Q1 - 2021Q4	86	66	17 (1075)	30 (3301)	13 (2338)	2 (2071)	Demande de valeurs foncieres	Median transacted price per m^2
GBR	2017Q1 - 2022Q3	86	62	36 (570)	27 (1233)	14 (1845)	4 (2556)	UK Government Price Paid data	Average of median transacted prices per type and age of property
HUN	2017Q1 - 2022Q1	92	74	11 (263)	7 (304)	-	1 (201)	Hungarian Central Statistics Office	Average transacted price per m^2
ISR	2017Q1 - 2021Q4	65	12	1 (5)	4 (27)	2 (25)	1 (59)	Central Bureau of Statistics	Average transacted price per m^2
KOR	2018Q1 - 2021Q4	81	26	1 (1)	10 (11)	6 (22)	5 (105)	MOLIT	Average transacted price per m^2
MEX	2017Q1 - 2021Q4	54	2	18 (246)	36 (885)	30 (1847)	8 (2070)	Sociedad Hipotecária Federal (SHF)	Average transacted price per m^2
NOR	2017Q1 - 2022Q1	65	12	2 (2)	3 (9)	1 (11)	-	Statistics Norway	Average transacted price per m^2
PRT	2017Q1 - 2021Q4	44	8	5 (15)	2 (22)	1 (43)	1 (110)	Confidencial Imobiliário	Average transacted price per m^2
SWE	2017Q1 - 2021Q4	90	98	6 (22)	3 (13)	2 (18)	1 (21)	Svensk Mäklarstatistik	Average transacted price per m^2
USA	2017Q1 - 2022Q3	96	56	34 (496)	84 (2181)	59 (3263)	34 (6617)	Zillow Research Institute	Zillow Home Value Index

Annex 4.B. Measuring the urban house price gradient and its changes

The following specification assesses whether house prices vary with distance to the city centre:

$$\ln P_{i,j} = \alpha_j + \beta_j \ln D_i^j + \varepsilon_{i,j} \quad (1)$$

where $P_{i,j}$ denotes the house price in local unit *i* of FUA *j* in 2018 and D_i^j the distance in metres from local area *i* to the centroid of the largest high-density cluster of the corresponding FUA *j*. The estimated coefficient β_j is referred to as *gradient*.

The core hypothesis tested is whether intra-FUA house price gradients have flattened in the wake of the COVID pandemic as remote work practices have become more widespread. To do so, the change in local house prices between the second half of 2019 (pre-COVID) and the second half of 2021 (the latest uniformly available data since the COVID outbreak) is regressed on the distance to the corresponding FUA centroid.

$$\Delta P_{i,j} = \alpha + \delta \ln D_i^j + \mu_j + \varepsilon_{i,j} \quad (2)$$

with Δ a log-difference operator (measuring the from 2019H2 to 2021H2 in per cent) and μ_j FUA-fixed effects. A positive slope coefficient δ implies a flattening of the intra-FUA house price gradient β_j from the level equation (1).

To better identify demand shocks in price movements, the reduced form baseline estimation (equation 2) is augmented by a proxy for new residential construction (S_i):

$$\Delta P_{i,j} = \alpha + \delta_0 \ln D_i^j + \boldsymbol{\delta_S}\left(\mathbf{ln}\, \boldsymbol{D_i^j} \times \boldsymbol{S_i}\right) + \boldsymbol{\gamma}\, \boldsymbol{S_i} + \mu_j + \varepsilon_{i,j} \quad (3)$$

$$\Delta P_{i,j} = \alpha + \delta_0 \ln D_i^j + \boldsymbol{\delta_{WFH}}(\mathbf{ln}\, \boldsymbol{D_i^j} \times \boldsymbol{WFH_j}) + \delta_S\left(\ln D_i^j \times S_i\right) + \gamma\, S_i + \mu_j + \varepsilon_{i,j} \quad (4)$$

Accordingly, the coefficient δ can be rewritten as a function of the rise in working from home (WFH) and additional supply (S) weighted by the respective elasticities:

$$\delta_{i,j} = \delta_0 + \delta_{WFH} WFH_j + \delta_s S_i$$

- Hypothesis 1: δ and δ_0 are positive, reflecting a flattening of the house price gradient since the COVID outbreak.
- Hypothesis 2: δ_{WFH} is positive in line with the assumption that a higher take-up of WFH increases, all other things equal, demand for more remote areas.
- Hypothesis 3: δ_s is negative since, all other things equal, more supply relieves demand pressure on prices.

Brick by Brick (Volume 2)

BETTER HOUSING POLICIES IN THE POST-COVID-19 ERA

Expanding on the findings of Brick by Brick: Better Housing Policies, this second volume delves into key trends shaping housing policies in the post-COVID-19 era. The first chapter provides an overview and discusses the need to monitor the pandemic's impacts on housing affordability, address the energy crisis through low-carbon housing initiatives, maintain financial resilience amid fluctuating housing cycles, and facilitate the reshaping of housing markets in response to remote work and environmental concerns. The second chapter focuses on the decarbonisation of the housing sector. It recommends a mix of carbon pricing, energy-efficiency certification and regulation, and subsidies to meet net-zero targets while accounting for housing market specificities. The chapter also calls for deploying complementary policies to limit adverse impacts on low-income households. The third chapter examines housing finance, focusing on the tension between supporting mortgage borrowing and promoting financial resilience. It also discusses the rise of non-bank real estate finance and the potential for mortgage finance to support housing decarbonisation. The fourth chapter explores how the new work-life balance, enabled by the rise of remote work, is reshaping housing demand and proposes a set of tailored urban policies to address this shift. Overall, the report provides a comprehensive blueprint for housing policies in the post-pandemic world.

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