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Provision of urban environmental amenities: A policy toolkit for inclusiveness

A policy toolkit for inclusiveness

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By Katherine Farrow (1), Ioannis Tikoudis (1), Grace Alexander (1), Apolline Saliou (1), Lea Stapper (1), Walid Oueslati (1)

(1) OECD Environment Directorate

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Keywords: Environmental amenities, Green gentrification, Open space, Public good provision, Housing affordability

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Katherine Farrow, katherine.farrow@oecd.org
Ioannis Tikoudis, ioannis.tikoudis@oecd.org

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Abstract

Environmental amenities provide a range of direct and indirect benefits in cities, and amenity provision often figures within policy portfolios to advance sustainability in urban areas. As environmental pressures and urban populations increase, it will be necessary to find ways to ensure that environmental policies do not contribute to existing inequalities in these areas. This report synthesises empirical research on the impact of environmental amenities on housing prices, examines implications on housing affordability, and offers perspectives on how negative impacts can be mitigated. The report finds that the provision of environmental amenities tend to raise housing prices, which reduces affordability, especially among renters and low-income households with reduced access to mortgages. The report concludes that there is scope to accompany amenity provision with complementary measures to mitigate distributional impacts and outlines policy avenues in that regard.

Keywords: environmental amenities, green gentrification, open space, public good provision, housing affordability

JEL codes: D63, H41, O18, Q52, R38.

Résumé

Les aménagements environnementaux ont des bienfaits directs et indirects pour les municipalités. Ces aménagements sont souvent inscrits dans les agendas politiques afin de promouvoir le développement durable en milieu urbain. Face à la croissance de la pression environnementale et de la population urbaine, il est nécessaire de s'assurer que les politiques environnementales ne contribuent pas aux inégalités existantes dans les territoires concernés. Ce rapport synthétise les travaux de recherche empiriques sur l'impact des aménagements environnementaux sur le prix du logement et les implications en termes d'accessibilité au logement, et propose des angles de réflexions sur les meilleures façons de réduire les répercussions négatives. Le rapport révèle que la mise en place d'aménagements environnementaux tend à augmenter le prix du logement qui devient donc moins abordable, en particulier pour les locataires et les ménages les moins aisés pour qui l'accès aux prêts immobiliers est plus difficile. Le rapport conclu que l'adoption de mesures complémentaires à ces aménagements sont possibles afin d'améliorer la répartition de leurs impacts et propose des pistes d'actions politiques en ce sens.

Mots clés : aménagements environnementaux, gentrification verte, espaces verts, fourniture de biens publics, logement abordable

Classification JEL : D63, H41, O18, Q52, R38.

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Executive Summary

Environmental amenities such as open spaces provide a range of direct and indirect benefits in cities. As such, amenity provision often figures within policy portfolios to advance sustainability in urban areas. Although their benefits are well-documented, there is growing recognition that the provision of environmental amenities can also be responsible for welfare losses. The most notable of these losses may occur through housing markets in the form of higher house prices and reduced affordability. Certain groups, such as low-income renters with limited access to capital borrowing mechanisms tend to be disproportionately affected by these impacts. As environmental pressures and urban populations increase, it will be necessary to find ways to ensure that environmental policies do not contribute to existing inequalities in urban areas.

This report synthesises the findings from empirical research on the impact of environmental amenities on house prices. It examines the subsequent implications on distributional equity, and offers perspectives on how these impacts can be mitigated. The report finds that environmental amenity provision tends to raise house prices, which can reduce affordability, particularly for low-income renters. In light of these impacts, there is scope to combine amenity provision with measures to shield low-income households from disproportionate reductions in affordability. Tools such as land value capture instruments offer promise insofar as they can finance such measures.

An extensive body of empirical evidence demonstrates a positive correlation between house prices and proximity to a variety of environmental amenities, such as open space (e.g. parks, forests, fields) and water bodies (e.g. wetlands, lakes, ocean). Conversely, proximity to disamenities, such as industrial sites and heavily polluted areas, is empirically correlated with lower house prices. Growing evidence furthermore suggests that providing environmental amenities and mitigating disamenities can generate negative distributional consequences via reductions in housing affordability. Housing price increases exert greater pressure on lower-income households as well as on households that rent, vis-à-vis those owning their primary residence. Accordingly, improved local public good provision may lead these households to relocate to more affordable but less desirable areas.

Mitigating the distributional consequences of environmental amenity provision in urban areas will require measures designed to shield low-income households from resulting housing price increases. Strategies to do so should seek to ensure that existing low-income households can continue to afford living in amenity abundant areas, and that these areas remain affordable to low-income households wishing to move there. To this end, amenity provision can be accompanied by a variety of complementary measures, including housing subsidies and the provision of affordable housing. The choice of specific measures should be informed by contextual factors such as existing land-use regulations, investment policies, legal frameworks, and fiscal and governance structures. Land value capture mechanisms offer one way to finance these measures, however there is little precedent for their use. A fuller consideration of the distributional consequences that can result from amenity-induced changes in affordability and of the methods for addressing these impacts, will contribute to improving the inclusivity of urban environmental policies.

1 Introduction

Environmental amenities generate myriad benefits in urban areas. Naturally occurring environmental amenities such as forests, parks and water bodies confer residents and users direct benefits in the form recreational opportunities, improved local air quality, reduced noise pollution and urban heat island effects (Zhou and Rana, 2012[1]; Hunter et al., 2019[2]; Van Leeuwen, Nijkamp and de Noronha Vaz, 2010[3]). Natural amenities also provide indirect benefits in the form of ecosystem services such as carbon sequestration[1] and biodiversity provision. To the extent that they provide ecosystem services, natural amenities also support critical ecological processes upon which economic activity relies, such as the primary production of biological matter, nutrient cycling, and the hydrological cycle. These ecosystem services constitute inputs to economic production and to household final consumption and directly contribute to well-being (OECD, 2018[4]).

This paper examines the impact of environmental amenities and dis-amenities on house prices and investigates the social desirability of amenity provision from an equity standpoint in light of these impacts. In this paper, urban environmental amenities include open spaces, such as parks, forests and nature reserves, as well as water bodies such as lakes, oceans, rivers and streams. Environmental disamenities include man-made sites and infrastructure such as power plants, landfills and other brownfield sites, proximity to which is generally associated with lower house prices. Environmental impacts stemming from human activity, specifically air, noise and water pollution are also considered disamenities due to their negative impacts on house prices. A comprehensive accounting of the social welfare impacts of environmental amenity provision in urban areas necessitates a consideration of not only their benefits, but also their negative impacts, as well. Some of these impacts are materialised in house prices.

Regarding the benefits of environmental amenities, a large number of nonmarket valuation studies have contributed to a better understanding of the social value of the benefits they confer (Hunter et al., 2019[2]). For instance, McPherson et al. (2017[5]), estimates the ecosystem services value provided by urban forests in California at USD 8.3 billion, with an asset value totalling USD 181 billion. In Finland, Silvennoinen et al. (2017[6]) estimated the ecosystem service value of rainwater runoff management at EUR 90,000 – EUR 270,000 per hectare. In a meta-analysis of contingent valuation studies, Brander and Koetse (2011[7]) find that open spaces, including forests and urban parks are valued at 2313 USD per hectare (2022 USD). Moreover, they find that the marginal value of these benefits decreases as the size of the park increases.

Some of the direct social welfare benefits generated by environmental amenities are reflected in higher house prices and land values. However, the private valuation of environmental amenities is not equal to their social value. Some of the benefits these amenities generate are not captured in the marketplace, as there may be intangible characteristics that are not possible to measure effectively in the presence of omitted variables (OECD, 2018[4]). For this reason, it is difficult to estimate the full range of the effects of environmental amenities on wellbeing such as the impact on health, social relations, the quality of the living environment and security. It is less well-recognised that in some cases environmental amenity provision can also be associated with welfare losses. In areas where environmental amenities are relatively abundant, for example, greater net social welfare benefits may be obtained by favouring urban development instead of preserving additional open space. This can be the case when, for example, open

[1] Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation (especially forests), and geologic formations.

space preservation encourages leapfrog development in periurban areas. Such development leads to fragmented and sprawled urban development patterns that are strongly associated with higher environmental impacts.

Environmental disamenities can lead to welfare losses. As with environmental amenities, some welfare losses generated by disamenities are reflected in the marketplace, e.g. in the form of lower house prices in close proximity to pollution sources. However, other types of welfare losses are not reflected in the marketplace, constituting negative externalities insofar as the value of the damages they cause are not borne by any actors in the marketplace. Higher average levels of outdoor air pollution, for example, has been associated with lower GDP (OECD, 2019[8]), and the market costs of air pollution alone are projected to reach 1% of global GDP by 2060 (OECD, 2016[9]). Von Graevenitz (2018[10]) estimates the social cost of noise pollution to be approximately EUR 700,000 annually for households living near large roads in Metropolitan Copenhagen.

Housing markets constitute a primary mechanism through which environmental amenities and disamenities can generate welfare impacts. Amenity provision can notably result in welfare losses insofar as it has the potential to reduce housing affordability for some groups (OECD, 2021[11]). As demonstrated in this report, a large body of evidence indicates that environmental amenities have well-established impacts on house prices. Amenities and disamenities are furthermore unequally distributed over space and can also impact affordability across socio-demographic characteristics. It follows that environmental policies impacting amenity provision have the capacity to exacerbate existing inequalities insofar as they can reduce access to affordable housing.

As urbanisation intensifies, cities around the world are experiencing increasing pressure on both the provision of environmental amenities and affordable housing (OECD/European Commission, 2020[12]; McCord et al., 2014[13]). Housing costs are the single largest expenditure item for households in the OECD, accounting for an average of 22% of final household consumption expenditure (OECD, 2021[14]). Furthermore, incomes have not been keeping pace with rising house prices, and the share of household expenditure as a percent of household budget has consequently increased by 5% between 2005 and 2015 in OECD countries (OECD, 2021[14]). At the same time, there is an increasing demand for open spaces (De Ridder et al., 2004[15]; McCord et al., 2014[13]). The distributional impacts of environmental policies that operate via house prices warrant specific attention by policymakers given the potential for trade-offs between policy objectives that target each of these issues in urban areas.

To the extent that inclusivity is also a priority for development in urban areas, environmental policies should be selected not only on the basis of their net social benefits, but the way in which these benefits are distributed. This entails a consideration of how both the benefits and costs associated with environmental amenity provision accrue across different groups and over space. Identifying efficient policies that are able to address the objectives of both environmental policy as well as housing affordability requires a more careful consideration of the distributional impacts of amenity provision than they have previously been afforded.

The remainder of the report is structured as follows. Section 2 reviews the existing evidence regarding the magnitude of the effect of environmental amenities and disamenities on house prices, indicating a strong justification for examining the affordability impacts of amenity provision. Section 3 explores the mechanisms through which environmental amenities and disamenities can impact housing affordability. Section 4 explores approaches for how environmental policies can better incorporate related inclusivity considerations in urban areas.

2 The impact of environmental amenities on house prices

2.1. Methodology

The study reviews the existing scientific literature to collect and distil insights from studies on the effects of environmental amenity provision on house prices. In a first step, key search terms were used to identify relevant literature.[2] Articles were retained for analysis if they addressed the environmental amenities considered in this report and they relied on hedonic pricing (revealed preference) methodology. Studies examining transport-related amenities, for example, were excluded. Results were then grouped according to the amenity or disamenity investigated (i.e. open space, waterbodies, infrastructure and pollution).

Within amenity groups, impacts on house prices are often measured in different ways. The literature on open space, for example, evaluates the impact of views of, distance to, as well as the size of open spaces on house prices. Distance metrics also vary, and span from the density of parks within a certain buffer zone, the linear distance from a park and the percentage increase in distance from a park. In order to better compare the results obtained across studies, reported results are harmonised where possible to marginal effects in terms of percentage change in housing price. For studies assessing the impact of distance to open space, for example, monetary values were converted to percentages where possible by using the percentage change associated with the amenity change and average house price in the study sample (see Table 2.1). Nevertheless, direct comparisons are not possible for some studies, the results of which are generally excluded from the figures presented in this paper.

2.2. Natural amenity effects on house prices

2.2.1. Open spaces

Open spaces, such as parks, urban forests and natural reserves, offer many advantages for residents and users. They provide health and social benefits, as well as environmental benefits that indirectly support society (Groenewegen et al., 2006[16]; Tzoulas et al., 2007[17]; Saphores and Li, 2012[18]). Open spaces can also promote social cohesion and improve the quality of life in urban areas, as they provide aesthetic value and function as hubs for recreational activities. Additionally, the presence of open spaces helps to reduce negative externalities such as noise and air pollution and to mitigate heat island effects in urban areas (Saphores and Li, 2012[18]; Kovacs, 2012[19]; McCord et al., 2014[13]). Willingness to pay for open space in residential transactions depends on whether the area is visible, its distance and accessibility from the residence, and the size of the area in question.

[2] Key word searches included: 'hedonic pricing', 'land use', 'construction', 'externalities', 'densification', 'urban sprawl', 'income', 'green spaces', 'housing prices', 'affordability', 'policies', 'environment', 'accessibility', 'hedonic', 'airport', 'view', 'pollution', 'amenities/disamenities', 'landscape', 'urban forests' 'hedonic price and amenities' 'eco-gentrification', 'Urban heat islands', 'ecosystem services', 'open space'. Searches based on these key words or a combination of them, gave results of a large range of literature on the topic (362 articles). More than 300 articles were located from searches of key words and the work of relevant authors; another approximately 50 articles were identified from literature reviews and meta-analyses. The remaining articles were found from database searches such as Google Scholar. The search took place between November 2020 and September 2021.

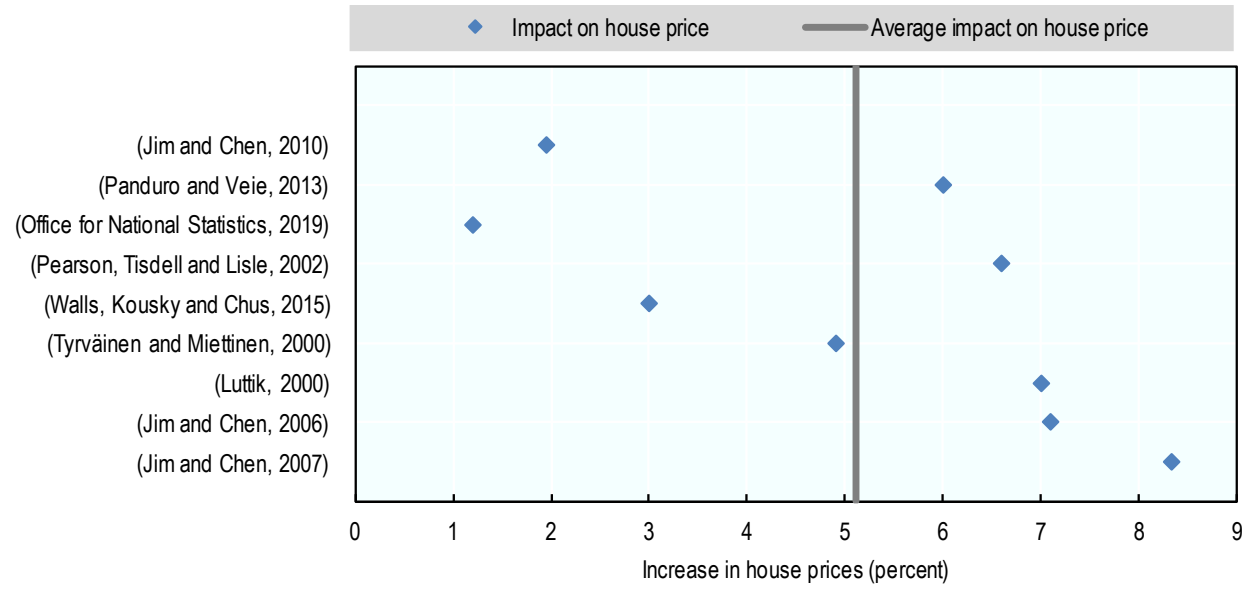
A large literature has examined the impact of proximity to open spaces, the presence of views of open spaces and the size of nearby open space on house prices. The empirical evidence across these indicators suggests that open spaces are correlated with higher house prices (Crompton, 2005[20]; Waltert and Schläpfer, 2010[21]; Crompton and Nicholls, 2019[22]; Crompton and Nicholls, 2020[23]). Studies discussing the impacts of open space on house prices primarily examine samples in the United States and Europe, with a number of studies addressing locations in China and elsewhere in Asia. Across all studies, parks generally have a positive effect on house prices, while the effects of forests and greenbelts were found to have a mixed effect.

View

Views of open space have a positive effect on house prices. Much of the literature covering the impact of views of open spaces on house prices address the impact of parks, typically in the form of maintained green spaces in urban areas. The positive impact of park views on house prices range from 1.2% to 35.3%, with the majority of results indicating a differential impact that lies between 4% and 8%.[3] In Shenzhen, China, a view of a park increases house prices by 4.67%, while each kilometre closer to a park is found to be associated with a 1.7% decrease in house prices (Chen and Jim, 2010[24]). In the Netherlands, a view of and increasing proximity to green spaces were found to increase house prices by 4% to 12%, respectively (Luttik, 2000[25]). Similarly, Jim and Chen (2006[26]), found that views of green spaces increased house prices by 7% in Guangzhou, China, and an analysis of five studies on neighbourhood park views in various regions in China found that views of a park increased house values by an average of 5.6% (Crompton and Nicholls, 2019[22]).

[3] Reported effects are based on point estimates which should be interpreted with caution. Any proportional scaling of effects of nominal shocks in amenity provision on percentage changes in prices may obscure possible non-linear effects.

Figure 2.1. 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[27]), which is an outlier, reporting an estimate of 35.5%. The high magnitude of this estimate could be due to the fact that the amenity in question was the New York High Line, which as a tourist attraction is arguably more than an environmental amenity, and is located in an area that undergoes a particularly high amount of real estate development.
Source: (Jim and Chen, 2007[28]; Jim and Chen, 2006[26]; Luttik, 2000[25]; Tyrväinen and Miettinen, 2000[29]; Walls, Kousky and Chus, 2015[30]; Pearson, Tisdell and Lisle, 2002[31]; Office for National Statistics, 2019[32]; Panduro and Veie, 2013[33]; Jim and Chen, 2010[34]; Black and Richards, 2020[27]).

Distance

Proximity to open spaces has generally been shown to have a positive impact on house prices (See Table 2.1). The underlying elasticity reported in most studies is low, i.e. smaller than -0.2, but some studies find that distance from open space amenities may have a profound effect on property value. The literature found that the existence of a park within 400 metres increases house prices by between 1.4% and 12% (Luttik, 2000[25]; Noor, Asmawi and Abdullah, 2015[35]; Panduro and Veie, 2013[33]). Chen and Jim (2010[24]) found that a 1 km increase in distance from a park was associated with 1.7% lower house prices in Shenzhen, China, but that a view of a park had a greater positive impact of 4.67%. Noh (2019[36]), found that for houses in the City of Whittier, California one mile of increased proximity to a nature reserve was associated with 15.79% to 17.09% higher house prices. Black and Richards (2020[27]) estimated an even greater impact in New York City, where houses within 80 metres of the New York High Line were associated with 35.3% higher house prices than others, partly due to the added view. Troy and Grove (2008[37]) found in Baltimore, the United States, that prices of houses located 1 km from a park were 5% lower than those adjacent to the park, but the positive impact of the park is reduced with the higher the crime score of the park.

Table 2.1. The effect of distance to open spaces on house prices

Type of Measure	Unit of Measure	Type of Open Space	Impact on House Price	Paper	Location
Buffer distance	*Within 800m*	Park	+16.88%	(Jim and Chen, 2010[34])	Hong Kong
	Within 400m	Park	+3-12%	(Noor, Asmawi and Abdullah, 2015[35])	Subang Jaya, Malaysia
	Within 457m	Park	+6.5% to +8.5% than those outside	(Espey and Owusu-Edusei, 2001[38])	Greenville, South Carolina, United States
		Open space	+1.43%	(Bolitzer and Netusil, 2000[39])	Portland, Oregon, United States
		Park	+1.8%	(Lutzenhiser and Netusil, 2001[40])	Portland, Oregon, United States
	Within 804m	Park	+6-9%	(Kovacs, 2012[19])	Portland, Oregon, United States
Distance	*1km increase*	Park	-1.7% to 5 %	(Chen and Jim, 2010[24]); (Troy and Grove, 2008[37])	Shenzhen, China; Baltimore, United States
		National parks Nature reserve National trust land	-0.24% for national parks -0.07% for nature reserves -0.70 % for National Trust land	(Gibbons, Mourato and Resende, 2013[41])	England
		Forest	-1.61%	(Jedlička and Vojáček, 2009[42])	Prague, Czech Republic
	100m increase	Green area (Urban parks and public gardens)	-1%	(Morancho, 2003[43])	Castellon, Spain
		Park	-2.45%	(Park et al., 2017[44])	Seoul, Korea
	100m decrease	Wildlife Refuge	+0.3%	(Neumann, Boyle and Bell, 2009[45])	Middlesex County, Massachusetts, United States
		Park	+2.7% in house price 100m from park compared to only 0.5%, 600m from park	(Panduro and Veie, 2013[33])	Aalborg, Denmark
		Tree cover	+0.04%	(Sander and Haight, 2012[46])	Dakota County, Minnesota, United States
		Park	+1%	(Engström and Gren, 2017[47])	Malmö, Sweden
		Open space	+0.15%*	(Nilsson, 2014[48])	Jonköping, Sweden
	10m decrease	Open space	+0.1%	(Brander and Koetse, 2011[7])	Worldwide
	1m increase	Protected areas and	-0.04%*for protected areas	(Melichar and Kaprová,	Prague, Czech Republic

		urban forests	-0.03%* for urban forests	2013[49])	
	1.6km decrease	Nature preserve	+17.06% and +15.79%	(Noh, 2019[36])	City of Whittier, California, United States
	305m decrease	Green space	+0.13%*	(Cho, Bowker and Park, 2006[50])	Tennessee, United States
	152m increase	Forest	+12.5%	(White and Leefers, 2007[51])	Michigan, United States
	304m increase	Forest	-1.82%*	(Kim and Johnson, 2002[52])	Oregon, United States
		Greenbelt	-8.5%*	(Correll, Lillydahl and Singell, 1978[53])	Colorado, United States
Percentage change (%) in distance to amenity	*1% decrease*	Park	+0.016% to +0.054%	(Poudyal, Hodges and Merrett, 2009[54]); (Xiao, Hui and Wen, 2019[55]); (Xiao, Hui and Wen, 2020[56])	Roanoke, Virginia, United States; Hangzhou, China; Hangzhou, China
		National Forest	+6.4%	(Ham et al., 2012[57])	Colorado, United States
		Forest	+5%	(Kong, Yin and Nakagoshi, 2007[58])	Jinan, China
	10% increase	Protected area	-0.35 to -1.8%	(Martínez-Jiménez, Pérez-Campuzano and Ibarra, 2017[59])	Mexico City, Mexico
	1% increase	Forest	-0.028% (price per square meter)	(Liu et al., 2020[60])	Wuhan, China
		Forest Park	-3% for forest (price per square meter) -1.5% for park (price per square meter)	(Czembrowski and Kronenberg, 2016[61])	Lodz, Poland
		Green space	-0.41% (price per square meter)	(Wu, Dong and Zhang, 2017[62])	Beijing, China
	1% increase	Forest	+0.01 if the forest is protected, +0.35% if the forest is not protected (price per acre)	(Sharma, 2013[63])	Colorado, United States

Note: * = percentage deviation calculated by re-expressing marginal effects as fractions of the mean house price or land value reported in the sample;

Size of open space

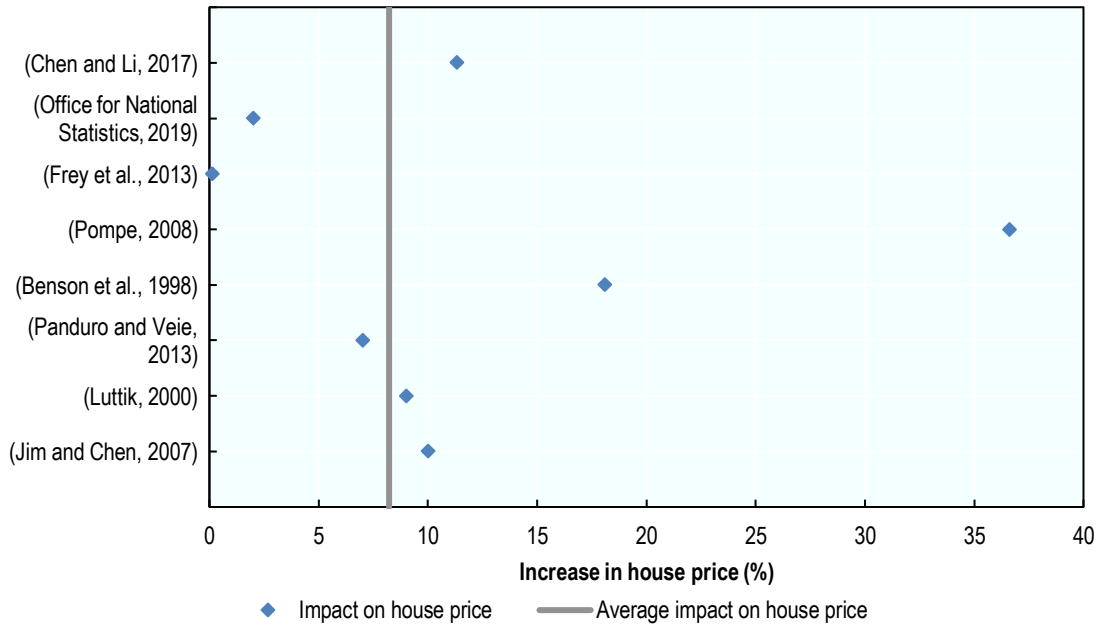
Evidence suggests that larger open spaces increase house prices. A 1% increase in the size of an open space area was found to increase nearby house prices between 0.01% and 1.04% (Panduro and Veie, 2013[33]; Gibbons, Mourato and Resende, 2013[41]). However, the elasticity of house price with respect to nearby open space size ranges between 0.013% and 0.07%. The effect of open space size on house prices also depends on the type of open space considered. Liu et al. (2020[60]), found that a 1% increase in forest area results in an increase in the house price of 0.054% per square meter, whereas the impact of an increase in grassland area results in a negligible 0.001% increase in the house price per square meter in Wuhan, China. Irwin (2002[64]) found that converting one acre of pastureland to forest is associated with a 0.82% decrease in house prices in Maryland, United States. Kolbe and Wüstemann (2014[65]) observe a decrease in house price of 1.46% for each percentage point increase of fallow land and 0.18% for farm land in Cologne, Germany.

2.2.2. Water bodies

Both proximity to and views of water bodies such as lakes, rivers, streams and oceans have been found to have a positive effect on house prices. A 1% increase in the distance to water bodies is reported to decrease house prices by 0.01-0.02% (Gibbons, Mourato and Resende, 2013[41]; Kolbe and Wüstemann, 2014[65]). This finding is supported by those from a study on two coastal cities in Alabama, United States, in which a 1% increase in the distance to water bodies was found to decrease house prices by 0.03-0.04% (Dahal et al., 2019[66]). Furthermore, a 1% increase in proximity to wetlands was found to increase house prices by 0.04% in Portland Oregon (Mahan, Polasky and Adams, 2000[67]). However, several papers found that proximity to water bodies, such as rivers and streams, had no clear effect on house prices (Cohen, Cromley and Banach, 2015[68]; Van Der Kruk, 2001[69]; Mei, Sohngen and Babb, 2018[70]; Sylla, Lasota and Szewrański, 2019[71])

Regarding the impact of views, the literature found housing price increases of between 0.14% and 36.6% with an interquartile range between 5.75% and 14.2% (see Figure 2.2). The type of waterbody can influence the magnitude of this impact. For example, a view of a lagoon was found to have a relatively small impact of +0.14% in a study in Southern California (Frey et al., 2013[72]), whereas a lake view has been found to incur a premium of between 7% and 18% in Aalborg, Denmark and Washington, United States respectively (Benson et al., 1998[73]; Panduro and Veie, 2013[33]).

Figure 2.2. Observed effect of water body view on house prices



Note: Average impact line is calculated as the average of the results excluding (Pompe, 2008), which is an outlier due to a particular sample of houses with above average prices.
Source: (Frey et al., 2013[72]; Office for National Statistics, 2019[32]; Chen and Li, 2017[74]; Jim and Chen, 2007[28]; Luttik, 2000[25]; Panduro and Veie, 2013[33]; Benson et al., 1998[73]; Pompe, 2008[75]).

An increase in the area of waterbodies also results in a housing premium. Increasing the size of a water body by 1% was found to increase the house price by 0.16% to 0.6% in Cologne, Germany and Kolkata, India, respectively (Kolbe and Wüstemann, 2014[65]; Bera et al., 2018[76]). Zhang and Dong (2018[77]) found that a 1% increase in nearby lake size is associated with a 0.04% increase in house prices in Beijing, China. Fernandez (2020[78]) found that an increase in wetland size by 100 m^2 resulted in a 0.07% decrease in the prices of houses lying closer than 300 metres from the wetlands in Auckland, New Zealand. However, houses lying between 300m to 600m from the wetlands saw a 0.12% rise in price with increased wetland size. This suggests that wetlands can be seen as both disamenities and amenities, depending on other contextual factors, such as relatively closer proximity to a water body.

2.3. Man-made amenities and disamenities

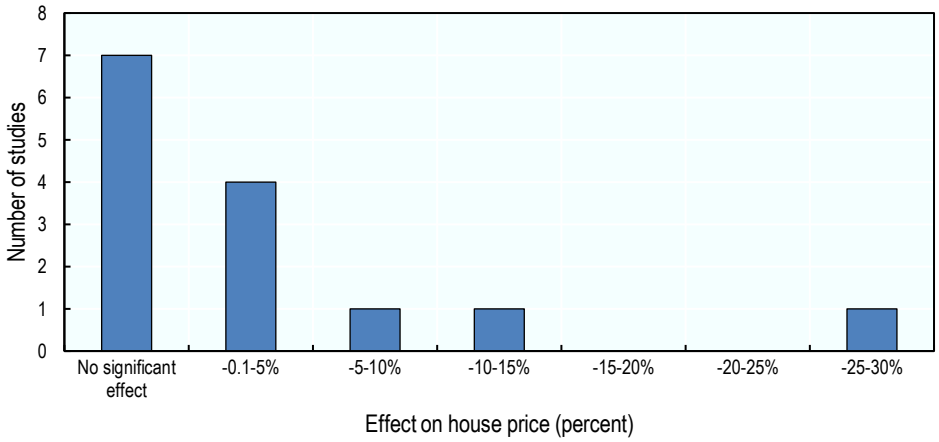
2.3.1. Industrial infrastructure

Solar and wind farms

The literature suggests that wind farms have a varied effect on house prices. This includes insignificant impacts and negative impacts that span a wide range of values. The price effect resulting from the presence of a wind farm ranges from -25.6%, when that lies within 1 km from the corresponding residential location, and -0.2%, when that distance increases to 3 km. Dröes and Koster (2021[79]) find that the impacts differ with the size of the turbines in the Netherlands. They estimate that turbines taller than 150 metres decrease house prices within 2 km by 5.4%, while wind turbines under 50 metres generate a much smaller effect (-2%) within 2 km and no significant effect beyond this distance. As detailed in a later section, noise

pollution has also been shown to reduce house prices. As a result, the negative impact of proximity to wind farms could in part be capturing this effect.

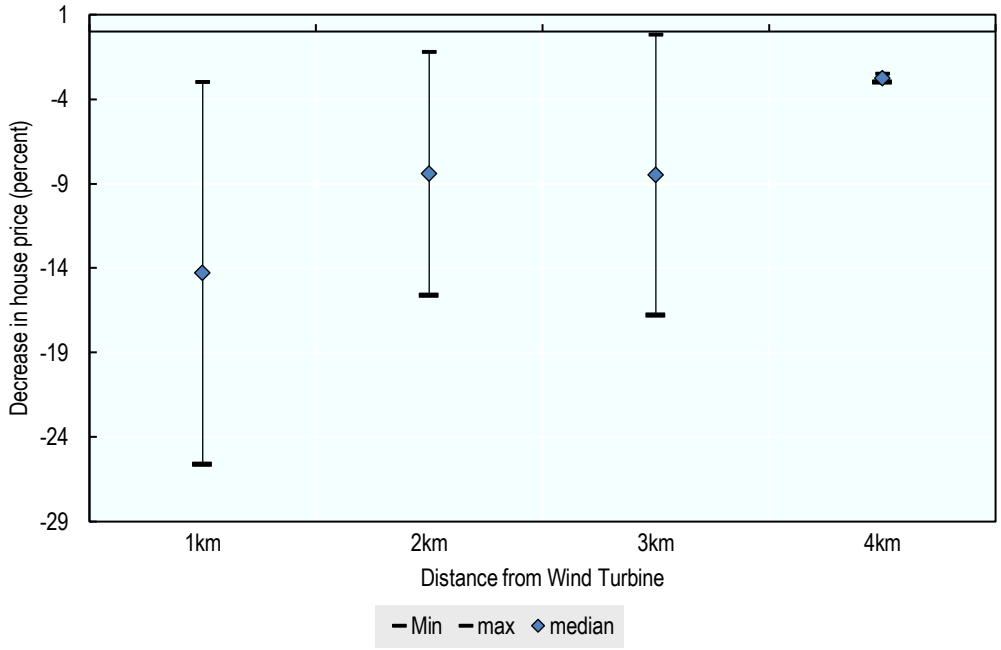
Figure 2.3. Effect of wind turbines on house prices



Note: The studies that found no significant effect on windfarms were based on measurements of houses within 8 km, 3 km, 16 km, 8 km, 800m of a wind farm, and the announcement for the construction of a wind farm.
Source: (Dröes and Koster, 2016[80]; Jarvis, 2021[81]; Gibbons, 2015[82]; Dröes and Koster, 2021[79]; Heintzelman and Tuttle, 2012[83]; Sunak and Madlener, 2017[84]; Hoen et al., 2014[85]; Hoen et al., 2009[86]; Jensen et al., 2018[87]; Hoen, 2006[88]) (Sims, Dent and Oskrochi, 2010[89]; Canning et al., 2010[90]; Laposa and Mueller, 2010[91]; Sterzinger, Beck and Kostiuk, 2003[92]).

On the other hand, several papers found no significant effects of wind turbines on house prices. That includes two studies employing large samples (24,000 and 50,000) (Sterzinger, Beck and Kostiuk, 2003[92]; Hoen et al., 2014[85]). However, Heintzelman and Tuttle (2012[83]) suggest that much of the relevant literature on this topic is characterised by limited small sample sizes or lack of continuous measures of proximity, which may fail to accurately capture some of the impacts of wind farms on house prices.

Figure 2.4. Effect of closer proximity to wind turbines on house prices



Note: This figure does not include observations of no significant impacts (See Figure 2.3)
Source: (Jensen et al., 2018[87]; Sunak and Madlener, 2017[84]; Gibbons, 2015[82]; Heintzelman and Tuttle, 2012[83]; Dröes and Koster, 2021[79]; Jarvis, 2021[81]).

Conventional power plants

Conventional power plants have been shown to negatively impact house prices with reported impacts ranging from -3% and -25%. The magnitude of this impact subsides with distance from the site of the plant. Davis (2011[93]), found a 25% decrease in the prices of houses that were adjacent to oil and gas power plants in the United States. This effect fades out with distance, i.e. the estimated decrease is 10% at 1-2 km and statistically insignificant at 3 km. Davis et al. (2008[94]) detect a decrease in prices of housing properties closer to fossil fuel power plants.[4] The decrease is between 3% and 7% for cases in which the property lies within 3.2 km from the power plant. Activities relating to conventional power plants can also affect house prices. In Colorado, United States, each well drilled for gas and oil within 800 metres of a house was found to be associated with a 1% decrease in house prices (Bennett and Loomis, 2015[95]).

Nuclear power pants

Nuclear power plants have mixed effects on house prices. Some studies report positive impacts on house prices with closer proximity to nuclear power stations, while others report no significant or a negative impact. In California, United States, Clark et al. (1997[96]) observe a premium for living in closer proximity to a nuclear power plant, which Brinkley and Leach (2019[97]), suggest may be related to the general positive impact job location proximity has on house prices. Bezdek and Wendling (2006[98]) offer a

[4] Coal-fired power plants are associated with greater disamenity value than natural gas plants as they involve increased road traffic and air pollution. However, the authors find that marginal willingness-to-pay estimates for coal and natural gas plants are not significantly different from each other. The authors of the study indicate that it is difficult to draw conclusions based on these results due to the high standard errors of the estimates for coal plants due to a relatively small sample size.

discussion of the increased premiums closer to nuclear facilities and their effects on schools and local development.

A number of articles have also found no significant or a negative impact of nuclear power plants on house prices. Gamble and Downing (1982[99]) and Metz and Clark (1997[100]) observe no significant effect on housing prices based on their proximity to nuclear power plants. However, Folland and Hough (1991[101]) note that unlike Gamble and Downing (1982[99]), Metz and Clark (1997[100]) took into account land values and observed a 6% decrease in value of agricultural land in close proximity to nuclear power plants. Meanwhile, Dickes, Wyman and Springs (2013[102]) found a 2.2% decrease in house prices per km closer to a nuclear power plant within a 16 km radius.

In general, the literature finds no statistically significant effects of proximity to nuclear power generation facilities on house prices. Nelson (1981[103]), found no significant impact on house prices after the Three Mile Island accident in the United States 1979 within 8 km of the plant, when comparing house prices before and after the incident. Gamble and Downing (1982[99]) observe a similar result, finding that there was no significant effect on house prices within a 40 km radius of four nuclear power plants in the North-eastern region of the United States following the Three Mile Island accident when observing house prices before and after the incident. However, it should be noted that both these studies employ limited spatial coverage relatively to an effect that is highly likely to subside in surrounding distance radius of house prices surrounding nuclear facilities. A larger radius may show further impacts of the incident on house prices, however this was not investigated. Two articles examine whether the effect of the Fukushima nuclear disaster could impact the perception of residential areas in close proximity to nuclear power stations facilities in Sweden and in Switzerland. The Swedish study concluded that the incident in Japan had no observed effect on house prices in Sweden and hence no preference against nuclear facilities as reflected in house prices (Ando, Dahlberg and Engström, 2017[104]). However, in Switzerland there was a decrease of 2.3% in house prices located close to nuclear facilities after the Fukushima incident (Boes, Nüesch and Wüthrich, 2015[105]). The lack of significant effects could reflect the low probability of accidents involving nuclear facilities. It could also be due to inadequate spatial coverage of estimated impacts if sampled households all fall within distances at which they would be uniformly impacted if such an accident were to occur.

Factories, brownfields

Other industrial infrastructure, such as factories, brownfields and landfills, have varied but generally negative impacts on house prices. The effect of remediation and the clean-up of brownfield sites, where hazardous pollutants may have been disposed, could increase house prices. Kaufman and Cloutier (2006[106]) note a lift of 1.7 – 6.2% in residential property values with the remediation of brownfields, which may further increase to 3.4 – 10% with the addition of green space in Wisconsin, United States. However, the general effect of brownfield regeneration can be much bigger. The national-wide study by Haninger, Ma and Timmins (2017[107]) reports a 5% to 11.5% house price increase in response to the clean-up of nearby brownfields. In extreme cases, where brownfields have possibly caused a major devaluation of property prices in the first place, the price lift effect could be remarkable. Woo and Lee (2016[108]) find that after remediation and the subsequent use a former brownfield for recreational purposes, house prices around it increased by 32.8% to 75.9%. The variance of the estimated effects also indicates that the type of industrial activity taking place on brownfield sites influences the magnitude of their impact on house prices. In the UK, a brownfield site with a waste incinerator found to decrease house prices by 0.4% to 1.3% (Rivas Casado et al., 2017[109]). Grislain-Letrémy and Katossky (2014[110]) found that the effect of industrial plants on house prices differed across three cities in France. Households in two of the cities in the sample displayed a considerable difference in their willingness to pay in order to relocate away from an industrial plant. That difference was attributed to the presence of green space in the proximity of the industrial plants, which neutralized the original negative impact of the latter.

Landfills have a significant negative influence on house prices. In a number of studies, greater distance from landfill sites has been associated with significant house price increases. In Cape Town, increasing the distance to landfills increased house prices by 2-12% per km (Rivas Casado et al., 2017[109]). Du Preez and Lottering (2009[111]) also found a 2 km increase in distance to a landfill site increased house prices by 8.73% in South Africa, and Hite et al. (2001[112]), found that moving 3.2 to 5.2 km away from a landfill, increases house prices by 17.84-19.90% in Ohio, United States.

2.3.2. Pollution

Air pollution

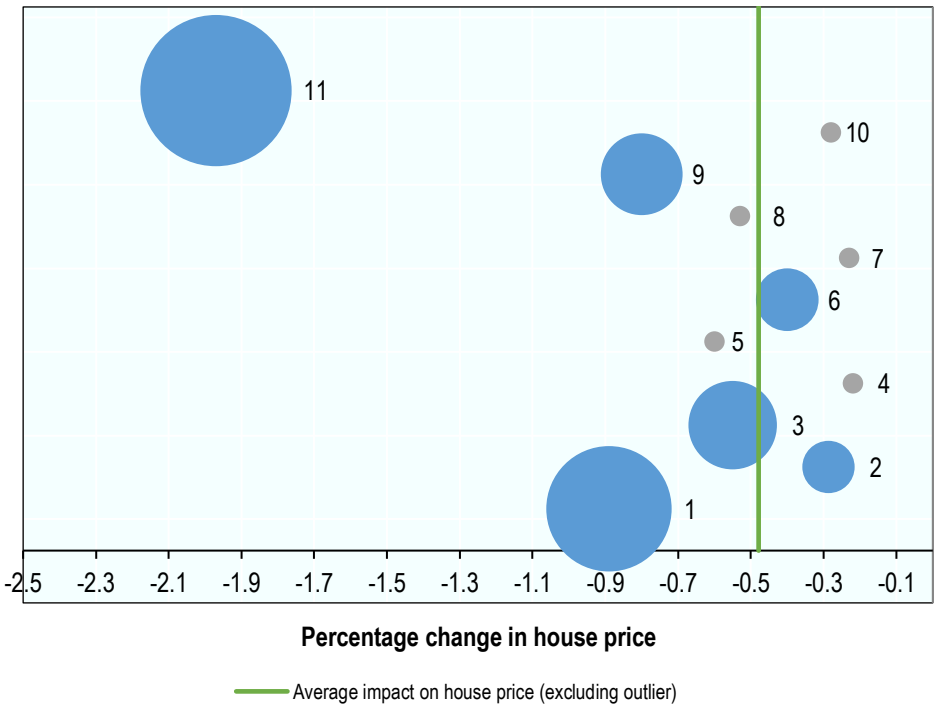
Although some studies have found no evidence of a significant association between house prices and air pollution levels, a number of studies have found negative impacts of up to 3.18% depending on the pollutant. A reduction in the concentration of particulate matter (PM_{10}) by one $\mu g/m^3$ was found to increase house prices by 0.2% to 0.4% in the United States (Chay and Greenstone, 2005[113]). Another study conducted in Lebanon reports a much larger effect of 2.88-3.18% (Marrouch and Sayour, 2021[114]). Evidence from the United States suggests an elasticity of -0.076 to -0.084 for PM_{10} pollution (Bajari et al., 2012[115]).

Transboundary air pollution reductions can also increase house prices. In two studies on the impacts of a reduction in transboundary air pollution in China, a 10% reduction in transboundary air pollution was associated with 0.76% to 1.8% higher house prices (Zheng, Cao and Kahn, 2011[116]; Zheng et al., 2014[117]). In France and Poland, air pollution was found to have no impact on house prices (Le Boennec and Salladarré, 2017[118]; Ligus and Peternek, 2016[119]; Brécard, Le Boennec and Salladarré, 2018[120]). One study has found a positive correlation between PM_{10} levels and house prices. The authors hypothesise that the positive effect could due to activities relating to air pollution i.e. growth of the business sector (Bajari et al., 2012[115]). Overall, the literature finds that higher levels of air pollution are associated with lower house prices.

Noise pollution

Noise pollution negatively affects house prices. According to the literature reviewed, a 1 decibel (dB) increase in noise pollution reduces house prices by 0.08 - 2.22%, with the majority of articles finding a range between 0.24% and 0.92%, as seen in Figure 2.5. With an average street noise level of 50 dB, this finding implies a property value elasticity that lies between -0.1 and -0.5 (King et al., 2012[121]). The elasticity decreases as reference noise levels fall. For instance, Tian, Wei and Li (2017[122]), as well as Le Boennec and Salladarré (2017[118]) report elasticities at the range from -0.03 to -0.04 for Utah, United States and Nantes, France. Similarly, homes located in areas with loud noise (above 65 dB) are found to sell for 12% less in the Netherlands (Theebe, 2004[123]). In Atlanta, areas with 70-75 dB background noise levels are characterised by house prices that are 20.8% less than those in areas under 65 dB (Cohen and Coughlin, 2008[124]).

Figure 2.5. Effect of a 1dB increase in noise level on house prices



Note: The size of the blue circles represents the standard deviation of the impact reported in the corresponding article. Articles represented by gray circles did not report standard deviation.
Source: (1) Gamble and Sauerlender (1974[125]), (2) Palmquist (1980[126]), (3) Bateman et al. (2001[127]), (4) Baranzini, Schaerer and Thalmann (2010[128]), (5) Wilhelmsson (2000[129]), (6) Nelson (1982[130]), (7) Brandt and Meannig (2011[131]), Chang and Kim (2013[132]), (9) Andersson, Johnsson and Ogren (2010[133]), (10) Brecard, Le Boennec and Salladarre (2018[120]), (11) Zambrano-Monserrate and Ruano (2019[134]).

Water pollution

Poor water quality is also associated with lower house prices. Houses in areas with poor water quality were found to be sold for almost 3 times less than those located in areas with better quality in Vermont, United States (Young, 1984[135]). Similarly, Gibbs et al. (2002[136]) also found a decrease in house prices of 0.9% to 6% for a decrease in lake water clarity due to pollution in New Hampshire. Feather, Pettit and Ventikos (1992[137]) found that a one unit increase in the level of eutrophication – a measure of water quality based on algae biomass – of a lake decreases single family residential property prices by 2.3 percent. Poor, Pessagno and Paul (2007[138]) found that a one mg/L change in total suspended solids and dissolved inorganic nitrogen decrease house prices by 0.6% and 9.6%, respectively.

Distributional issues can also be observed regarding the negative impacts of water quality. People downstream from the source of the pollution, for example in the case of a factory, may not have the same economic benefits as those nearer the source. Cho, Roberts and Kim (2011[139]) find differentiated implications of bad water quality in two areas in the United States, where one area enjoys the economic benefits of proximity to a paper mill, while the other does not.

2.4. Moderating Factors

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 utility that residents of an area can derive from them may both increase local house prices. Regarding environmental disamenities, for example, evidence indicates that information on flood risk and awareness of the disamenity effects of a local river can influence house prices (Chen, Li and Hua, 2019[140]; OECD, 2018[4]). Awareness correlates with population density, especially in the case of disamenities (Chen, Li and Hua, 2019[140]).

Overall, the net effect that population density has on the benefits associated with urban environmental amenities, such as parks, appears to be positive. For example, higher density can foster information transfer regarding the presence of amenities, which can enhance their impact on house prices, as noted above. There can also be ways in which such amenities (e.g. dog parks) provide more utility to users when there are more users. Additionally, it can be assumed that greater population density corresponds with more frequent real estate transactions, which can offer more opportunities to observe the effect of amenities on house prices. The ease with which a given amenity can be accessed can also moderate the impact of an amenity on house prices. In support of these hypotheses, a meta-analysis of contingent valuation and hedonic pricing literature on house prices and open spaces found that a 10% increase in population density was associated with a 5% increase in willingness-to-pay per additional hectare of open space (Brander and Koetse, 2011[7]). On the other hand, density could conceivably reduce the benefits of environmental amenities if crowding contributes to lower user enjoyment (Neuts, Nijkamp and Leeuwen, 2012[141]).

As seen above, the type of environmental amenity considered also influences the degree to which the amenity impacts house prices. The provision of some amenities or disamenities is binary, e.g. the presence of a park view. Others, however, are continuous in nature, e.g. air quality as defined by the concentration of air pollutants like PM_{10}. Open spaces and waterbody view are mainly reported in binary measures, while distance and size are mainly reported in marginal measures. An exception regards some measurements of the distance from an open space reported in a binary change, i.e. in terms of buffer zones. Many of the studies that cover disamenities, such as industrial infrastructure and pollution, express the amenity change in marginal values, such as distance to a brownfield site or an incremental change in pollution reduction (e.g. 1µg/m^3 decrease), respectively. As is reflected in the literature reviewed in this paper, step-wise changes in amenity provision are generally associated with greater impacts on house prices. The presence of rent controls would also dampen the upward pressure exerted by environmental amenity provision on house prices.

2.5. Welfare considerations

This paper considers welfare gains from amenity provision incorporated into property prices, as well as welfare losses rising house prices cause to specific population cohorts. The study is built on the premise that willingness-to-pay for an amenity is only a partial measure of the total well-being effects that amenity generates to society. The presence of external effects in the use of environmental amenities cause their valuation estimates in the aforementioned studies to deviate from the social value they may have. For example, improved long term health outcomes resulting from better air quality could be a benefit of urban forest creation that is not reflected in house price changes associated with its provision.[5] Similarly, altered traffic patterns could result in increased congestion and noise pollution in certain areas, generating

[5] The presence of positive externalities associated with environmental amenity provision does not necessarily reduce the distributional impacts of rising house prices, as the benefits associated with these positive externalities accrue equally to all nearby residents irrespective of income.

negative welfare impacts for some that may not be reflected in house price changes. As long as externalities exist, the prices that materialise in housing markets can be considered to deviate from the true social value of housing. Any changes in house prices associated with a change in environmental amenity provision can therefore be thought of as only a partial reflection of the full spectrum of potential welfare changes implied.

Open space provides a characteristic example on why willingness-to-pay for an amenity may be an incomplete measure of its societal value. When provided in areas where it is highly needed, for instance central areas with high air pollutant concentrations, open space may reduce other external effects. These include air pollution and noise. From this viewpoint, the individual willingness-to-pay for open space falls short of the welfare it actually generates. In contrast, when open space deteriorates existing external effects the valuations reported in literature could overstate its actual welfare contribution. An example of such provision is urban growth boundaries, which increase open space supply to suburbs but may cause leapfrog development (OECD, 2018[142]). Scattering development results in larger amounts of urban fabric hosting economically viable levels of population density (Tikoudis et al., 2022[143]).[6] Most importantly, it may increase car dependency, the cost of public transport provision (OECD, 2018[144]) and results in more traffic externalities on the road (OECD, 2020[145]). In this case, valuation studies tend to overstate the social value of open space, which lies lower than the reported individual valuations.

Behavioural biases and incomplete information may also cause willingness-to-pay to be an incomplete welfare measure. Home buyers often have imperfect knowledge regarding purchased properties. Although this assumption has limited application in housing markets, where renters and buyers are often well informed about amenity provision, deviations from perfect information are common. Information asymmetries and various perceptive biases (e.g. social contagion, loss aversion, representativeness heuristics) can contribute to inaccurate individual valuation of environmental amenities (Salzman and Zwinkels, 2017[146]). Such inaccurate valuations are eventually reflected in house prices.

Most importantly, even in the absence of the above limitations, willingnesses to pay would still constitute an incomplete measure of societal welfare. The reported amenity valuations would be informative on how much an amenity could contribute to total welfare, but not about the distributional impacts of that provision. Capital gains would in this case be the central driver of redistribution. For instance, using public budgets to provide amenities that are valued very differently by renters and buyers could cause asymmetric welfare gains, or even welfare losses for the former group.[7] These asymmetries could be exacerbated in cases where access to mortgages is limited for low-income renters. The next section examines the joint role of home ownership, housing affordability, capital borrowing mechanisms and the public provision of local environmental amenities.

[6] The reader is referred to the OECD (2018[186]) and (2018[187]) an intertemporal measurement (1990, 2000, 2014) of various sprawl indicators across 29 countries.

[7] The assumption of diminishing marginal utility of income implies that the utility value of a unit change in a poor individual's income is greater than the utility value of the same unit change in income of a rich person. Other things being equal, this implies that a dollar or euro of benefit received by the latter receive less weight by the same change for the former reflecting this difference in its relative contribution to social welfare (OECD 2018).

3 The impact of environmental amenities on housing affordability

Environmental policy objectives generally seek to maximise social welfare by reconciling private and social costs and benefits. Section 2 provides considerable evidence that environmental amenity provision contributes to higher house prices across different contexts. As such, it may generate a trade-off between environmental policy objectives that prioritise amenity provision and the social policy objective of maintaining affordable housing. This section reviews the mechanisms and conditions through which such a trade-off occurs.

In general, housing affordability refers to the share of housing expenses in total expenditure. A variety of metrics exist, including price-to-income and rent-to-income ratios, expenditure-to-income ratios, residual income measures, housing quality measures and subjective indicators (OECD, 2021[14]). Table 3.1 provides an overview of different types of indicators. The expenditure-to-income ratio is defined as actual spending on housing as a proportion of gross income and is typically viewed as a straightforward indicator for most contexts. As it is measured at the household level, the expenditure-to-income ratio also allows for disaggregated analysis of affordability across household and tenure types, incomes, and regions.[8]

Table 3.1. Select housing affordability metrics

Measurement group	Metric	Definition
Cost of housing relative to income measures	Price-to-income ratio	The association between prices and incomes at the aggregate (median) level
	Expenditure-to-income ratio	Actual spending on housing relative to income at the individual level
	Housing overburden rate	The share of households spending over a certain percentage (e.g. 40%) of disposable income on housing costs
Residual income measures	Shelter poverty indicator	Income available after housing costs to cover non-housing expenses
Housing quality measures	Housing overcrowding rate	Captures the proportion of housing units that provide sufficient space
	Housing deprivation rates	Measures maintenance deficiencies and the absence of essential conditions
Subjective measures of housing quality and supply	Housing satisfaction	Level of satisfaction with the availability of good quality, affordable housing
	Housing concern	Measures whether residents identify housing quality or affordability as a primary short-term concern

Note: For a discussion of the relative advantages and disadvantages of various housing affordability measures, see (OECD, 2021[14]).
Source: Adapted from (OECD, 2021[14]).

The OECD maintains data on two expenditure-to-income ratio measures, namely housing-related expenditures and housing costs over income. The indicator on *housing-related expenditures* (HC1.1) measures the final household expenditure on housing, water, electricity, gas and other fuels, as a percentage of their overall expenditure. The data in this indicator are mainly taken from the OECD Annual National Accounts Database on Final consumption expenditure of households, along with the categorisation in the Classification of Individual Consumption According to Purpose (COICOP). Housing-

[8] However, specific indicators may be more or less useful depending on specific geographic characteristics. Areas with a significant number of homeowners who have paid off their mortgages, for example, may find housing quality measures to be of more use when evaluating the degree to which housing needs are met in this context.

related expenditures also include actual rentals for housing, energy costs, and costs for maintenance and repair. Water supply and miscellaneous services related to the dwelling, such as waste collection and co-proprietor charges for multi-occupant buildings, are also considered. For outright homeowners, the indicator considers imputed rental for housing rather than actual rentals, defined as the rental-equivalence that homeowners would pay for a house with similar characteristics to the one they own (OECD, 2021[147]).

The second expenditure-to-income indicator is *housing costs over income* (HC1.2). This measures the median housing cost as a share of household disposable income. Housing costs can be defined narrowly, to include rent and mortgage costs, or broadly, to include costs related to maintenance, repair, taxes, and utilities. Household disposable income is adjusted for household size (using an equivalence elasticity, i.e. the square root of household size). The adjustment implies that a household's expenditure increases with household size at a marginally decreasing rate. This report considers housing affordability as an expenditure-to-income ratio, focusing on the narrow definition of the OECD housing cost to income indicator (HC1.2).

A number of factors can impact the ratio of housing expenditure to income. This includes not only house prices and income themselves, but also tenure status, access to loans, liquidity constraints, etc. As such, the equity impacts of environmental amenity and disamenity provision in a given area depend on the entirety of the existing policy context. This includes policies that influence the elasticity of housing supply and demand, such as interest rates (housing demand) and land-use policies (housing supply). The initial distribution of environmental amenities and disamenities in the area, the distribution of renters vs. owners, and low- vs. high-income owners can also determine how the benefits of amenity provision are distributed.

Evidence indicates that environmental amenities and disamenities are unequally distributed across the population in terms of income, race, nationality and other socioeconomic characteristics, and furthermore, that disadvantaged populations are disproportionately exposed to disamenities. Studies in the US, France, Germany, the UK, and the Netherlands, for example, have found that lower-income neighborhoods experience greater exposure to pollution than higher-income neighborhoods (Demetillo et al., 2020[148]; Padilla et al., 2014[149]; Rüttenauer, 2018[150]; Fecht et al., 2015[151]; Mitchell, Norman and Mullin, 2015[152]; Mitchell and Dorling, 2003[153]; Raddatz and Mennis, 2013[154]; Glatter-Götz et al., 2019[155]; Logan and Parman, 2017[156]; Casey et al., 2017[157]).[9] Accordingly, health inequalities related to outdoor air pollution have been found to be persistent and increasing in some regions of Europe (World Health Organization, 2019[158]). Exposure to hazardous waste facilities also disproportionally affects households of lower socio-economic status (Depro, Timmins and O'Neil, 2015[159]; Ringquist, 1997[160]; Raddatz and Mennis, 2013[161]; Laurian and Funderburg, 2014[162]). A number of studies find correlation between water quality, heat stress exposure, and proximity to brownfield sites and indicators of socioeconomic status, including income and race (OECD, 2006[163]; Hales et al., 2003[164]; Harlan et al., 2006[165]; US EPA, 2015[166]).

Existing inequalities in the baseline 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[167]). Melstrom et al. (2021[168]) find that valuations of brownfield cleanup differ by race and tenure status. As a result, cleanup of such sites can deliver disproportionate benefits across groups. Whether environmental amenity provision exacerbates or reduces inequalities depends on the factors driving any existing inequities in amenity or disamenity provision across socioeconomic 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).

As demonstrated by the substantial body of evidence presented in Section 2, environmental amenities have well-established effects on house prices. To the extent that environmental amenities and disamenities

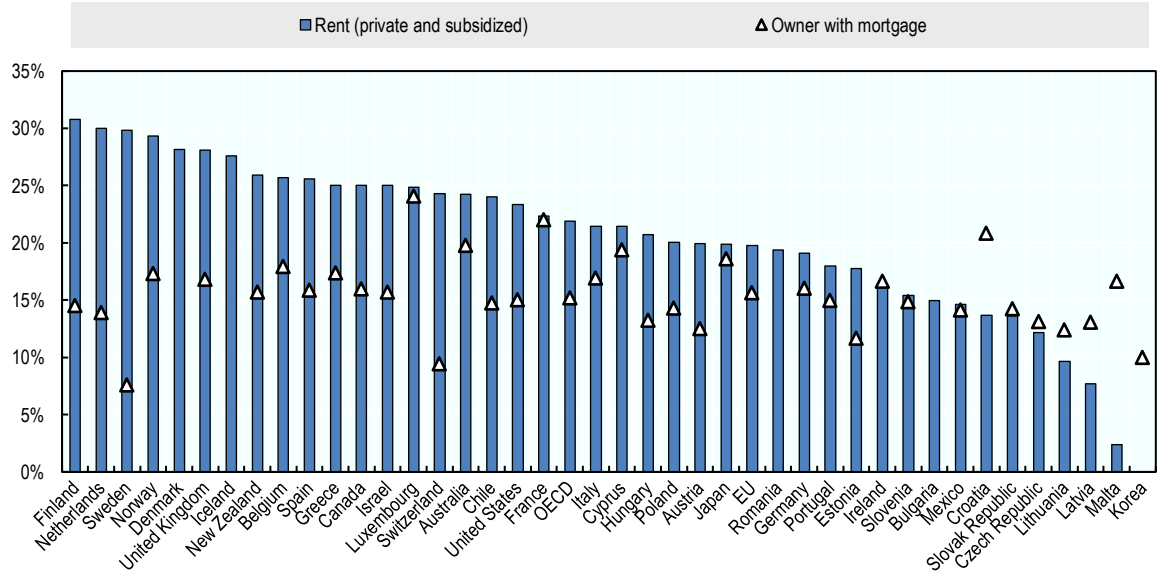
[9] This picture may substantially differ regarding the exposure to non-environmental externalities such as congestion. Higher income group may be exposed to lower commuting speeds in monocentric urban areas (Tikoudis, Verhoef and van Ommeren, 2015[184]). In polycentric urban areas the relation could be more complicated (Tikoudis, 2020[183]).

are local goods, changes in their provision can result in spatially differentiated impacts on house prices. The process through which the provision of environmental amenities contributes to gentrification, or "green gentrification", has been the subject of a growing literature stream. Ownership status can also interact with the spatial distribution of public good provision in determining the impacts of amenities or disamenities on housing affordability.

Ownership rate plays an important role in the impact of local amenity provision on housing affordability. Rises in house prices resulting from uplift or gentrification programs may decrease affordability for renters. This may occur because property values and rental rates tend to be simultaneously determined by the economic conditions and often display a strong temporal correlation.[10] Unlike homeowners, renters do not collect any of the capital gains arising from housing price increases. They may also be more vulnerable to increases in the housing costs as they typically spend a larger part of their budget on housing-related expenditures, Figure 3.1. Among renters, low-income households have a higher housing cost burden than do higher-income households, as seen in Figure 3.2. The arguments regarding the potential adverse effects of local amenity provision on the well-being of low-income renters do not carry over to owners with mortgage, as long as the periodic mortgage payments of the latter are detached from housing market prices.

Figure 3.1. Households' housing cost burden (mortgage and rent cost) as a share of disposable income

Median of the mortgage burden (principal repayment and interest payments) or rent burden (private market and subsidized rent) as a share of disposable income, in percent, 2019 or latest year available

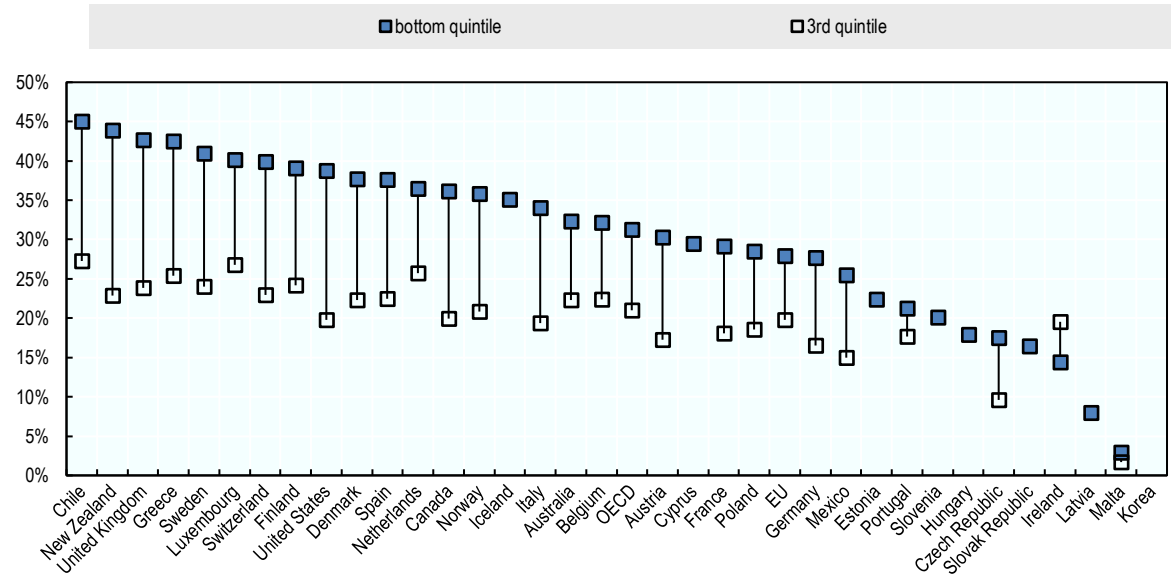


Source: (OECD, 2021[147]).

[10] Hargreaves (2008[185]) finds that the correlation between house prices and 6-month lagged rents in New Zealand is 0.80.

Figure 3.2. Housing cost burden as a share of disposable income of low- and middle-income households with a mortgage

Median of rent burden (private market and subsidized rent) as a share of disposable income in the bottom and the third quintiles of the income distribution, 2019 or latest year available

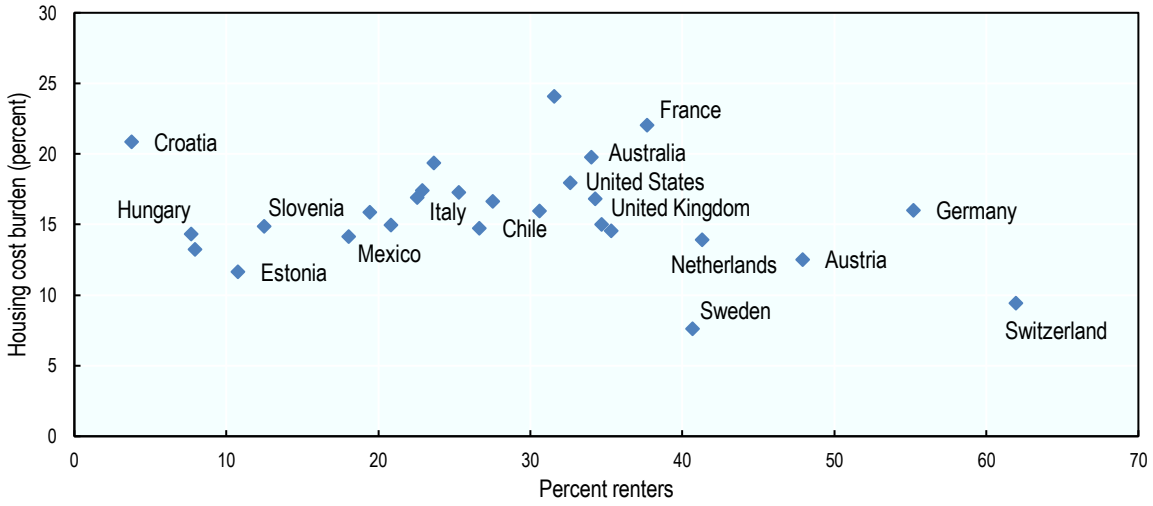


Source: (OECD, 2021[147]).

The OECD Housing Affordability Database includes a tenure status indicator (HM1.3). This indicator identifies the arrangements under which households occupy their housing units. Arrangements fall into four categories: own outright, owner with mortgage, rent (private), rent (subsidised) and other. Households considered outright owners have no mortgage repayment obligation for the housing unit they occupy. Therefore, they are distinguished from households who are owners of their housing unit but are still making mortgage payments. Private renters pay rent at market prices on the private rental market, whereas subsidised renters pay rents that are fixed by law, typically lower than market rents. Households under other arrangements includes fully subsidised accommodation or arrangements that fall into other categories.

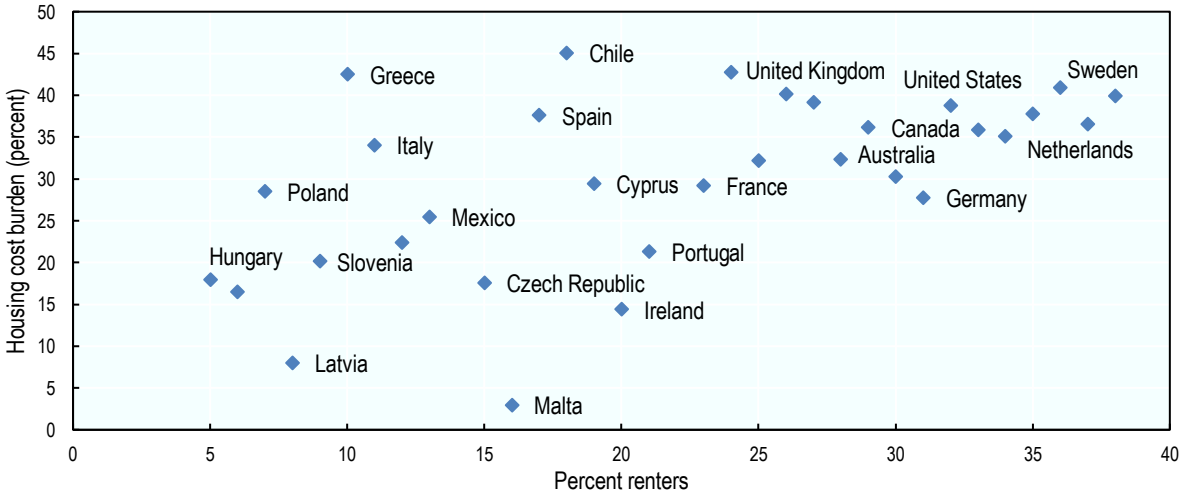
Contexts with a high percentage of renters and a high housing cost-to-income ratio can be susceptible to distributional impacts resulting from housing price increases. In these contexts, environmental policymaking should pay particular attention to the potential for negative distributional impacts arising from the local provision of environmental amenities. Avenues for mitigating distributional consequences of environmental amenity provision are presented in Section 4. Expected changes in welfare due to such consequences can be compared with the expected value of amenity provision in ex-ante cost-benefit analyses. Figure 3.3 and Figure 3.4 show countries with high housing cost burdens and high percentage of renters on the basis of indicators in the OECD Housing Affordability Database (OECD, 2021[147]).

Figure 3.3. Tenure status and housing cost burden in OECD countries, all income quintiles



Note: Percent of renters is calculated as the percent of households renting in the private or subsided market divided by the total percent of renters plus owners with and without a mortgage.
Source: Calculated on the basis of OECD Housing Affordability Database Indicators HM13.3 and HC12.2 (OECD, 2021[147]).

Figure 3.4. Tenure status and housing cost burden in OECD countries, bottom income quintile



Note: Percent of renters is calculated as the percent of households renting in the private or subsided market divided by the total percent of renters plus owners with and without a mortgage.
Source: Calculated on the basis of OECD Housing Affordability Database Indicators HM13.3 and HC12.2 (OECD, 2021[147]).

Spatial segregation in tenure status and income level can be the outcome of various processes.[11] Some degree of segregation can be considered economically efficient insofar as it reflects differences in preferences. Those living near environmental amenities are often willing to pay more for this proximity, relative to those who do not. The results presented in Section 2 provide evidence that this segregation can also be driven by housing cost burdens. Households with higher housing cost burdens are disproportionately exposed to housing price increases, which could also result from amenity provision. These households tend to have lower valuation for these amenities (Stromberg et al., 2021[169]), even if they may have similar environmental preferences to households with lower housing cost burdens. Empirical literature provides evidence for the gentrification effects of exogenous provision of environmental amenities (Banzhaf and Walsh, 2008[170]; Shokry, Connolly and Anguelovski, 2020[171]). Little evidence exists regarding differences in the local provision of environmental amenities across public and private housing supply. To the extent that local governments determine both urban development via permitting processes, as well as the provision of public environmental amenities, differences in this provision will depend on the specific characteristics of these processes (e.g. siting criteria and the bargaining power of local households and communities).[12]

The displacement of renters and low-income households as a result of environmental amenity provision can occur via two mechanisms (Anguelovski et al., 2019[172]; Immergluck and Balan, 2017[173]). First, as amenity provision in an area increases, the area attracts households of higher incomes that are willing to pay more for the locally provided amenity. For instance, the conversion of empty space to an urban park will attract potential buyers and renters that evaluate public open space and related recreational facilities. Subsequently, the increase in housing demand will introduce pressures in house prices and rents. Renters with low valuation of the amenity that resided in that area prior to the materialisation of the uplift programme may then be obliged to relocate. Second, inelastic housing supply exacerbates the displacement of low-income renters over time in areas with weak rent control. The literature refers to the displacement of low-income households that occurs as result of these forces as *exclusionary displacement* (Haase et al., 2017[174]). Preventing exclusionary housing patterns near environmental amenities therefore entails accompanying environmental amenity provision with measures that address both the supply- and demand-side aspects of this process. Accordingly, such measures would aim to shield low-income households from negative affordability-related impacts of amenity provision in two ways. First, measures addressing the supply aspect should aim to maintain an adequate supply of affordable housing in amenity-rich areas.

Local fiscal policy determines the relative access to loans and the borrowing cost at which renters can become owners. Low interest rates facilitate home ownership, allowing larger parts of the population to

[11] In Tiebout's model of residential sorting, households choose their residential location based on their willingness to pay for amenities subject to their budget constraint, meaning that households are responsible for correlations between socioeconomic status and environmental amenities. This implies that so-called green gentrification is economically efficient and that inequalities in environmental provision simply reflect inequalities in income. A second explanation for observed inequalities in exposure to environmental disamenities is that it can be due to disproportionate siting. Firms may be siting polluting activities in a discriminatory way or based on local economic conditions that correlate with residential socioeconomic patterns. Government agencies can also influence the location of polluting activities and amenity provision through via permitting processes. The Coase theorem of property rights could also explain differences in incentives to provide amenities. Given that residents hold relevant property rights, polluters must theoretically compensate them for any degradation in environmental quality. As a result, polluters have an incentive to locate where residents are willing to accept low compensation. Since willingness-to-accept is determined in part by a households budget constraints, such a process can to an unequal distribution of disamenity provision across incomes.

[12] Prioritising environmental amenity provision for social housing units can be accomplished by incorporating relevant criteria into development processes, e.g. by incorporating amenity-related requirements into social housing developments and by selecting sites for amenity provision and disamenity mitigation in part based on their proximity to low-income areas. The city of Vienna, for example, buys land suitable for residential development and solicits proposals from private developers to build and retain ownership of the housing units to be developed. Development proposals are evaluated based on criteria that include environmental performance and social sustainability.

collect the social value of amenity provision that capitalizes into property prices. However, low-interest rates can also fuel house price increases by boosting the demand for housing. Moreover, the change in demand and property values will not be uniform over space, with the provision of local amenities playing a central role in the asymmetric distribution of capital gains. Monetary policies that determine interest rates lie outside the purview of environmental policy planning. Nevertheless, local environmental policies should account for the monetary policy context. That will inform policy makers about the level of capital gains local amenities may generate, and their distribution across different areas and population groups. Upward housing price shocks could make ownership less affordable, as rises in property values increase minimum capital requirements for loans to finance house purchases. This reduces the number of households that are able to afford a transition of status, from renting to owning.

The extent to which the public amenity provision is distributionally neutral depends on the degree to which those that benefit from amenities pay for these benefits via the tax system. Insofar as municipal tax systems are typically insensitive to differences in the provision of environmental amenities and disamenities, they can foster distributional impacts. Financing schemes that would contribute to mitigating distributional impacts in housing markets as a result of environmental amenity provision would ensure the supply of social housing and provide assistance to existing low-income households.

4 Improving the inclusivity of environmental amenity provision

Despite their myriad benefits, environmental amenities remain undersupplied in many urban areas. Evidence shows that public investments with strong spatial dimensions, such as the provision of open space, can increase property values. These increases can burden residents who do not collect the capital gains from public good provision, leading to an unequal distribution of the net benefits of public good provision. 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. For example, although amenity provision may be intended to benefit residents in a certain area, if these residents are low-income renters, they may instead experience a net welfare loss if not protected from rent increases. Additional attention should be given to displacement effects, whereby such residents can face pressure over time to relocate out of the area due to amenity-induced increases in housing costs. Housing subsidies for low-income households and investments in social housing stock are examples of measures that can mitigate such pressures. Coordination between policymakers in the environmental and housing spheres will likely be necessary in order to facilitate the implementation of such measures. Following a social welfare approach, investing in the provision of environmental amenities and the mitigation of disamenities should be pursued if the net social welfare benefits of investing exceed the corresponding social welfare costs. Beyond net benefits, however, the equity of environmental amenity provision should be assessed based on how the resulting changes in welfare are distributed.

The demonstrated impact that environmental amenities have on house prices should not deter local planners from investing in the provision of these amenities. Instead, policymakers should seek to provide environmental amenities in ways that minimise affordability-related impacts and mitigate existing inequalities, such as housing subsidies and investments in social housing stock. Specifically, environmental amenity provision should not exacerbate the extent to which low-income households may already experience a disproportionate exposure to environmental burdens. Similarly, it should not increase the extent to which high-income households may already enjoy a disproportionate share of the benefits of environmental amenities. A number of instruments are available that can improve both the efficiency and the inclusivity of such efforts, and their use should be tailored to the specific land-use, socioeconomic, environmental and legal contexts of the urban areas in which they are implemented. The literature reviewed and examined in Section 2, as well as the accompanying observations in Section 3 point to several key implications for policymaking toward this end.

4.1. Use a social welfare approach to evaluate amenity provision options and incorporate compensation mechanisms in order to avoid or minimise negative distributional effects.

Environmental policies should support the provision of environmental amenities when net welfare benefits exceed net costs. However, amenity provision may need to be accompanied by complementary measures designed to mitigate economy-wide effects (OECD, 2018[175]) and negative distributional impacts that occur via housing markets. Examples of policy measures that address both sustainability and inclusivity include split-rate or spatially-differentiated property taxes, enabling transferable development rights in environmentally valuable areas, subsidising the retrofitting of existing housing stock, and relaxing building

height restrictions.[13] Investments in green social housing stock and enabling portable eligibility with respect to social housing could also be included in the toolkit of feasible interventions. However, the level and the financing of the underlying social housing subsidies should in all cases be in alignment with the relevant budget constraints.

4.2. Make use of land value capture measures to generate revenue for complementary measures enhancing inclusivity.

Land value capture measures provide a way to raise the necessary funds for financing measures that will enhance the inclusivity of environmental amenity provision (Germán and Bernstein, 2021[176]). Land value capture measures are designed to convert the benefits generated by environmental amenities into funds that credit public budget balances.[14] Examples of land value capture strategies relevant to environmental amenity provision include betterment contributions and special assessments, impact fees, land readjustment, and inclusionary zoning (OECD, 2021[177]; Lincoln Institute of Land Policy, 2018[178]; UN Habitat, 2021[179]).[15]

Betterment contributions and special assessments require owners of properties benefitting from a public investment to pay the municipality a fee assessed on the basis of the added property value accrued 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 environmental amenity (Germán and Bernstein, 2021[176]).

[13] See Bertaud and Brueckner (2005[189]) and Tikoudis, Verhoef and van Ommeren (2018[188]) for an analysis of the social cost of building height restrictions in monocentric urban areas. Tikoudis and Oueslati (2017[190]) that is tailored to examine the social impacts of environmentally relevant policies in urban areas. They apply the model to analyse how transport and land use policies affect welfare in the case of Auckland (Tikoudis and Oueslati, 2020[191]).

[14] The added value of property price increases that is subject to land value capture measures does not include value that has been generated by private investments. As such, appropriate fee calculation relies on accurate assessments of the proportion of property value increases that are attributable to environmental amenity provision and other public investments (Ingram and Hong, 2012[192]). As with other types of taxes, policy measures designed to collect the value gains from environmental improvements could encounter low political support. However, empirical evidence has shown that earmarking the revenues generated by such mechanisms and communicating their purpose to the public significantly enhances public opinion (Dechezleprêtre et al., 2022[193]).

[15] As noted in the section above on moderating factors, there are a number of conditions that can influence the magnitude of home price effects. Balancing home price effects via spatially-differentiated land-value taxes is likely to be practically challenging to implement due to the uncertainty surrounding their magnitude and fluctuations in this value over time. As a result, while taxes may be suitable for environmental externalities that can be estimated with more precision and confidence. The challenges associated with using land value taxes to capitalise on the benefits of environmental amenity provision are similar to those of betterment levies to finance public infrastructure investments. These challenges are described in Peterson (2008[182]) and include low public acceptance that may stem from uncertainty surrounding the land-value gains of nearby amenity provision. As noted in Peterson (2008[182]), betterment levies can be calculated based on additional factors that enable them to fall more heavily on industrial-commercial uses rather than residential use, and to take into account income levels.

Potential uses of these revenues vary according to the specific context and can include the provision of housing subsidies for low-income households and investments in social housing stock.[16] Given that the efficient provision of environmental amenities is conditional on the internalisation of both the positive and negative externalities they generate, 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.

4.3. Contextual considerations should be taken into account when designing policies aiming to provide amenities and mitigate disamenities.

Existing local fiscal and land-use policy, 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, the 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[177]). 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[180]).

4.4. Critically evaluate alternative policy strategies determining where new amenities are provided or existing amenities are improved.

The inequitable spatial access of various socioeconomic groups relative to environmental amenities has been observed in many contexts. While certain processes operating via housing markets are responsible for these patterns, it has also been observed that low-income areas tend to be overlooked in green renewal projects (Haase et al., 2017[174]; Anguelovski et al., 2016[181]). It would therefore appear that 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 socioeconomic status in participatory planning processes. Enhancing amenity provision in amenity-scarce areas would generate greater marginal benefits than provision in areas with substantial existing supply. Policymakers should aim for a more uniformly distribution of amenities, which may involve targeting areas with relatively less supply.

[16] Beyond the welfare impacts of house price increases as a result of environmental amenity provision, a variety of impacts should be considered when assessing the appropriateness of policy instruments (e.g. impacts to public finances and other distributional welfare implications).

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