2 Why are cities and regions important for decarbonising buildings?

This chapter documents why cities and regions are important for the decarbonisation of buildings, and discusses the factors that influence local variations in policy and the multiple benefits generated at the local scale. Carbon emissions and energy consumption in buildings vary across cities and regions. In addition, buildings and construction are local in nature, with unique climatic conditions, varying building stock, and differences in the speed of new construction and renovation. Cities and regions face varying issues, including housing affordability, energy poverty and lack of capacity in government and local industries. The benefits of building decarbonisation at the local level include job creation, well-being and more affordable energy.

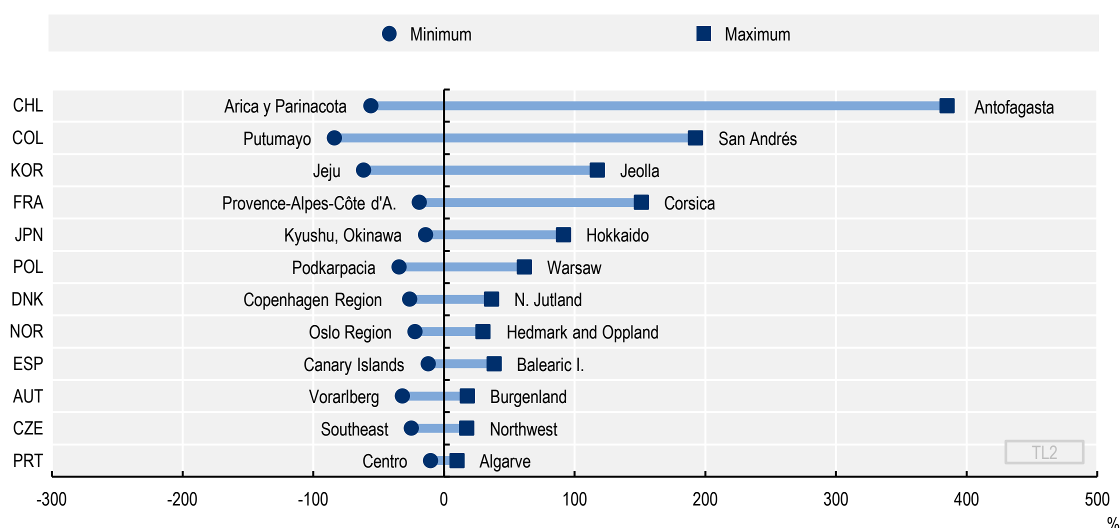
Carbon emissions and energy consumption vary across cities and regions

The share of carbon emissions from buildings varies across cities and regions. Buildings accounted for 28% of global energy-related emissions in 2018 (IEA, 2019[1]). In large cities, these percentages are even greater. Greenhouse gases (GHGs) or carbone dioxide (CO_2) emissions from buildings in London, Tokyo, Paris and New York were measured at 76%, 71%, 70% and 67% recently (Greater London Authority, 2018[2]; Tokyo Metropolitan Government Bureau of Environment, 2018[3]; City of Paris and Paris Climate Agency, 2020[4]; New York City Mayor's Office of Sustainability, 2017[5]). Comparing the share of greenhouse gas emissions from the building sector by type of region, the share is the highest in large metropolitan regions and the lowest in remote regions (OECD, 2021[6]).

Energy efficiency investments in buildings offer huge potential for reducing energy consumption and GHG emissions, but energy consumption per capita varies across the cities and regions in a country. Within OECD countries, household energy consumption per capita in the region with the highest consumption is typically three times higher than in the region with the lowest consumption (Figure 2.1). Different cities and regions diverge in outlook for energy consumption per capita. This can be partly attributed to the various modes they have adopted for water heating, space cooling and heating, or lighting, depending on unique geographical or climatic conditions, but also on different types of urban forms.

Figure 2.1. Disparities in household energy consumption per capita, large regions (TL2), 2018

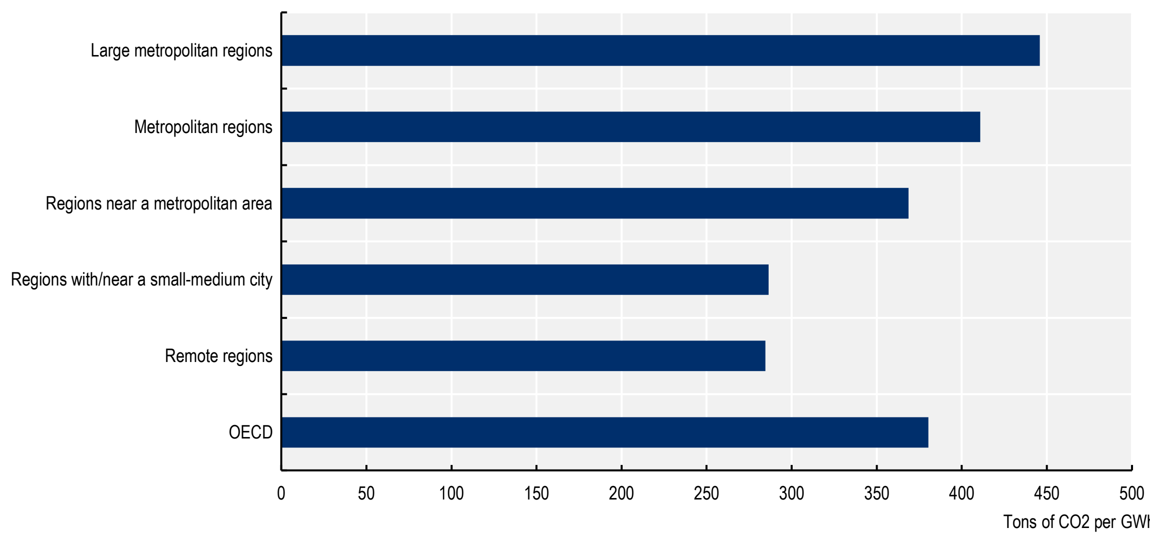
% deviation from country average of electricity and heat consumed at home (kilogrammes of oil equivalent)



Note: Household energy consumption includes water heating, space cooling and heating, cooking, lighting and electrical appliances but excludes transport and consumption outside the house.
Source: OECD (2020[7]), *OECD Regions and Cities at a Glance 2020*, https://dx.doi.org/10.1787/959d5ba0-en.

The energy mix differs across countries as well as regions. Countries such as Sweden, Brazil or France, with a larger share of low-carbon energy sources (i.e. renewables and nuclear), have much lower per capita carbon emissions in general for the same per capita energy consumption (OECD, 2021[8]). Even within the same country, the carbon intensity of electricity varies across regions, and remote regions tend to have the lowest carbon intensity, with the highest share of electricity from renewable sources (Figure 2.2). Electricity accounts for a significant share of energy consumption in buildings (e.g. 25% of household energy consumption in the European Union (EU) (European Commission, 2021[9]) and 43% in the US (U.S. Energy Information Administration, 2021[10]). This regional diversity affects the capacity of realising net-zero-energy buildings at local scale, and by extension, local strategies for decarbonising buildings. At the same time, cold regions with low-carbon electricity often have high building emissions, due to fossil fuel heating. Subnational authorities may not be able to control the average carbon intensity of electricity, which is subject to change, given energy prices and national energy policies. However, they can support electrification and clean power by promoting energy efficiency in buildings and efficient electric equipment, like heat pumps.

Figure 2.2. Carbon intensity in electricity production by region, 2017



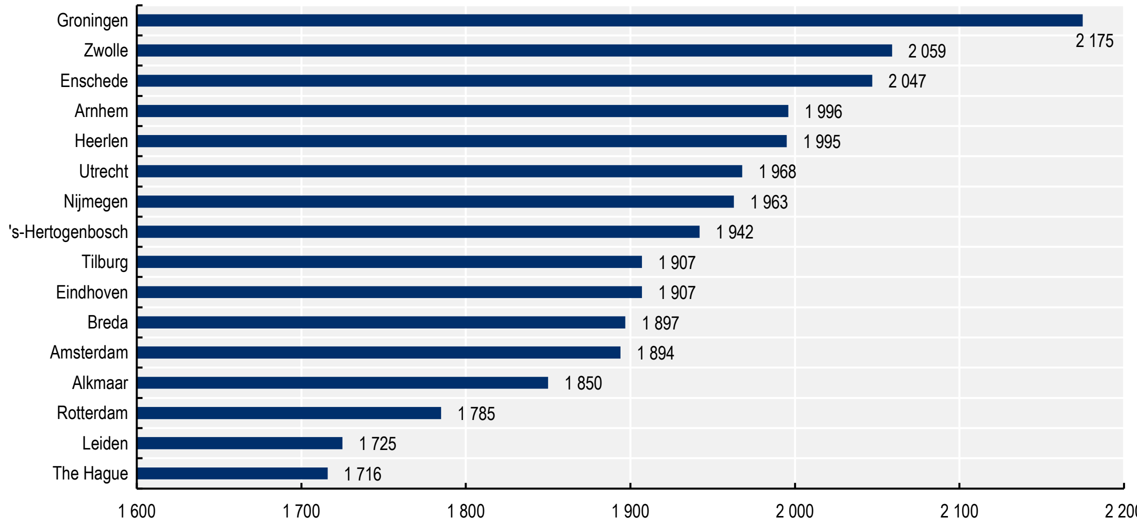
Source: OECD (2020[11]), "The role of regions and cities towards a climate-neutral economy (SDG 13)", https://dx.doi.org/10.1787/6acbc792-en.

Buildings and construction follow local patterns

While each country and region has a different energy mix, buildings within a given country also differ across regions, given the country's climatic conditions, the composition of the existing building stock and the speed of new construction and renovations. For example, a detailed spotlight of the situation in the Netherlands helps document such regional disparities, based on data provided by the Ministry of the Interior and Kingdom Relations.

Climatic conditions affect the energy performance of buildings that households and businesses require and also the property owners' motivation to invest in energy efficiency. Energy in buildings is consumed in the form of heat (e.g. cooking, heating) and electricity (e.g. TV, lights, air conditioning). The amount of energy used for heating and cooling varies greatly depending on geographic and climatic conditions, across and within countries. In general, households in colder regions consume larger amounts of energy for heating, which explains the larger per capita energy consumption in these regions, but also means that property owners have a strong financial incentive to make energy efficiency investments in heating. "Annual heating degree days" are one indicator that indicates a location's heating needs. The indicator represents the sum over a year of the differences between the threshold temperature (15.5°C) and the daily mean outdoor temperature, when the daily mean outdoor temperature is below 15.5°C. Figure 2.3 shows how heating degree days differ greatly within the Netherlands, from 1 716 in The Hague, to 2 175 in Groningen. The implication is that cities have different heating needs and adopt different strategies.

Figure 2.3. Annual heating degree days in metropolitan areas in the Netherlands, 2018



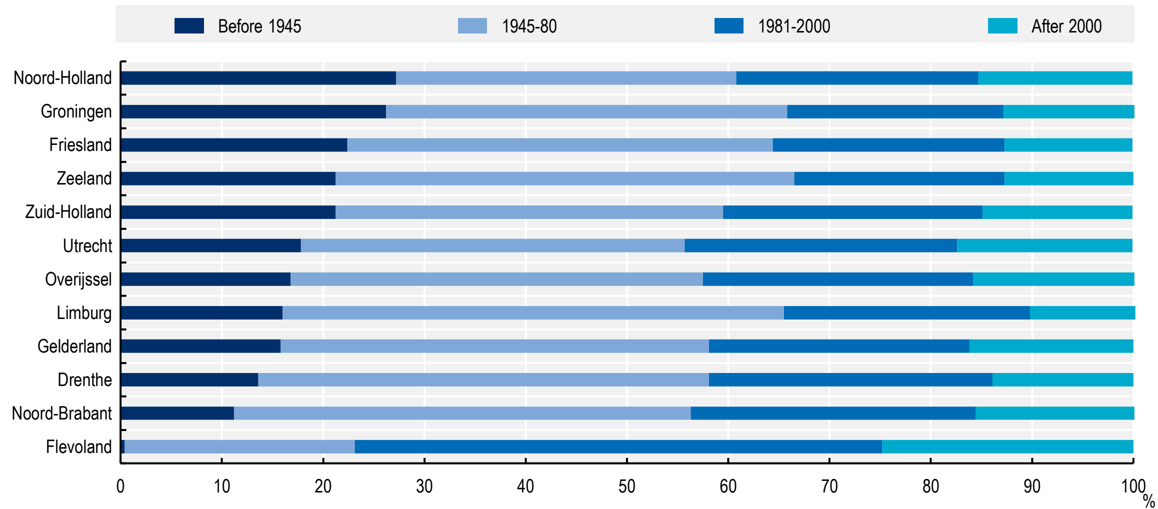
Note: Annual heating degree days is the sum over a year of the differences between the threshold temperature (15.5°C) and the daily mean outdoor temperature, when the daily mean outdoor temperature is below 15.5°C.
Source: OECD (n.d.[12]), *OECD Metropolitan Database*, https://stats.oecd.org/Index.aspx?Datasetcode=CITIES.

In warmer regions, increasing use of air conditioners raises concerns and requires policy attention. It is estimated that without energy efficiency measures, energy demand in cooling will triple globally by 2050, and that space cooling will become the fastest-growing use of energy in buildings (IEA, 2018[13]). Due to climate change, even the coldest regions have seen an increase in average temperature in recent decades, which has increased demand for air-conditioning and other cooling systems.

Composition of existing building stock by age, by scale, by tenure or by use varies across regions. This influences buildings' energy performance, as well as potential targets for investment and barriers associated with building types. While data on the energy performance of the existing building stock is the key to identifying the worst-performing buildings, the age of buildings can be used as a proxy if such data are not available. Better data on the tenure of buildings could also help to guide the design and implementation of appropriate policy tools, since tenure status can present barriers to energy efficiency investments. In the case of buildings with multiple owners, the owners' individual vested interests may prevent them from reaching agreement on building renovation plans. Owners and renters may have "split incentives", because investment in energy efficiency may not necessarily benefit the parties that invest more. For instance, when owners invest in improving the energy efficiency of a building, it is typically the tenants who primarily profit from the energy savings (Erbach, 2015[14]).

The share of old building stock differs significantly across regions in the Netherlands. The percentage of buildings built before 1945 varies from close to zero in Flevoland, the most recently reclaimed province in the Netherlands, to 27.2% in Noord-Holland, where Amsterdam is located. The share of buildings built before 1980 also varies across regions, if not as much as housing built before 1945. Since older buildings generally consume much higher amounts of energy, the urgency and need for public policies and investment in decarbonising buildings also vary across regions (Figure 2.4).

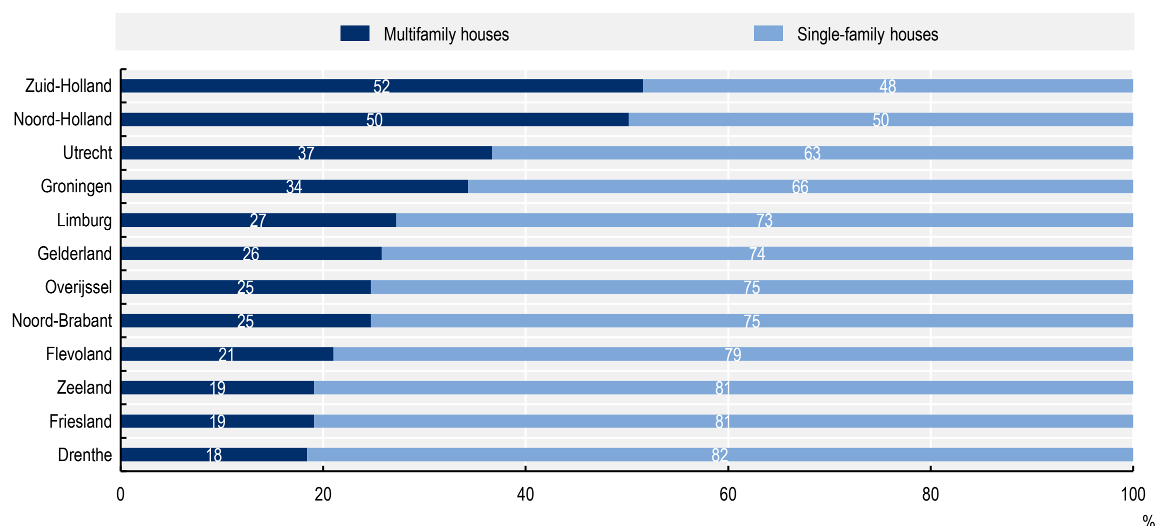
Figure 2.4. Share of old building stock in the Netherlands by province



Source: Calculated based on the data provided by Ministry of the Interior and Kingdom Relations.

The share of multifamily housing and single-family housing in total housing stock varies significantly across regions in the Netherlands. The percentage of multifamily housing ranges from 18% in Drenthe to 52% in Zuid-Holland, reflecting the percentage of urban population (Figure 2.5).

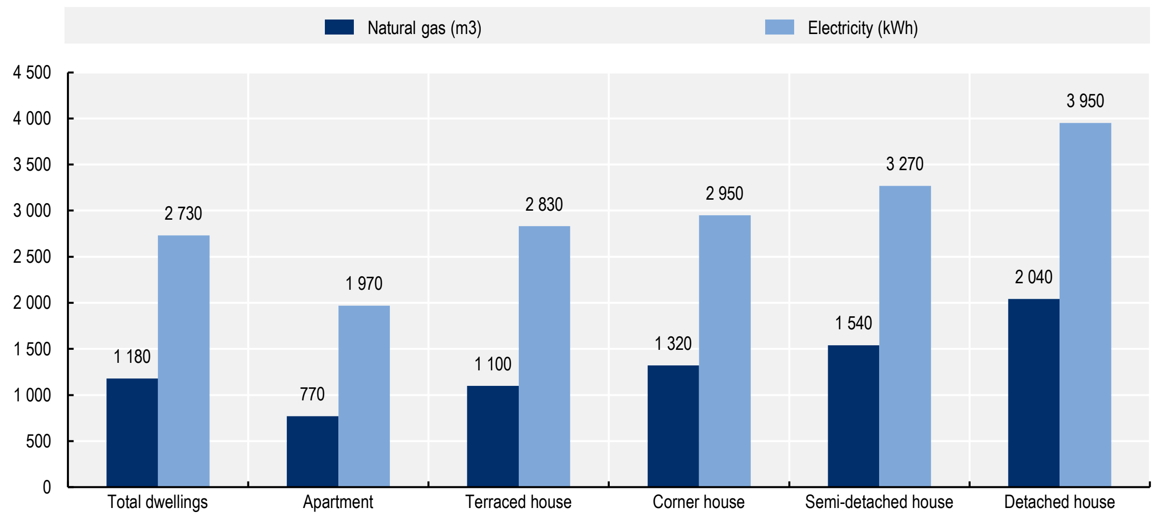
Figure 2.5. Share of multifamily housing and single-family housing in the Netherlands by province



Source: Calculated based on the data provided by Ministry of the Interior and Kingdom Relations.

From an energy perspective, a higher share of multifamily housing reduces household energy consumption per capita. This is not only because multifamily housing is smaller in size than single-family housing, but also because its overall building structure makes the units more energy efficient (Obrinsky and Walter, 2016[15]). In the Netherlands, an average household living in a detached house consumes more than twice as much energy as a household in an apartment, in both natural gas and electricity (Figure 2.6).

Figure 2.6. Average energy consumption by type of dwelling in the Netherlands (per year)

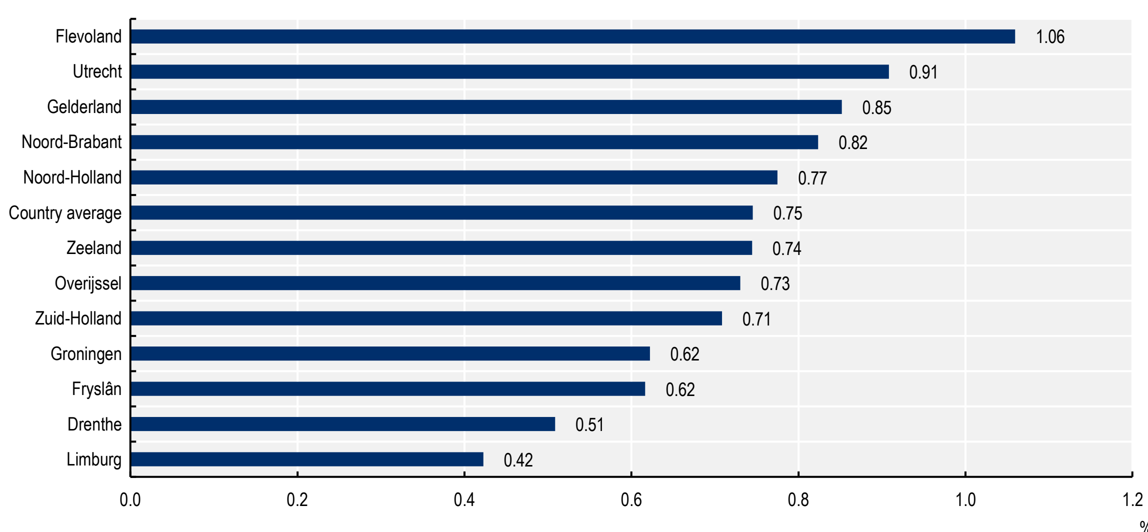


Source: Calculated based on the data provided by Ministry of the Interior and Kingdom Relations.

The rate of new construction and renovations is an important factor in designing and implementing policies, since they offer precious opportunities for energy efficiency measures. Energy efficiency investments are often much less costly in new construction than in renovations. The investment opportunity is high in regions with urban expansion, since the regions require a faster rate of new construction to accommodate population growth.

The rate of new construction differs greatly across regions in the Netherlands, ranging from 0.42% in Limburg to 1.06% in Flevoland. Although new construction does not necessarily replace old buildings, this indicator indicates to some extent the opportunities for comprehensive energy performance improvement in buildings. While new construction provides ample opportunities for local communities to modernise the built environment in regions with a higher construction rate, communities with a lower construction rate need to consider energy renovations more seriously (Figure 2.7).

Figure 2.7. Average new construction rate in the Netherlands by province (all buildings), 2012-20



Source: Calculated based on the data provided by Ministry of the Interior and Kingdom Relations.

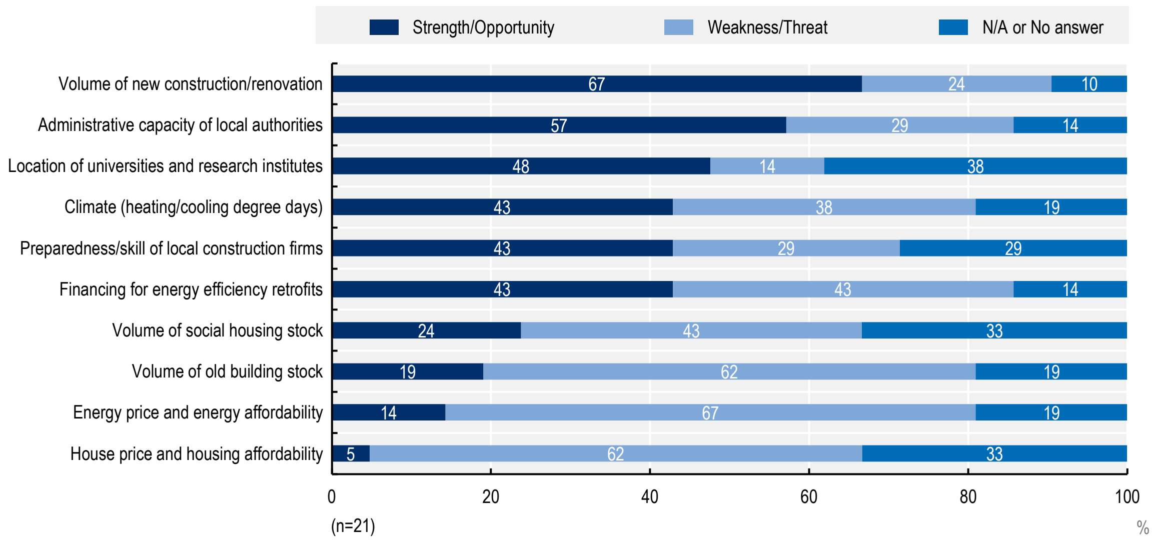
Cities and regions face different policy environments

Policy environments vary across regions, in various dimensions, including the status of housing affordability and energy poverty, how prepared the construction industry is, and the enforcement and certification capacities of local institutions. All these factors, which vary locally, affect the effectiveness of policy implementation to promote energy efficiency in buildings.

- For example, housing affordability has increasingly attracted political attention, especially in large metropolitan areas. Policies to require energy efficiency in housing are known to place upward pressure on house prices, given their effect on construction and maintenance costs (OECD, 2021[8]). Cities and regions need to assess carefully how policies governing decarbonisation of buildings affect house prices and rents and provide measures to reduce the housing burden.
- Energy poverty requires specific attention of policy makers, providing assistance for energy retrofits to low-income households. In OECD countries, nearly 20% of low-income populations have difficulty heating their homes (OECD, 2021[8]). In Portugal, 19.4% of the population were unable to keep their homes warm in 2018; in response, the government has been developing a National Long-Term Strategy to Tackle Energy Poverty. The strategy plans to reduce energy poverty at the national, regional and local level by 1) increasing energy efficiency in homes; 2) reinforcing access to energy services; 3) sharing robust knowledge and access to information about energy use, in order to improve energy literacy; and 4) reducing the burden of energy consumption (IEA, 2021[16]).
- The skill levels and capacity of local construction and other relevant industries may limit the expansion of energy efficiency measures. Energy efficiency investments require a certain set of knowledge and skills, both in design and in construction. Cities and regions need to consider developing the skills of local actors, in collaboration with experts.
- Finally, in most cases, national governments design building energy codes and regulations, but their adoption and enforcement depend on local governments (EBC, 2021[17]). Local governments' capacity to enforce building energy codes also varies and affects the efficiency and credibility of building decarbonisation policies and the motivation of property owners. Cities and regions need to pursue efficient and effective enforcement, while national governments also play an important role in ensuring that enough enforcement capacity exists at the local level.

Cities and regions' self-assessment of their strengths and weaknesses on energy efficiency in buildings also varies significantly. While the "Volume of new construction/renovation" and "Administrative capacity of local authorities" are recognised as strengths by most cities and regions in the OECD-CoR survey (67% and 57%, respectively), other cities and regions consider them their weaknesses (24% and 29%). On the other hand, "House price and housing affordability" and "Energy price and energy affordability" are recognised as weaknesses by most cities and regions (62% and 67%), while other cities and regions recognise them as their strengths (5% and 14%). In the case of cost of energy, high electricity prices may encourage building owners and tenants to adopt energy-saving measures and make energy efficiency investments, while relatively high electricity prices by comparison with natural gas prices may also provide negative incentives. In countries where the cost of electricity and natural gas varies steeply, electrifying the heating system is an expensive option for cities. In the UK, for example, 23% of the electricity price derives from climate and social levies, as compared with only 2% for gas. Consumer prices for electricity are five times more expensive than for gas. This deters consumers from adopting electric heat pumps (Rosenow and Lowes, 2021[18]). "Volume of old building stock" and "Volume of social housing stock" are also recognised as weaknesses by over 40% of cities and regions (62% and 43%), while some cities and regions recognise them as their strengths (19% and 24%). This suggests significant potential for improving energy efficiency for such building and housing stock. "Location of universities and research institutes" and "Preparedness/skill of local construction firms" are recognised as strengths by almost half of cities and regions. Recognition of the preparedness of local industry varies widely, and there would be diversifying needs across cities and regions (Figure 2.8). As for “Preparedness/skill of local construction firms”, 29% of cities and regions consider this a weakness.

Figure 2.8. Local specificities and unique contexts related to decarbonisation of buildings



Source: OECD Survey on Decarbonising Buildings in Cities and Regions.

Decarbonisation of buildings offers multiple benefits at the local level

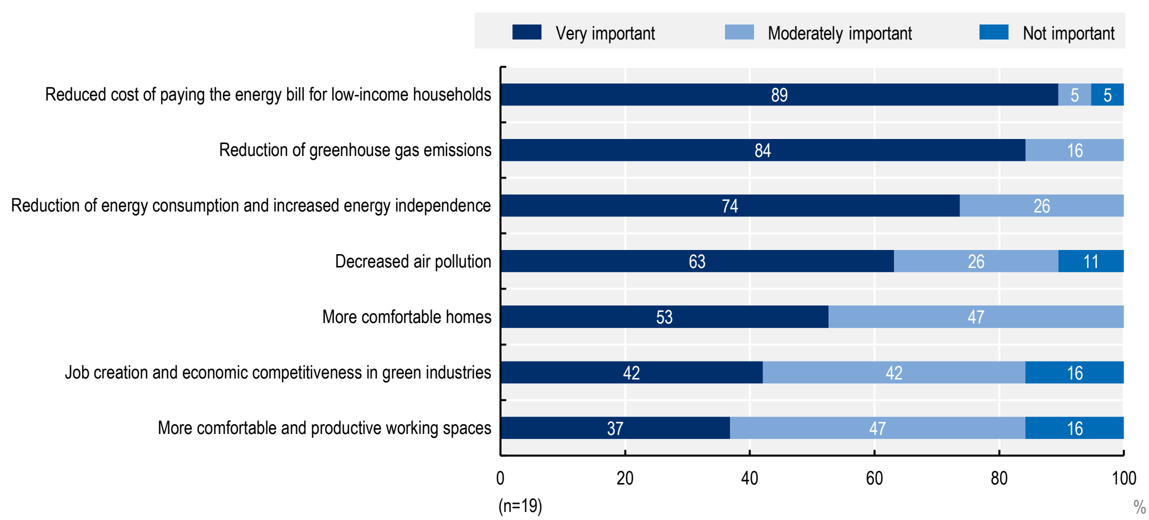
Energy efficiency improvements in buildings will generate multiple benefits, including job creation, health improvements and increased energy affordability, which will contribute to a green and inclusive recovery from COVID-19:

- **Job creation** (green growth, green recovery). The potential for job creation is estimated at from 9 to 30 jobs for every USD 1 million spent on energy efficiency measures in buildings (IEA, 2020[19]). In the EU, EUR 1 million investment in energy renovation of buildings is estimated to create 18 jobs on average (Renovate Europe, 2020[20]). In addition, these jobs are non-relocatable and include relatively low- to medium-skilled jobs, such as installation of insulation and window replacement in single-family homes, which can be accessed by unemployed workers (OECD, 2013[21]).The European Commission expects up to 160 000 additional green jobs to be created in the construction sector by 2030, by doubling renovation rates with its Renovation Wave Strategy (EC, 2020[22]).
- **Well-being** (health benefits, air pollution, etc.). In the EU, improving indoor air quality with enhanced energy efficiency measures and electrical equipment is estimated to save as much as USD 259 billion (EUR 190 billion) per year in savings in public health spending (IEA, 2014[23]). But the potential health benefits of energy efficiency improvements in buildings offer more than simply the cost savings. Measures to improve insulation, heating and ventilation enhance physical health, reducing symptoms of respiratory and cardiovascular conditions and improving mental health by reducing chronic stress and depression (IEA, 2019[24]). A Japanese survey of more than 2 000 houses and 4 000 occupants found that residents’ blood pressure was significantly reduced after energy efficiency renovations, thanks to better indoor air temperature (MLIT, 2019[25]).

- **Energy affordability** (energy poor, etc.). Energy efficiency improvements in housing will also lead to increased energy affordability, especially among low-income households, even though the housing costs upfront could rise. For example, a study on Cincinnati's low-income weatherisation programme found that the average arrears of households that joined the programme fell by more than 60% after energy efficiency improvements (IEA, 2014[23]).

Cities and regions value social and environmental benefits of energy efficiency in buildings. The benefit most valued by the cities and regions that responded to the survey is "Reduced cost of paying the energy bill for low-income households" (rated very important by 89%), followed by "Reduction of greenhouse gas emissions" (84%), "Reduction of energy consumption and increased energy independence" (74%) and "Decreased air pollution" (63%) (Figure 2.9). Economic or well-being benefits such as "Job creation and economic competitiveness in green industries", "More comfortable and productive working spaces" and "More comfortable homes" are not considered as important, but they are rated at least moderately important by most cities and regions. Other benefits for cities include raising capacity of existing electrical grids and facilitating electrification, since the energy savings can be used to electrify high-efficiency home appliances, air-conditioners and electric vehicles (EV) without further increases in electricity consumption, in particular for peak loads, and upgrades in electricity production capacity (IEA, 2021[26]).

Figure 2.9. Primary benefits of energy efficiency in buildings recognised by cities and regions



Source: OECD Survey on Decarbonising Buildings in Cities and Regions.

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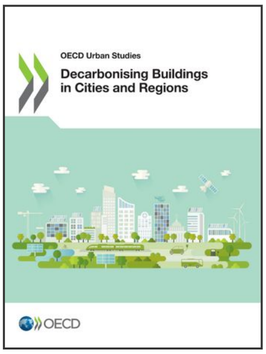

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