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Valuing Density: An Evaluation of the Extent to which American, Australian, and Canadian Cities Account for the Climate Benefits of Density through Environmental Review

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Abstract

This study looks at the extent to which major cities in the United States, Australia, and Canada assess the climate impacts of densification through the environmental review process. Research indicates that greater urban density is associated with lower household greenhouse gas (GHG) emissions in high GDP countries. Yet, there is reason to believe that cities may be taking a parochial approach to evaluating the climate impacts of rezonings in their environmental reviews that fails to consider the environmental costs of maintaining low density. In this study, we survey the legal and policy frameworks governing environmental reviews in American, Australian, and Canadian cities to determine the extent to which they consider and analyze the GHG benefits of land use changes that increase urban density. We also analyze environmental review documents for proposals to increase residential density in cities to determine the extent to which policy makers have incorporated empirical knowledge regarding the relationship between density and GHGs emissions into their environmental reviews of proposed land use changes. We find that very few of the cities we surveyed use a formal environmental review process for analyzing the GHG impacts of land use changes. In addition, the small number of cities in our survey that analyze the GHG implications of land use changes do not appear to comprehensively consider the broader GHG benefits of densification. In fact, cities that assess the GHG impacts of zoning changes appear more likely to consider densification as causing climate harms rather than climate benefits.

Keywords: environment, land use planning, local government, planning, urban, urban development, urban sprawl, zoning

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Introduction

Broadly speaking, academic research indicates that greater urban density is associated with lower household greenhouse gas (GHG) emissions in countries with high gross domestic product (GDP). Yet, there are reasons to believe that cities in high GDP countries, where densification would be most helpful from a climate perspective, may be failing to consider the potential benefit that increasing urban density will reduce GHG emissions. In neglecting this potential, cities may be driving development away from urban centers and toward outlying areas where GHG emissions per household are likely to be higher, thus increasing GHG emissions. Even cities with their own GHG reduction goals may neglect the GHG benefits of densification because their goals focus on reducing emissions within their borders. Urban densification may not contribute to achieving such goals, because, if it reduces emissions, it does so by avoiding emissions that would be generated by development that would otherwise occur in outlying areas beyond a city’s jurisdictional borders.¹ Also, quantifying the GHG impacts of densification requires expertise and resources that even large cities may lack.

This study analyzes the extent to which major American, Australian, and Canadian jurisdictions evaluate the GHG implications of proposals to increase urban density through environmental review. We are particularly interested in understanding whether local governments that analyze the environmental impacts of land use changes—intended to increase greater urban density—consider densification’s potential to reduce GHG emissions.

The extent to which decision-makers consider environmental impacts when evaluating proposed land use changes varies considerably across jurisdictions. The concept of “environmental review”² was pioneered in the United States when it enacted the National Environmental Policy Act (NEPA) in 1970. NEPA requires the federal government to conduct an environmental review of any major federal action that has a significant impact on the human environment. The

¹ We acknowledge that the definition of a “city” can vary academically, legally, and colloquially, and, unless otherwise noted, use the term in this paper broadly to refer a highly urbanized, self-governing local jurisdiction. We also take into account that the legal frameworks that define cities vary across different countries, such that a “city” in one country may be governed by a single local government authority (e.g. New York City), while a “city” in another country may comprise multiple local government areas, each with their own local government authority (which may even be legally considered “cities” in their own right) (e.g. Sydney).

² The terminology for this concept varies across jurisdictions; while in some jurisdictions this process is referred to as “environmental review,” in others it is known as “environmental assessment.” These terms are sometimes used interchangeably, and this report uses both terms to refer to the formal process by which an action taken by a government entity, or a proposal requiring a decision by a government entity, is analyzed for its potential environmental impacts before the action is permitted to proceed.

outcome of this process, the environmental impact statement (EIS), is intended to inform the public of the potential impacts of proposed actions and to encourage government decision-makers to take these impacts into account.³

After NEPA's passage, many jurisdictions around the world—at the international, national, and subnational levels—adopted their own versions of environmental review laws and policies (Lazarus 2004). At the subnational level, the laws and policies in some U.S. states require or permit the assessment of the environmental impacts of land use actions, including zoning changes. Other jurisdictions have built alternative procedures to account for environmental concerns into the planning process. For example, while many Australian states have enacted environmental review statutes similar to NEPA, some do not apply these statutes to land use decisions and instead have separate requirements in their planning statutes, requiring authorities to consider the environmental effects of proposed land use changes. In Canada, many provinces legislatively require provincial and local governments to adopt planning instruments and mandate reviews of land use changes, such as rezonings, for their consistency with the environmental objectives in those instruments. Though they differ in form, the fundamental purpose of these processes is similar: to get decision-makers to think about the environmental consequences of their actions.

When environmental review was initially developed in the United States in the 1970s, climate change was not a mainstream environmental concern, and environmental reviews generally did not consider GHG impacts. In the time since, climate change has become a paramount concern, and many jurisdictions have incorporated GHG considerations into their environmental review frameworks. Planning frameworks, which inform zoning decisions in many jurisdictions, have also been broadened over time to incorporate climate objectives. Still, regardless of whether a review is undertaken as part of a formal environmental review statute similar to NEPA or as part of the planning process, local analyses of the GHG impacts of land use changes might be expected to be rudimentary because of the mixed incentives local governments face and their limited capacity and resources.

In this study, we examined the ways in which major cities in the United States, Australia, and Canada analyze the GHG impacts of urban densification in their environmental review processes. This study is the first of its kind of which the authors are aware. The paper provides evidence that local environmental review processes are not systematically considering the potential benefit that densifying cities may reduce or avoid GHG emissions. It also highlights the potential for land use regulators to take greater account of urban densification's potential to reduce GHG emissions.

³ For actions not categorically excluded from review, federal agencies seeking to comply with NEPA may first prepare Environmental Assessments (EAs) to determine whether it is necessary to prepare an EIS. If, through the EA, the agency determines that the action will not have significant environmental impacts, the agency may issue a Finding of No Significant Impact (FONSI); if, on the other hand, it determines that the action *will* likely have significant impacts, the agency is then required to prepare an EIS (National Environmental Policy Act Implementing Regulations, 40 C.F.R. § 1501.5).

This paper proceeds as follows. Part I sets out the background for the study. It summarizes the current academic literature on the relationship between density and GHG emissions, provides background on the role of cities in shaping land use, and makes the case for why cities should be pursuing densification as a climate mitigation policy. It also suggests why local governments may not be systematically considering urban densification's potential for reducing GHG emissions as part of land use decision-making. Part II sets out the study's hypotheses and methodological approach. Starting from the position that cities are ignoring the opportunity cost, from a climate perspective, of maintaining low urban density, we hypothesize that: (1) local governments are not likely to assess the potential benefit that increasing urban density may reduce GHG emissions using formal environmental review processes; and (2) where local governments do analyze the potential benefit that increasing density may affect (i.e., reduce) GHG emissions, they are not likely to do so in a comprehensive manner. Part III reports the results of our research. Part IV analyzes our findings, discusses the implications of these findings for policy, and identifies areas for potential future research.

In brief, we find that very few of the cities surveyed utilize a formal environmental review process for analyzing the GHG impacts of land use changes. In addition, the small number of cities in our survey that do analyze the GHG implications of land use changes do not appear to comprehensively consider the GHG benefits of urban densification. Our findings raise important policy questions about whether major cities should be further encouraged to consider the GHG emission reduction potential of urban densification. If cities should be encouraged to do so, a related question is whether environmental review is the appropriate vehicle for doing so, given the many criticisms of environmental review.

Part I. Background

The Relationship between Density and Climate Change

Over the past two decades, scientists and economists have extensively examined the relationship between urban density—the concentration of people living in a particular geographic area—and GHG emissions. Broadly speaking, empirical data points to a negative correlation between density and GHGs—that is, as density increases, per capita and household GHG emissions generally decrease (Glaeser & Kahn 2010; Grubler et al. 2012).⁴ However, this effect only holds in countries with a relatively high national GDP. While the per capita energy use of city residents in high GDP countries is lower than the national average, the opposite is true in low GDP countries. In these countries, urban dwellers tend to have higher incomes than the national average and use more energy per capita (Grubler et al. 2012). For the purposes of this study, we

⁴ Studies examining the relationship between density and GHG emissions have often examined either household or per capita emissions, with few examining both or comparing the two units of measurement. As it would be difficult to standardize the units across studies, we have considered both types of studies in our review and have identified whether a study examines household emissions or individual emissions.

therefore limit our analysis to the ways in which large cities in high GDP countries evaluate the GHG impacts of density.

Notably, even within high GDP countries, the exact correlation between density and emissions varies between cities in different regions. Of particular note, emissions tend to be greater in regions with more extreme climates, where households may use more energy for heating and cooling, than in regions with more temperate climate (Glaeser & Kahn 2010).⁵ Still, on average, urban inhabitants of high GDP countries produce less carbon dioxide on a per capita basis than those who live in suburbs (Nolon 2009).⁶ Moreover, research has found that densification in larger cities with higher populations yield greater emissions reductions than equivalent levels of densification in smaller and less populous areas (Riberio, Rybski & Kropp 2019).⁷ Thus, there is a strong argument that increasing the density of major cities will help to lower emissions.⁸ If true, densifying major cities in high GDP countries, particularly those cities in temperate climates, could play an important role in the race to reduce GHGs (Grubler et al. 2012).

Emissions reductions associated with higher density largely flow from reductions in energy usage in two major sectors: transportation and buildings (Leibowicz 2017; Kennedy et al. 2009). Looking first at transportation, research reveals an inverse relationship between population density and vehicle miles traveled (Marshall 2008).⁹ This situation correlates with a decrease in transportation-related emissions. For example, one study, which compared emissions from

⁵ For example, there is a greater difference between household GHG emissions of urban versus suburban dwellers in the New York City metropolitan region, which experiences cold winters and hot summers, than there is between urban and suburban dwellers in the temperate San Francisco region. It should be noted, as well, that the type and size of housing units and the spatial arrangement of residential buildings within cities can lead to variations in emissions between different cities. For example, in cities where residences are more spread out, there is generally greater energy loss on the grid due to the need for longer low-voltage wires (Andrews 2008). Nevertheless, despite these inter-city variations, the research suggests that emissions from the building sector remain on average lower in denser urban environments.

⁶ Note that most studies, like this one, generally consider the emissions that are expended or produced within the city boundaries (production-based accounting) and do not generally account for all the emissions associated with the creation and transportation of goods and services consumed within the city, even if those emissions occur outside of the city's boundary (consumption-based accounting).

⁷ Riberio, Rybski, and Kropp found that within the United States, a 1 percent increase in the density of a city with 10,000 inhabitants results in a 0.42 percent reduction in emissions, while the same change in a larger city with 1 million inhabitants results in a 0.56 percent reduction in its emissions (2019).

⁸ A counterargument is that urban densification may not, in fact, reduce GHG emissions, because growth in city centers (lowest emissions per capita) tends to bring greater wealth and more development in the suburbs (highest emissions per capita) (Jones & Kammen 2013).

⁹ Research has also revealed an inverse relationship between transportation energy use and population density (Kennedy et al. 2009).

ground transportation fuels across 10 global cities,¹⁰ found that a doubling of urban population density—from 2,500 to 5,000 persons per square kilometer—correlated with a 40 percent reduction in GHG emissions (Kennedy et al. 2009). There are two main reasons for this finding. First, density is associated with shorter commute times, which means less vehicle miles traveled per car trip (Muñiz & Dominguez 2020). Second, once a certain degree of density is reached, alternative modes of transportation, including mass transit, bicycling, and walking, become practical (EPA 2007; Bereitschaft & Debbage 2013).¹¹ For both reasons, more compact cities are associated with lower transportation-related GHG emissions than suburbs (Leibowicz 2017). For example, studies based on the 2001 National Household Travel Study show that suburban households in the New York City metropolitan area emitted 3,800 more pounds of CO₂ emissions than urban households when accounting for emissions from both driving and public transportation (Glaeser & Kahn 2008; Lewyn 2012). Other studies have also found that transportation emissions decrease as population density increases (Andrews 2008). Notably, if automobiles were to electrify, the difference between transportation-related GHG emissions in urban and suburban areas would likely narrow, particularly in regions that have relatively clean sources of electricity.¹² For the time being, however, the difference remains considerable.

A second reason for why density is associated with lower household GHG emissions is that residential energy use tends to be lower in denser areas (Ewing & Rong 2008; Andrews 2008; Glaeser & Kahn 2010). Denser cities typically have multi-family buildings with smaller units, which tend to be more efficient and use less energy than the larger single-family detached houses that are more commonly found in suburban and rural areas (Andrews 2008; Nolon 2009; Leibowicz 2017). One study modeling the direct and indirect impacts of population density on carbon emissions found that housing units in urban areas emitted on average 5.7 percent less carbon than non-urban households (Timmons, Ziogiannis, & Lutz 2016).¹³

¹⁰ Note that most, but not all, of the 10 cities and city-regions considered in this study are in high GDP countries. The cities included in the study are: Bangkok, Barcelona, Cape Town, Denver, Geneva, London, Los Angeles, New York City, Prague, and Toronto.

¹¹ A study by the U.S. Department of Energy, for example, found that greenhouse gas emissions are generally lower in dense areas due to driving reductions (National Research Council 2009; Lewyn 2012). Because cities are more compact, there also tends to be a greater reliance on alternative forms of transportation, such as transit, walking, or cycling. This reduction in driving generally correlates with a reduction in emissions (Lewyn 2012). Gasoline consumption, on the other hand, tends to increase the further individuals live from dense downtown regions, where there is less access to public transportation and neighborhoods are less walkable (Leibowicz 2017).

¹² Fleet electrification—achieved by transitioning to plug-in hybrid vehicles (PHEVs) or battery electric vehicles (BEVs)—has been widely considered “a promising alternative to reduce the dependence on fossil fuels, mitigate GHG emissions, and improve air quality in urban areas” (Cai & Xu 2013).

¹³ Notably, however, building GHG emissions depend on the size and income of the city, as well as the age and quality of the housing. Glaeser and Kahn, for example, found that central city residents in New York City emitted less carbon dioxide than suburban residents from heating-related emissions, but saw the opposite result with residents in Detroit, where there were

In short, scholarly literature suggests that—at least in high GDP countries—households in denser urban areas emit fewer GHGs than households in non-urban areas. In theory, then, increasing urban density in such countries could lower regional GHG emissions by avoiding development elsewhere. There are, of course, several caveats to the durability of this prescription. For example, if non-urban areas were to move more quickly to green their electricity grids, and if heating in those same areas were electrified, the GHG benefit of urban development might be substantially reduced. For the time being, however, it seems that urban households will generally have lower GHG footprints than non-urban ones.

Despite the climate argument for densifying major cities in high GDP countries, some recent research suggests that many cities' land use policies encourage precisely the opposite outcome. For example, New York City, which, on average, has vastly lower per-household emissions than suburban and rural areas, significantly restricts new construction and, in so doing, presumably drives new households towards areas in which they will have larger carbon footprints. (Glaeser & Kahn 2010). If widespread among other major cities, the cumulative effect of encouraging development in areas with higher per-household emissions would likely undermine climate change mitigation.

Criticisms of Densification from Other Perspectives

Despite the apparent GHG benefits of urban densification in high GDP countries, proposals to upzone parts of cities have faced staunch political resistance (Flint 2019) including, in some instances, from environmental advocates. Environmental nongovernmental organizations (NGO) do not appear to be consistently pressuring local governments to promote greater density.¹⁴ In a number of instances, environmental NGOs have shied away from supporting land use changes to increase the density of cities and have sometimes even outright opposed initiatives to increase density (Marin Post 2018).

Part of the resistance to proposals to rezone for denser development is rooted in a belief that densification will lead to gentrification,¹⁵ and contribute to the displacement of people of color

significantly higher emissions associated with heating in the city than the suburbs; Glaeser and Kahn noted that “the heating gap between central cities and suburbs is larger for bigger, richer, and more centralized cities.” (Glaeser & Kahn 2010). Another study noted that the “age and quality” of housing units can impact their energy usage as well (Andrews 2008).

¹⁴ For example, in Minneapolis, while some environmental groups supported upzoning efforts, others opposed the city's plans—in the case of the Audubon Society, for example, owing to a lack of proper environmental review (Budds 2020).

¹⁵ New York University's Furman Center for Real Estate and Urban Policy (Furman Center) describes gentrification as: “the accepted term to describe neighborhoods that start off predominantly occupied by households of relatively low socioeconomic status, and then experience an inflow of higher socioeconomic status households.” They further note that, “[s]ince entering the mainstream lexicon, the word ‘gentrification’ is applied broadly and interchangeably to describe a range of neighborhood changes, including rising incomes,

and low-income communities.¹⁶ Whether rezonings that facilitate more development actually cause gentrification is a matter of scholarly debate. For example, one recent study of new construction in Minneapolis found that lower-priced rental housing close to new construction had 6.6 percent higher rents, while higher-priced housing units had 3.2 percent lower rents (Damiano & Frenier 2020). However, a recent review of existing literature concluded that adding new housing actually “moderates price increases” and increases the affordability of housing (Been, Ellen & O’Regan 2018). Some cities (and states) have, in fact, turned to increasing density as a strategy to target inequities in the housing market. Minneapolis, for example, recently passed legislation allowing up to three dwellings on lots previously zoned for single-family homes in all of its neighborhoods in an effort to address disparities and inequalities in home ownership among communities of color (McCormick 2020).¹⁷ Moreover, even setting aside the uncertainty about whether the effects of upzoning cause gentrification, the relationship between gentrification and displacement is itself controversial; some studies have found a link between gentrification and displacement, (Brummet & Reed 2019), while others have found contrary evidence (Dragan, Ellen & Glied 2019).¹⁸ In short, the scholarly literature on the neighborhood impacts of upzonings is equivocal.

The COVID-19 pandemic has also raised new concerns about whether density in cities presents a danger to public health because it may facilitate the spread of disease. Historically, cities have been associated with disease, and epidemics of diseases such as yellow fever, cholera, and the

changing racial composition, shifting commercial activity, and displacement of original residents.” (Furman Center 2015).

¹⁶ Local plans to upzone have frequently been challenged on the grounds that they will result in gentrification and displacement. Some organizations expressed opposition to California Senate Bill 50, a bill intended to promote dense development near transit, because they concluded that it did not include sufficient provisions to avoid gentrification and prevent displacement (Alliance for Community Transit LA 2020). Moreover, in Austin, environmental advocates were sharply divided over a proposed plan to densify the city; while some supported the proposal, others spoke out against it, and in favor of delaying it, due to fears about gentrification and displacement (Crunten 2018).

¹⁷ Other cities and states have also either imposed or proposed similar zoning changes (Infranca 2019; Elmendorf 2019). For example, California legislators have introduced several bills over the years, as well as amendments to a more recent iteration (Senate Bill 50), to override local zoning laws to promote dense development near transit. (Infranca 2019; Elmendorf 2019; Cowan, Dougherty & Bowles 2020). Though these bills ultimately failed to pass, they signaled a strong interest by the state to relax zoning restrictions in favor of policies that promote greater urban density. In 2019, Oregon became the first state to essentially ban single-family zoning statewide by requiring cities with a population of greater than 10,000 people to allow duplexes in areas zoned for single-family homes (Britschgi 2019). A bill was introduced in Washington State in 2020 to ban single-family zoning (Albanese 2020). Portland has recently passed a proposal to allow up to four homes on nearly all residential lots (Andersen 2020).

¹⁸ This study, which tracked the mobility of low-income children in New York City during a period of rapid gentrification, found no evidence associating gentrification with “meaningful changes in mobility rates.” (Dragan, Ellen & Glied 2019).

bubonic plague were once a feature of life in American cities (Taylor 2009). More recently, some have pointed to population density as a catalyst for the spread of COVID-19 (Kotkin 2020; Rocklöv & Sjödin 2020). New York State Governor Andrew Cuomo, for example, pointed to density as a contributor to the spread of the virus in New York City during one of his early press conferences (Press Conference, April 13, 2020).

In light of these concerns, it is important to understand the relationship between density and the spread of infectious diseases like COVID-19. While the research is nascent, studies aimed at better understanding the link between density and the spread of COVID have not found a significant correlation between the two variables. One preliminary study of 913 U.S. counties found that, when controlling for metropolitan population, density was “not significantly related to the infection rate” of COVID-19. Rather, crowding (defined simply as “a large number of persons gathered closely together”) and connectivity (the degree to which counties are connected to other counties in the same region or to the outside world) were deemed to contribute more to the spread of the virus. (Hamidi, Sabouri & Ewing 2020).¹⁹ Moreover, some denser metropolitan counties have, in fact, been shown to have lower overall COVID mortality rates than less dense counties, likely a result of the higher-quality health care systems located in these areas (Hamidi, Sabouri & Ewing 2020). And, in New York City, COVID-19 attributable hospitalizations and deaths were not, in fact, found in the densest neighborhoods or boroughs; this finding suggests that other factors, such as socioeconomic status and race-based structural inequities, may be involved (Wadhera et al. 2020). Thus, in formulating society’s response to the COVID-19 crisis, we must take care to avoid conflating the concepts of density and overcrowding; while density is an inexorable feature of urban life, overcrowding can occur anywhere, and it need not be that all dense urban areas are overcrowded (Hamidi, Sabouri & Ewing 2020). In fact, overcrowding can result from under-building in areas where demand is high enough.

The Role of Cities in the Land Use Process

Cities in the United States, Australia, and Canada all play a principal role in determining how land within their borders is used and are therefore well-positioned to give legal effect to development policies that meaningfully incorporate climate considerations. First, local governments in all three countries have authority to enact and amend zoning laws, which affect the types and scale of structures and population densities in a given area. Through one particular type of zoning law amendment—an “upzoning”—cities can achieve greater densities by changing the zoning on a particular tract of land to permit a greater number of residential units to be built or to allow for higher-value uses (for example, rezoning from industrial to residential). In doing so, cities can encourage developers to build up rather than out and help to mitigate urban sprawl in the process.

Not only are cities principally responsible for dictating the zoning laws which govern development in their jurisdictions, but cities across all three countries are often empowered—and

¹⁹ Similarly, a study conducted by the NYU Furman Center found that, within New York City, COVID-19 was “more prevalent in areas where more people reside in crowded units.” (Furman Center 2020).

sometimes required—to adopt planning instruments that outline the city’s economic, social, and environmental objectives, as well as their strategies for achieving and sustaining growth in the both the short- and long-term. These planning instruments thus present an opportunity for cities to translate GHG-emission reductions objectives into workable land use polices and, in some cases, law. For many jurisdictions, these planning instruments are not merely aspirational goals, but rather bind subsequent lawmaking. For example, many local governments are required not only to adopt their own local plans but also to demonstrate that subsequent zoning amendments are consistent with these planning instruments.²⁰ Thus, to the extent that these planning instruments comprehensively incorporate climate considerations into their growth strategies, they may also help promote the development of a legal framework that encourages emissions reductions by supporting urban densification.

It should be noted, however, that there are some significant differences in the distribution of authority over land use among the three countries. While most cities in the United States retain significant autonomy over zoning decisions, many Australian and Canadian cities share this authority with their state or provincial governments. For example, in Victoria and New South Wales, zoning amendments proposed by local councils must be approved by a state minister before they are deemed enacted into law (Planning and Environment Act 1987 § 35; Environmental Planning and Assessment Act 1979 § 3.34); the states of Victoria and South Australia retain the authority to unilaterally initiate and adopt zoning amendments affecting local governments’ jurisdictions (Planning and Environment Act 1987 § 8; Planning, Development and Infrastructure Act 2016 §§ 94, 95); and the Canadian province of British Columbia can override zoning laws enacted by a local government if it considers that all or part of the bylaw is contrary to the public interest (Local Government Act § 584). Moreover, while U.S. cities generally receive few directives from their state governments about the contents of their local planning instruments, many Australian and Canadian cities are required by law to ensure that their local planning instruments are also consistent with the policies and objectives set out in state or provincial planning instruments (Hirt 2014, 63).

Why Local Governments May Not Consider the GHG Benefits of Densification

Despite the GHG reduction benefits of consolidating growth in cities, there are reasons to predict that cities are not meaningfully considering this potential benefit in their environmental review of proposed land use changes. First, some cities may lack the institutional capacity or expertise

²⁰ Of the countries reviewed in this study, some states and provinces also required local planning instruments to conform to regional and state or provincial plans and strategic policies. For example, municipalities in Quebec are not only required to ensuring that their zoning bylaws conform to the city’s land use plan, but also that the city land use plan is in conformity with land use plans adopted at the regional level, which must in turn be in conformity with provincial planning policies (Affaires Municipales Régions at Occupation du Territoire (Québec), p. 3). Thus, zoning bylaws must implement and support the policy directions, objectives, and criteria established in a hierarchy of land use plans adopted by higher levels of government, including any environmental objectives contained therein.

to conduct sophisticated analyses of the impact of land use decisions on GHG emissions.²¹ Forecasting the GHG impacts of land use changes requires substantial technical expertise and can be a time-consuming and costly process for cities, whose resources are often more limited than their state or federal counterparts. Indeed, one of the reasons environmental law was federalized in the United States in the mid-twentieth century was because cities (and states) lacked the expertise and financial resources to craft environmental policies based on the best available science (Kendall 2005).

Second, to the extent that cities have adopted GHG reduction targets as part of their climate goals—for example, New York City has committed to reducing city-wide GHG emissions to 80 percent below 2005 levels by 2050 (New York City Mayor’s Office of Sustainability n.d.)—they typically have only counted emissions produced within their borders in measuring progress towards their goals while excluding GHG emissions associated with consumption (Erickson et al. 2012; Rosenbloom 2021). In fact, a number of commentators have argued that this approach underestimates city inhabitants’ emissions and have called for cities to adopt a consumption-based accounting method instead (see, e.g., C40 2018).²² Yet cities have largely failed to respond to these criticisms. And so long as cities continue to use production-based accounting methods to measure progress towards their emissions goals, they may be inclined to use a similarly geographically constrained approach to measuring the GHG impacts of land use changes.²³ It seems apparent then that officials focused on meeting local GHG reduction targets have no incentive to consider the impact of their activities on emissions outside the city limits (indeed, they may even seek to push high-emitting activities outside their borders).

For these reasons, local officials may discount the emissions-reduction potential of new urban development in their environmental reviews unless cities are mandated to consider these potential emissions impacts, for example by a higher level of government or the judiciary. By contrast, higher levels of government, which have jurisdiction over and responsibility for broader geographic areas and more technocratic resources at their disposal, may be inclined to take a broader view of the GHG impacts of land use changes. Our research does not aim to determine why cities might take a narrow view of the GHG impacts of land use changes; instead, we have sought to document whether many cities are narrowly examining the GHG impacts of land use changes and whether involvement by higher levels of government in land use planning influences cities’ approach to thinking about growth and its connection to climate change.

²¹ This is more likely to be true for smaller or mid-size cities, while the opposite may be true for larger cities, particularly megacities.

²² See footnote 6 above for a description of the distinction between consumption-based and production-based accounting methods.

²³ Of the cities studied, we are not aware of any that have per capita emissions targets as opposed to absolute emission targets.

Part II. The Study

This study seeks to understand the extent to which major cities in Australia, Canada, and the United States consider the potential benefit that new development in cities might reduce GHG emissions in their environmental assessments of land use proposals. Consistent with the evidence discussed in Part I—that urban density is associated with lower GHG emissions relative to non-urban areas—we were specifically interested in assessing whether jurisdictions consider the GHG emissions that might be avoided through densifying cities, by avoiding new construction in outlying areas, when evaluating proposals for new development.²⁴

Selection of the Three Countries

We focus on American, Australian, and Canadian jurisdictions for three reasons. First, all three countries have high GDPs. Because there is a stronger negative correlation between density and household emissions in high GDP countries than low GDP countries (Grubler et al. 2012), greater urban density in major cities in these three countries could lead to important GHG reductions. Second, major cities in each country are experiencing acute housing shortages (Guran et al. 2019; McCormick 2018; Kershaw & Eaves 2019). Such shortages presumably increase the likelihood that restrictive development policies in cities will encourage urban sprawl that will increase GHG emissions. Some of these housing shortages correspond with significant population growth, creating further demands on the housing supply and potentially exacerbating urban sprawl. For example, in 2019, Toronto had the largest population growth in terms of absolute numbers of any city in North America (45,742 persons, a 0.94 percent increase from 2018) (Petramala & Chan Smyth 2020, 2).²⁵ During that same period, capital city growth accounted for 79 percent of Australia’s total population growth, with Melbourne and Brisbane experiencing the highest rates of growth, at 2.3 percent and 2.1 percent, respectively (Australian Bureau of Statistics 2020).

A third reason we selected these three countries is that they are all democratic federations where land use tends to be regulated locally, subject to some amount of oversight by state or provincial authorities. Broadly speaking, cities in the United States, Australia, and Canada derive their authority over local land use from state and provincial laws. These laws also limit local land use authority to varying degrees and prescribe certain requirements that local governments must follow. Local governments in all three countries have authority to set controls for how land in their jurisdictions may be used by adopting local zoning laws. Many cities are also permitted—and sometimes required by higher levels of government—to set their own long-term strategies

²⁴ For the purposes of this study, we assume that greater urban densification necessarily means less non-urban development.

²⁵ Ryerson University’s Centre for Urban Research and Land Development also reports, however, that New York City, Los Angeles, and Chicago all experienced negative population growth between 2018 and 2019. In particular, they report that “New York was the fastest contracting area in all of U.S. and Canada by a wide margin, with a population loss of 60,462 persons,” and that “Los Angeles and Chicago ... were second and third by population loss, with a loss of 35,080 and 25,619 persons respectively” (Petramala & Chan Smyth 2020, 2).

and goals for land use in their jurisdictions by adopting local planning instruments. However, while municipalities in the United States tend to maintain a fair amount of autonomy from state oversight, Australian states and Canadian provinces tend to exert more influence over local land use, including by requiring local conformity with provincial planning instruments and requiring state approval of zoning amendments (Hirt 2014, 84–87). This dynamic mix of state and local control over land use means that there is the potential for substantial intra-country, as well as inter-country, variation in review procedures to provide a basis for comparative assessment.

Hypotheses

In embarking on our research, we were skeptical about the extent to which major cities in the United States, Australia, and Canada account for GHG reduction benefits that might flow from densifying cities. As discussed in Part I, local governments may lack the incentive to consider the potential benefit that densifying cities reduce GHG emissions, because these reductions have global benefits and do not assist local governments in meeting whatever local GHG reduction goals their cities have set, typically based on reducing GHG emissions within the city. In addition, analyzing the implications of proposed land use changes for GHG emissions requires expertise and resources, and many cities across the United States, Australia, and Canada may lack the resources and capacity to account for the GHG reduction benefits of increasing density.

With these general points in mind, we established two hypotheses. One concerns the likely prevalence of analyzing the implications of densification on GHG emissions. The second concerns the comprehensiveness of such analysis when it is undertaken.

First, we hypothesize that local governments are not likely to assess the potential benefit that increasing urban density may reduce GHG emissions, using formal environmental review processes. This hypothesis reflects our understanding of local-government incentives and capacity constraints.

Second, where cities *do* analyze the potential benefit that increasing density may affect (i.e., reduce) GHG emissions, we hypothesize that they are not likely to do so in a comprehensive manner. For example, we predict that cities are only likely to assess the GHG impacts that would occur within their own geographic borders. Considering only intra-city GHG impacts likely means that cities will focus on the increases in GHG emissions that new development may generate within cities while ignoring the GHG emissions that might be reduced or avoided in outlying areas, beyond local borders, by increasing density within their jurisdictions.²⁶

Methodology

This study proceeded in two phases. In the first phase, we identified a sample of major cities in the United States, Australia, and Canada that have formal, documented processes in place for

²⁶ For example, cities may overlook the potential benefit of building more multi-family buildings in urban areas to reduce vehicle miles traveled in outlying areas, and therefore reduce transportation emissions in those areas.

reviewing the environmental impacts of proposed land use changes. To determine this sample, we first identified cities in the three countries meeting certain population thresholds. Then we researched whether the cities meeting these population thresholds are legally required to review the environmental impacts of land use changes and document their findings. Thus, cities in our sample meet both demographic and legal criteria.

In the second phase, we evaluated the extent to which the cities in our sample, all of which are required to undertake documented environmental reviews of land use changes, consider the GHG impacts of proposed land use changes in their formal review processes. For each city, we collected a sample of environmental review documents prepared in connection with land use actions affecting residential development. We then analyzed each document using a set of specific survey questions to evaluate the comprehensiveness of the document's assessment of GHG impacts.

First Phase: Identifying Sample of Cities

The first phase of our research was aimed at identifying a sample of major cities in the United States, Australia, and Canada that have formal, documented processes in place for reviewing the environmental impacts of local land use changes affecting residential development.

Demographic Criteria

To determine the sample of cities for our study, we began by sorting the cities in each country according to two demographic criteria: population rank and population size. First, using the most recently available federal census data, we identified the most populous city in each state or province for each country—one city from each of the fifty U.S. states, six Australian states, and ten Canadian provinces. We only considered the single largest city in each state or province in order to diversify the jurisdictions represented in our sample, because one of our goals was to better understand the effect of the involvement of higher levels of government in local land use processes, and what, if any, impact it has on reviewing local land use changes.²⁷

Then, we eliminated cities with populations under 400,000. This criterion stems from an interest in studying cities which have the greatest potential for emissions reductions through densification. A 2019 study by Riberio, Rybski, and Kropp found that densification in more populous cities yields greater emissions reductions than equivalent levels of densification in less populous cities, which suggests that increasing density in larger cities may be especially valuable if the goal is to reduce GHG emissions. Our preference for cities with larger populations is also informed by a study by Kallergis et al., which found a negative correlation between population size and housing

²⁷ We acknowledge, however, that there may be differences in the land use process of different cities within a state, and we do not purport to suggest that the conclusions we draw about state-local dynamics in one city apply to all cities within the same state.

affordability in cities across the globe (2018).²⁸ This fact suggests that restrictive residential zoning policies in larger cities would be more likely to undermine climate mitigation goals, to the extent that a lack of affordable housing in larger cities diverts new development to areas with higher per-household emissions.

Based on these two demographic criteria, our initial research yielded a preliminary sample of 37 cities. This sample is composed of 27 cities from the United States, five cities from Australia, and five cities from Canada. These cities are identified in tables 9, 10, and 11. The large number of American cities reflects the greater number of U.S. states compared with Australian states and Canadian provinces, and the higher overall population in the United States compared to Australia and Canada.

Legal Criteria

Once we identified cities that met our demographic criteria, we then conducted legal research to determine in which of the 37 cities local land-use decisions are subject to formal environmental review requirements by either state or local law, eliminating those cities from our preliminary sample that lack such requirements.

Our legal criteria had two main dimensions. First, we defined environmental review to mean a legally required process by which a proposed governmental action, or a proposal requiring governmental approval, is analyzed for its potential environmental impacts before the action is permitted to proceed, and where this analysis is formally documented and made available to the public. For our purposes, this definition included environmental review requirements that derive from standalone environmental review statutes,²⁹ as well as requirements embedded in planning statutes.³⁰ We did not define environmental review to include requirements for assessing whether a development proposal meets certain standards under existing environmental or building codes (such as energy efficiency standards or site contamination inspections), though we acknowledge that such practices may be widespread.

²⁸ Kallergis et al. also found that density negatively correlates with housing affordability, but they did not assess whether density *causes* decreasing affordability or is simply associated with it (2018).

²⁹ For example, as mentioned in the introduction, some U.S. and Australian states have specific environmental review legislation mandating that local governments consider the environmental impacts of decisions that include land use changes, such as New York State's Environmental Quality Review Act (known by its acronym "SEQRA").

³⁰ Here, we determined whether the state or provincial planning statute requires cities to undertake formal environmental assessments of land use changes. For example, Section 12(2)(b) of the State of Victoria's Planning and Environment Act 1987 (PEA) requires the planning authority to assess all local planning schemes (which contain local zoning bylaws) and subsequent amendments for "any significant effects which it considers the scheme or amendment might have on the environment or which it considers the environment might have on any use or development envisaged in the scheme or amendment."

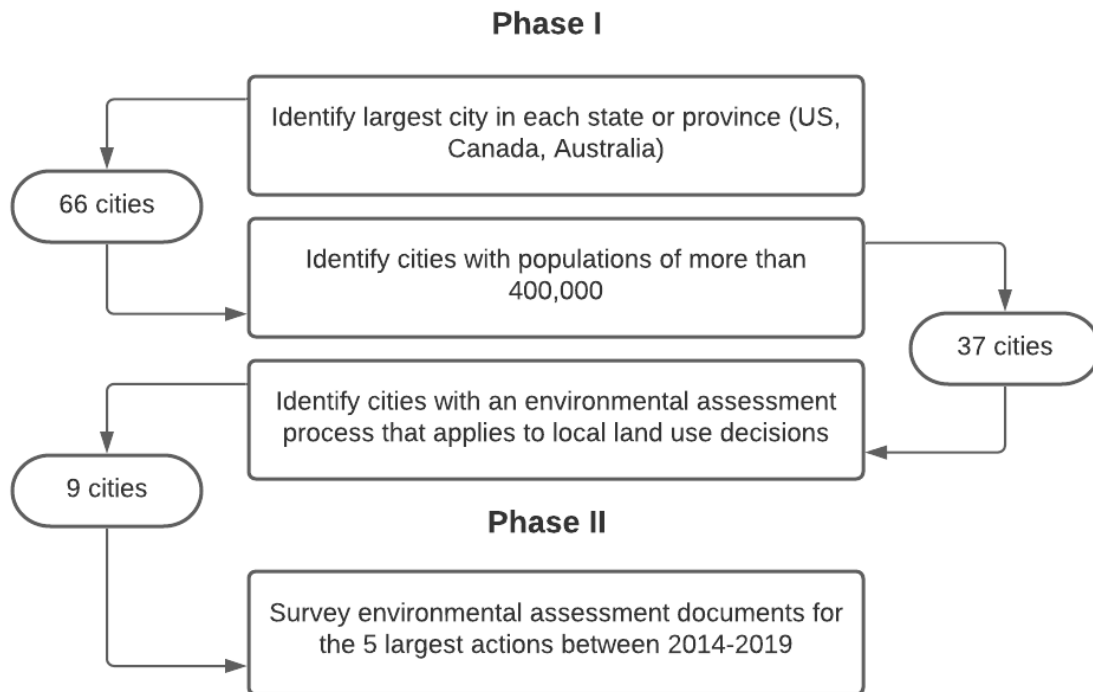
Second, in examining whether there are formal environmental review requirements for land use decisions, we focused on where such requirements exist for a specific type of land use decision, namely ones that legally restrict or expand permissible residential development in a specified local area (such as changes to zoning laws or amendments to statutory plans).³¹ We looked at whether there are environmental review requirements for land use changes that create greater (or lesser) scope for residential development, because we were interested in determining whether cities consider the potential reductions in GHG emissions from increasing density. We did not count local decisions pertaining to development proposals that conform to existing zoning standards (such as issuing a permit for construction), as we were only interested in land use decisions that yielded substantive legal changes to the amount of residential development permissible by law.

We focused on whether environmental review requirements exist for land use decisions, because some jurisdictions have environmental review requirements that only apply to limited types of local actions but not consistently to local land use decisions, such as rezonings. For example, the Georgia Environmental Policy Act requires environmental reviews for local government actions only where a local project is more than 50 percent funded by a state agency or involves state funds of \$250,000 or more (Official Code of Georgia Annotated § 12-16-3 (7)(B)). Moreover, cities that did not have a process that potentially applies to residential land use changes were generally excluded from our sample. For example, Portland, Oregon, has enacted local laws requiring environmental review of development proposals, but only when the proposed development affects designated environmental zones (Code of the City of Portland, Oregon § 33.430.220).

For this criterion, we consulted a variety of sources, including primary legal sources (such as statutory legislation, regulations, and local ordinances), and official state and local policy and guidance documents. We also supplemented our legal research with a review of secondary legal sources (such as law review articles and academic papers) and by conducting interviews with land use and planning experts. After eliminating cities which did not meet our legal criteria, we were left with nine cities: five in the United States (New York, Los Angeles, Seattle, Boston, and Minneapolis) and four in Australia (Sydney, Melbourne, Perth, and Adelaide).

³¹ By “statutory plan,” we mean planning instruments that local governments are legally required to adopt and which bind subsequent lawmaking by requiring the local government to adhere to the plan when adopting new laws, including zoning laws. Notably, this definition includes some but not all comprehensive plans, which, while common in the United States, do not always have a binding effect on local governments.

Figure 1: Diagram of research process



Second Phase: Sampling and Surveying Environmental Review Documents

In the second phase of our research, we collected and surveyed environmental review documents for land use changes from each of the nine cities included in our final sample. Our objective was to evaluate the extent to which these cities considered the climate impacts of proposed land use changes in their formal review processes. It should be noted that this study only focused on the ways in which authorities consider a proposal’s impact on GHG emissions (i.e., climate change mitigation), without reviewing the ways in which they might assess a proposal’s effect on the city’s ability to respond or adapt to the impacts caused by climate change (i.e., climate change adaptation).

We collected environmental review documents for five distinct actions in each city. These documents were obtained from public databases available on state and local government websites. Twenty-five documents came from five cities in the United States (New York, Los Angeles, Seattle, Boston, and Minneapolis), and 15 documents came from three cities in Australia (Sydney, Melbourne, and Adelaide), for a total of 40 documents.

All the documents collected were published between 2014 and 2019. We selected a five-year time frame to minimize the chance of a change in law and policy that might substantively affect the content or scope of analysis included in the documents for any one city. We also chose a time frame closer to the present to help ensure that the documents reflected current law and policy.

Within this five-year control period, we aimed to identify the five largest proposals for land use changes affecting residential development. We defined “largest” as those actions which were

projected to result in the greatest increases in population or housing units (depending on the metric used by the city). We went with the largest actions based on an assumption that, because they affect a larger area and are projected to result in the largest increases in population or housing units, they would be most likely to consider GHG impacts more comprehensively. In identifying the largest actions, we manually surveyed documents for information on projected growth impacts, but also reviewed official announcements and public news articles, and made direct requests for information to officials and local land use experts where possible. In isolating the sample of documents for our survey, we also excluded any actions which were deemed exempt from providing environmental assessment. Table 12 identifies each of the 40 actions included in our survey.

Once we collected environmental review documents for all 40 actions, we then reviewed the documents to determine the extent to which they considered the action's impact on GHG emissions.³² In analyzing these documents, we sought to answer eight questions, described below. These questions are intended to get at whether the documents bring to the attention of land use regulators and other stakeholders the reductions in GHG emissions that existing research indicates should flow from densifying cities. Because there is no single format for the environmental review documents we examined, and because they consider different factors, we included questions with nuanced differences that enable us to bring out general features of these documents.

1. Does the document³³ consider the GHG impacts of the proposed action?

Possible answers: yes or no.

As an initial matter, we determined whether the document discusses if the proposed action will impact GHG emissions (for example, if the document analyzes rezoning consequences, does it discuss whether the rezoning will likely increase or reduce GHG emissions?). A document was marked "yes" even if it merely discussed the GHG impacts of the proposal qualitatively; we did not limit "yes" answers to documents that attempt to quantify the volume of GHG emissions that might result (or be avoided) through a proposal. For example, a general statement that the proposal could be expected to lead to densification, and compact urban development is associated with lower GHG emissions compared with non-urban development, would be marked as considering the action's GHG impacts. Documents that only considered the proposed action's

³² It should be noted that there are many other environmental consequences of development apart from GHG emissions that an environmental review might consider, for example, impacts on natural resources, such as wetlands or biodiversity, on historic and cultural sites, or on air or water quality. Moreover, because a single local action likely only ever comprises a small fraction of global GHG emissions, officials may discount its contribution to climate change, such that it is not deemed legally significant for the purposes of review. Thus, it is quite plausible that an environmental review document might not even consider GHG emissions, particularly if the proposed action poses other more immediate environmental threats.

³³ We use the term "document" to refer to all documents associated with a single proposed action.

effects on the city’s ability to respond to climate change were assigned a negative response, consistent with our focus on climate change mitigation.

2. Does the document explicitly consider the GHG impacts of *densification*?

Possible answers: yes or no.

A rezoning or change to a legally binding planning document could impact GHG emissions in multiple ways. For example, it could induce construction that releases additional GHG emissions. Also, as described in Part I, such a change could reduce GHG emissions by enabling more people to live in multi-family buildings in cities and avoid long car commutes.

Through this question we sought to determine if the document expressly acknowledged a connection between the action’s density consequences and its impact on GHG emissions, regardless of whether detailed analysis was provided. Here, we looked for any express language in the documents referencing the potential for increasing density to reduce GHG emissions.

3. Does the discussion of a proposed action’s impacts on GHG emissions refer to the effects that the proposal might have on GHG emissions from: building operations, transportation, construction, solid waste, land use, and supporting infrastructure?

Possible answers: yes or no for each of the six categories. Documents could be marked as considering multiple categories.

While question 2 asks whether a document expressly considers the GHG emission reductions that might flow from densification, a document might still reveal the potential of densification to reduce GHG emissions without expressly referring to the consequences of densification for GHG emissions. As discussed in Part I, increasing urban density may reduce GHG emissions by lowering the use of automobiles or facilitating greater use of mass transit. Hence, a document that refers to a proposed rezoning as reducing GHG emissions from transportation might capture some of the GHG reduction potential of increasing density (even though the document does not expressly state that densification will reduce GHG emissions). Similarly, a document that refers to a proposed rezoning as reducing emissions from buildings might likewise capture some of the GHG reduction potential of urban densification, because densification may reduce GHG emissions from buildings.

We used this question to assess whether a document that discusses if a proposed action increases or reduces GHG emissions considers the proposal’s effect on GHG emissions from five categories of activity:

- building operations (emissions from the on-site or off-site generation of energy associated with new buildings during the project’s operation);
- transportation (emissions from trips to or from the site during the project’s operation associated with private or public modes of transportation);

- construction (emissions from the construction of the proposed action);
- solid waste (emissions associated with additional waste generated during the project’s operation); and
- supporting infrastructure (emissions from density-supporting infrastructure).

We derived this list of five categories inductively, after reviewing environmental review documents from the American and Australian cities. We counted a document as considering a proposal’s potential impact on a category of activity if the document referred qualitatively or quantitatively to the proposal affecting GHG emissions from the activity.

As mentioned above, discussing these impacts of a proposal on GHG emissions from some of these activities (such as transportation, building operations or land use) might indirectly capture some of the GHG reduction potential of densification. However, we say “might” advisedly because much depends on the specifics of the analysis.

4. In assessing the GHG impacts of a proposed action, does the document consider whether development might still occur if the proposal is not approved?

Possible answers: yes or no.

Maintaining restrictive land use policies may increase GHG emissions by displacing new development to outlying areas or other regions where GHG emissions are higher from transportation and buildings, as discussed in Part I. This question seeks to determine whether, in its assessment of GHG impacts of a proposed action that will increase urban density, the document recognizes that if the proposal is not approved, development might still occur elsewhere—for example in a non-urban area where GHG emissions per household might be higher. Recognizing that a “no-action” or “business-as-usual” scenario may still lead to development is one way to (indirectly) flag the potential that maintaining the status quo in a city might increase GHG emissions by leading to development elsewhere.

5. In assessing a proposed action’s GHG impacts, what is the largest geographic unit over which the impacts are analyzed?

Possible answers: project area, city, region, or state/province.

When a document analyzed the impact of a proposed action on GHG emissions, we sought to determine the largest geographic unit over which the impacts on GHG emissions were considered or studied (such as the lot where the development would occur). Our primary interest was whether the document only analyzed whether GHG emissions would increase or decrease in the area directly considered for the proposed land use changes (for example, the lots being upzoned), or whether the document expanded its scope of analysis to a larger area. The intuition behind this question is that an analysis covering only a relatively small area (such as only the project area) is likely to undercount the project’s potential for reducing GHG emissions, because it will not consider the GHG emissions reduced or avoided in outlying areas. Densifying any area

will likely increase GHG emissions in that area (because of emissions associated with every additional individual from the baseline population), but it also may affect GHG emissions beyond the area, and even the city's borders. For example, building more multi-family buildings in a city might enable some people to move from a neighboring non-urban area into the city, reducing vehicle miles traveled in the non-urban area, and thus reducing transportation-related GHG emissions.

6. Does the document assess GHG emissions outside of the city's geographic borders that would be avoided as a result of the action?

Possible answers: yes or no.

This question sought to determine whether the document explicitly considered the GHG emissions that might be avoided outside the city by allowing new development within a city. It uses consideration of emissions avoided outside the city as one measure of the comprehensiveness of the document's analysis. Enabling new development in a city might avoid the need for new development in outlying areas and therefore avoid GHG emissions in those outlying areas. We assigned a "yes", if the document qualitatively or quantitatively discussed the proposed action's potential to reduce GHG emissions outside the city.

7. If the document assesses GHG emissions outside of the city's geographic borders that would be avoided as a result of the action, does it quantify these impacts?

Possible answers: yes or no.

For documents that considered emissions avoided outside of a city's borders (i.e., documents with "yes" answers to question 6), we sought to identify whether the document's discussion was qualitative, or whether it sought to quantify the avoided GHG emissions. Quantification of avoided emissions might be seen as a proxy for analytical sophistication and comprehensiveness.

8. As a whole, how does the document characterize the proposed action's GHG impact?

Possible answers: beneficial, harmful, or both.

Finally, we assessed whether the document characterized the action's overall GHG impact as beneficial or harmful. We defined "beneficial" as reducing GHG emissions or creating GHG benefits, and "harmful" as increasing GHGs or hindering emissions reductions. We marked a document as "both" where it did not draw an overall conclusion, but rather found that one or more individual elements of the action would produce both beneficial and harmful effects, or where one element of an action was determined to have a beneficial impact and another was determined to be harmful. For example, if the document concluded that GHG emissions from transportation would decline while construction would cause an increase in emissions and did not provide an overall assessment of the proposed action's effect on GHG emissions, we marked the document as "both."

In conducting our analysis, we did not take into account whether an impact was found to be legally significant under applicable law, because jurisdictions in the United States can find that an action results in an increase in emissions (i.e., harmful), but that the impact does not cross a threshold of legal significance so as to trigger certain procedural or substantive requirements prescribed by law.

Part III. Findings

Our goal was to assess the extent to which major cities in three high GDP countries use environmental review to analyze densification's potential for reducing GHG emissions. Our findings fall into two broad categories: (1) ones regarding the prevalence of a formal environmental review of land use changes at the local level and the source of these requirements; and (2) ones regarding the comprehensiveness of environmental reviews in analyzing the GHG consequences of density-inducing land use changes. These findings are discussed in detail below.

Prevalence and Sources of Local Environmental Review Requirements

Finding 1. *Many cities have no legal requirement to formally assess the potential environmental impacts of land use changes affecting residential development.*

Of the 37 cities that met our demographic criteria, only nine (24 percent) were legally required to conduct formal environmental assessments of local land use changes affecting residential development (such as residential rezonings). Of these nine cities, however, one (Perth) was routinely exempted by state authorities from having to conduct formal environmental impact assessments for residential rezonings during our study's survey period.

Our country-level information suggests cross-country differences in the pervasiveness of environmental review requirements. Local land use decisions were subject to environmental review requirements in four (80 percent) out of the five Australian cities we researched, compared to five of the 27 cities reviewed in the United States (19 percent). Notably, none of the five Canadian cities we researched were subject to either state or local law requirements to publish an assessment of the environmental impacts of proposed land use changes affecting residential development (Table 1).

Finding 2. *Cities not required by state law to assess the environmental impacts of land use decisions did not independently adopt their own local requirements.*

Of the 28 (out of 37) cities in the United States, Australia, and Canada in which there is no state (or provincial) law requiring local governments to assess the environmental impacts of land use changes, no city has independently adopted its own local requirements (Table 1). Notably, the four cities that *have* local laws or ordinances pertaining to the environmental review of land use changes (New York, Los Angeles, Seattle, Boston) use them to implement state environmental review requirements at the local level.

Table 1: State and city environmental review (ER) laws and their application to local land use decisions in sample cities

City	State ER law?	State ER law applies to city?	State ER law applies to land use?	Local ER law applies to land use?
UNITED STATES				
New York	yes	yes	yes	yes
Los Angeles	yes	yes	yes	yes
Chicago	no	-	-	no
Houston	no	-	-	no
Phoenix	no	-	-	no
Philadelphia	no	-	-	no
Jacksonville	no	-	-	no
Columbus	no	-	-	no
Charlotte	yes	no	-	no
Indianapolis	yes	no	-	no
Seattle	yes	yes	yes	yes
Denver	no	-	-	no
Boston	yes	yes	yes	yes
Nashville-Davidson	no	-	-	no
Detroit	no	-	-	no
Oklahoma City	no	-	-	no
Portland	no	-	-	no
Las Vegas	no	-	-	no
Louisville-Jefferson	no	-	-	no
Baltimore	yes	no	-	no
Milwaukee	yes	no	-	no
Albuquerque	no	-	-	no
Atlanta	yes	yes	no	no
Kansas City	no	-	-	no
Omaha	no	-	-	no

City	State ER law?	State ER law applies to city?	State ER law applies to land use?	Local ER law applies to land use?
Virginia Beach	yes	no	-	no
Minneapolis	yes	yes	yes	no ³⁴
AUSTRALIA				
Sydney	yes	yes	yes	no
Melbourne	yes	yes	yes	no
Brisbane	yes	yes	no	no
Perth	yes	yes	yes	no
Adelaide	yes	yes	yes	no
CANADA				
Toronto	yes	yes	no	no
Montréal	yes	yes	no	no
Vancouver	yes	yes	no	no
Calgary	yes	yes	no	no
Winnipeg	yes	yes	no	no

Source: Authors

Finding 3. *Legal requirements for environmental review of land use changes in surveyed U.S. cities originate primarily from state environmental review statutes, while requirements in surveyed Australian cities are mostly from state planning statutes.*

In all five U.S. cities where local land use changes are required to undergo formal environmental review, these requirements are set out in state environmental review statutes. While these statutes' procedural (and sometimes substantive³⁵) requirements apply to decisions affecting

³⁴ Minneapolis does not appear to have a local law implementing Minnesota's environmental review requirements. Though, the Minneapolis Municipal Code does state that an application for rezoning is not deemed complete unless "all required environmental reviews" are submitted. Minneapolis Code of Ordinances, 525.140 (a)(5).

³⁵ Environmental review in the United States was initially conceived as strictly creating procedural requirements. Under this conception of the law, an environmental review statute might require a decision-maker to consider potentially harmful environmental impacts and possible alternatives, but it does not require them to choose the least environmentally harmful alternative. Its principal purpose is not necessarily to avoid adverse impacts on the environment; rather, it is simply meant to inform decision-makers and the public about an action's potential harms. Some state statutes, however, have gone a step further by imposing substantive

local residential land use changes, they also cover a range of other state actions (such as infrastructure projects) and are not strictly confined to the universe of land use decisions. On the other hand, in three out of four cities in Australia, environmental review requirements came from state planning statutes, with the exception being the city of Perth (Table 2). Notably, all three Australian cities subject to requirements stemming from state planning statutes were in states that also had environmental review statutes, but these environmental review statutes did not apply to land use decisions. Instead, requirements for the environmental review of land use decisions in Sydney, Melbourne, and Adelaide came out a distinct and separate legal framework for planning.

Table 2: State law source and type of statute in cities with legal requirements for the environmental review of land use changes

City	Source of legal requirement	Type of statute
UNITED STATES		
New York	State Environmental Quality Review Act	environmental review
Los Angeles	California Environmental Quality Act	environmental review
Seattle	State Environmental Policy Act	environmental review
Boston	Massachusetts Environmental Policy Act	environmental review
Minneapolis	Minnesota Environmental Policy Act	environmental review
AUSTRALIA		
Sydney	Environmental Planning and Assessment Act 1979	planning statute
Melbourne	Planning and Environment Act 1987	planning statute
Perth	Environmental Protection Act 1986	environmental review
Adelaide	Development Act 1993 / Planning, Development and Infrastructure Act 2016	planning statute

Source: Authors

Summary of Findings on the Prevalence and Sources of Local Environmental Review Requirements

To test our first hypothesis—i.e., that few cities use environmental review to assess the GHG impacts of land use changes—we surveyed the legal frameworks of large cities in the United States and Australia. We found that many large cities in the United States, Australia, and especially Canada, are not legally required to conduct formal environmental assessments of land use changes. Out of the 37 American, Australian, and Canadian cities that met our demographic

requirements in addition to procedural ones, including requiring a decision-maker to mitigate identified harms where feasible.

criteria, only nine are subject to a process for assessing the environmental impacts of land use changes: five in the United States (New York, Los Angeles, Seattle, Boston, and Minneapolis) and four in Australia (Sydney, Melbourne, Perth, and Adelaide). However, while Perth has laws in place subjecting land use decisions to formal environmental assessment, in practice, we found that it has been routinely exempted from having to conduct assessments of such changes, thus reducing the number of cities required in practice to consider environmental impacts to eight.³⁶

Notably, while five Canadian cities met our demographic criteria, we discovered that none of them subject proposals for the types of local land use changes contemplated by our study—residential rezonings—to a formal environmental review process in which decision-makers are required to produce a written report, study, or document analyzing or describing the environmental impacts of the proposed action.³⁷ Instead, environmental impacts may be debated verbally at local council hearings or appellate tribunals, for which there are limited records of the discussions. Because the second phase of our research relied on analyzing environmental review documents produced for local land changes, the five Canadian cities were eliminated from our sample for the remainder of the analysis.

This finding that many large cities are not required to analyze the GHG (or more broadly, environmental) impacts of land use changes suggests that many large cities may not systematically analyze the GHG reduction potential of upzonings and other measures to densify cities. To clarify, this finding does not conclusively prove that cities are not considering this potential; they may still consider densification's potential to reduce GHG emissions, even though no legal requirement exists for formal environmental review.

Our findings about the prevalence of environmental reviews for local land use actions are consistent with our hypothesis that local governments are not likely to assess the potential benefit that increasing urban density may affect (i.e., reduce) GHG emissions using formal environmental review processes. However, the finding extends beyond this hypothesis, as it suggests that many local governments in major cities in the three countries are not systematically analyzing any of the environmental impacts (not just the GHG impacts) of land use changes through environmental review-like processes.

³⁶ Because residential land use decisions in Perth have been routinely exempted from environmental assessments, Perth was excluded from the second phase of our research on the comprehensiveness of environmental review documents on technical grounds, as no environmental review documents were available for our study's control period.

³⁷ Because all five of the Canadian cities which met our demographic criteria did not meet our legal criteria, they were excluded from the second phase of our research on the comprehensiveness of environmental review documents.

Comprehensiveness of Environmental Review Documents

Finding 1. *Jurisdictions in both the United States and Australia, which are legally required to assess the environmental impacts of local land use changes, were very likely to consider the action’s GHG impacts.*

The vast majority of the 40 documents surveyed across both countries analyzed the impact of the proposed action on GHG emissions. Of the 40 actions surveyed, 36 (90 percent) analyzed the action’s GHG impacts, representing 24 (95 percent) of the 25 actions surveyed in the United States, and 12 (80 percent) of the 15 actions surveyed in Australia (table 3). Of the four documents not analyzing GHGs, one came from Seattle and three were from Sydney.

Finding 2. *Only about half of all documents analyzing GHG impacts explicitly considered the GHG benefits of densification, though actions in the United States were one-and-a-half times more likely to do so than those in Australia.*

While the vast majority of the 40 documents analyzed the proposed action’s GHG impacts, only about half expressly considered the link between the action’s densification consequences and GHG emissions. Of the 36 documents that considered GHG impacts, 20 (56 percent) considered the GHG impacts of increased density. However, jurisdictions in the United States were approximately one-and-a-half times more likely than those in Australia to consider this link. Of the 24 actions from the United States that analyzed GHGs, 15 (63 percent) included at least some discussion of the link between densification and climate mitigation, compared to five actions (42 percent) in Australia (Table 3).

Table 3: Frequency/Proportion of environmental review documents which analyze GHGs and explicitly consider the GHG impact of densification

Country	documents surveyed	analyzes GHGs		considers GHG impact of densification	
United States	25	24	96%	15	63%
Australia	15	12	80%	5	42%
Total	40	36	90%	20	50%

Source: Authors

Finding 3. *In both Australian and U.S. cities, documents were most likely to assess an action’s effect on transportation and building emissions.*

In both countries, where documents considered GHG impacts, they most frequently analyzed emissions from building operations and transportation impacts. These elements were assessed for more than two-thirds of documents surveyed, while only about one-third of documents analyzed construction and solid waste emissions. Of the 36 documents that considered the action’s GHG impacts, 30 (83 percent) considered emissions from building operations; 29 (81 percent)

considered transportation emissions; 12 (33 percent) considered construction and solid-waste emissions; and two (six percent) considered emissions from supporting infrastructure (table 4).³⁸ Notably, only 23 (64 percent) considered emissions from *both* transportation and building operations, rather than just one element or the other.

At the country level, however, there are some notable differences. While documents in both countries most frequently analyzed the emissions impacts of building operations and transportation, building operations were the most frequently analyzed element in the United States, appearing in 23 (96 percent) of the 24 documents that analyzed GHG impacts, while transportation was most frequently analyzed in Australia, appearing in 11 documents (92 percent). On the other hand, U.S. jurisdictions analyzed transportation in 71 percent of documents, while those in Australia analyzed building operations in roughly half of the documents (58 percent). Moreover, all documents analyzing emissions from construction and solid waste came from jurisdictions in the United States, constituting exactly half the documents in the United States that analyzed GHGs. Similarly, all documents analyzing emissions from supporting infrastructure came from jurisdictions in Australia, though these were only a small fraction of the total (Table 4).

Table 4: Elements covered in GHG analysis in environmental review documents

Element	Frequency in Subsample (analyzes GHGs)					
	Total (36)		United States (24)		Australia (12)	
building operations	30	83%	23	96%	7	58%
transportation	29	81%	17	71%	11	92%
construction	12	33%	12	50%	0	-
solid waste	12	33%	12	50%	0	-
supporting infrastructure	2	6%	0	-	2	17%

Source: Authors

Finding 4. *Jurisdictions in both countries were unlikely to account for development that would occur elsewhere in the action’s absence.*

When analyzing GHG impacts, few documents considered the potential development that might occur elsewhere in the absence of the proposed action. Of the 36 documents that considered the action’s GHG impacts, only eight (22 percent) considered development that would otherwise occur in a no-action scenario (Table 5). Documents from the remaining actions either presumed that no development would occur in the action’s absence or did not consider a no-action scenario at all.

³⁸ Because more than one of these elements are typically assessed in a single document, total percentages do not equal 100 percent.

Table 5: Frequency/Proportion of environmental review documents which account for development in a no-action scenario

Country	Analyzes GHGs	Accounts for other development	
United States	24	7	29%
Australia	12	1	8%
Total	36	8	22%

Source: Authors

Finding 5. *Most documents in both countries only analyzed projected GHG impacts within the project area. However, jurisdictions in Australia were more likely than those in the United States to consider GHG impacts outside the project area.*

The vast majority of documents surveyed did not look outside the immediate project area in analyzing GHG impacts. Documents most frequently assessed GHG impacts at the project level and assessed city-wide GHG impacts least frequently. Of the 36 documents that considered the action’s GHG impacts, 29 (81 percent) had a geographic scope of analysis that included only the project area; two (seven percent) used a regional scope of analysis for at least one element; and five (or 14 percent) used a state-wide scope of analysis for at least one element (table 6). Notably, all five actions which analyzed state-wide impacts were in Adelaide (Australia), and the two actions which analyzed regional impacts were in Seattle (United States).

Of the 24 documents from the United States that considered GHG impacts, 22 (92 percent) had a geographic scope of analysis that only included the project area, and two (nine percent) considered regional impacts for at least one element of the GHG analysis (both from Seattle). Of the 12 documents from Australia, seven (58 percent) analyzed impacts from within the project area (all from Melbourne and Sydney) and five considered state-wide impacts (all from Adelaide) (Table 6).

Table 6: Largest geographic scope of analysis in environmental review documents

Country	Analyzes GHGs	Project area		City-wide		Regional		State-wide	
United States	24	22	92%	0	-	2	9%	0	-
Australia	12	7	58%	0	-	0	-	5	42%
Total	36	29	81%	0	-	2	6%	5	14%

Source: Authors

Finding 6. *Cities in both countries were unlikely to consider avoided extra-municipal GHG emissions.*

As a whole, cities were not particularly likely to assess emissions from outside of their own geographic borders that would be avoided as a result of the action. Of the 36 documents that analyzed GHG impacts, nine (25 percent) assessed avoided extra-city GHG impacts. At the country level, four (17 percent) of the 24 documents from the United States analyzing GHG impacts assessed the GHG impacts that would occur outside of the city’s geographic borders as a result of the action, while five (42 percent) of the 12 actions from Australia did the same (table 7). As with Finding 5, all five of the documents from Australia that considered avoided emissions outside the city came from Adelaide. Of the four documents from the United States that considered avoided extra-municipal emissions, one came from Los Angeles and three from Seattle.

Finding 7. *The city of Seattle was the only jurisdiction to quantify avoided extra-municipal GHG emissions.*

Not only were cities unlikely to consider avoided extra-municipal GHG emissions, they were also unlikely to assess those avoided emissions quantitatively where they did consider them. Of the nine documents that considered avoided extra-municipal emissions, only two (22 percent) assessed those impacts quantitatively. These made up only six percent of the 36 actions that analyzed GHG impacts. Both documents that quantitatively assessed the GHG impacts that would be avoided outside the city’s borders came from Seattle (both quantified avoided GHG emissions for transportation), while none came from Australia (Table 7).

Table 7: Frequency/Proportion of environmental review documents that assess and quantify extrajurisdictional GHG impacts

Country	Analyzes GHGs	Assesses avoided GHG emissions		Quantifies avoided GHG emissions	
United States	24	4	17%	2	8%
Australia	12	5	42%	0	-
Total	36	9	25%	2	6%

Source: Authors

Finding 7. *The majority of documents from Australia characterized the GHG impact of an action as having beneficial GHG impacts, while the majority of documents from the United States characterized the GHG impact as harmful.*

Between the two countries, there was a fairly even spread between actions that characterized GHG impacts as beneficial, harmful, and both. Of the 36 documents that analyzed the GHG impacts of the action, 14 (39 percent) characterized the impact as harmful; 12 (33 percent) characterized the impact as beneficial; and 10 (28 percent) characterized the impact as both

beneficial and harmful.³⁹ However, jurisdictions in the United States were more likely to conclude that the action would cause an increase in GHG emissions, while Australian jurisdictions were more likely to conclude that an action would reduce GHG emissions. Of the 12 actions that strictly characterized the GHG impacts of an action as beneficial, 10 (83 percent) came from jurisdictions in Australia. Moreover, all 14 of the actions that strictly characterized the GHG impacts as harmful came from jurisdictions in the United States (table 8).

Broken down at the country level, however, 10 (83 percent) of the 12 actions from Australia that analyzed GHG impacts characterized the impacts as being beneficial overall, while none characterized the impacts as harmful overall. By contrast, two (eight percent) of the 24 actions from the United States that analyzed GHG impacts characterized the impacts as beneficial overall, while 14 (58 percent) characterized the impacts as harmful overall. Jurisdictions in the United States were also more than twice as likely than those in Australia to conclude that a single action would both reduce emissions in some aspects and increase emissions in others (33 percent in the United States and 17 percent in Australia) (Table 8).

Table 8: Characterization of GHG impacts as beneficial, harmful, or both in environmental review documents

Country	Analyzes GHGs	Beneficial		Harmful		Both	
United States	24	2	8%	14	58%	8	33%
Australia	12	10	83%	0	-	2	17%
Total	36	12	33%	14	41%	10	28%

Source: Authors

Summary of Findings

To test our second hypothesis (i.e., that cities that conduct formal environmental reviews of land use changes would be unlikely to consider the GHG benefits of increasing density), we surveyed 40 environmental review documents from eight American and Australian cities legally required to consider the environmental impacts of land use changes: New York, Los Angeles, Seattle, Boston, Minneapolis, Sydney, Melbourne, and Adelaide. In two cities, Adelaide and Melbourne, the documents we surveyed were prepared by state authorities, not the local government.⁴⁰ Our survey produced mixed evidence about whether the analyses recognize the potential benefit that densification may reduce GHG emissions. For example, of the 40 documents we examined, 36

³⁹ Note that the percentages listed were averaged and therefore may not total 100 percent.

⁴⁰ As noted above, the Victorian and South Australian state governments have retained the authority to unilaterally adopt zoning amendments affecting local governments' jurisdictions. In the cases of both Adelaide and Melbourne, all five documents were prepared by state authorities. For every other city, the documents we surveyed were prepared exclusively by local government authorities.

(96 percent) analyzed the GHG impacts of the proposed land use changes, but only 20 (50 percent) of the 40 documents expressly drew the connection between densification and reducing GHG emissions.

Many of the documents discussed the proposed action’s impacts on GHG emissions from transportation and building operations, the two main sectors through which densification reduces GHG emissions.⁴¹ On the other hand, there are also indications that the documents were considering the impacts of proposals too narrowly in geographic terms to fully account for the potential reductions in GHG emissions. For example, of the 36 documents that analyzed a proposed action’s GHG impacts, 29 (81 percent) discussed whether GHG emissions would increase or decrease only in the project area (a smaller subsection of the city where the changes were proposed to take place).⁴² Thus, the overwhelming majority of documents did not address whether the proposal to increase urban density would reduce GHG emissions beyond that subsection of the city, for example through reducing vehicle miles traveled in a nearby non-urban municipality by enabling more people to live in the city.

The analysis’s narrow geographic unit may help to explain why only 12 (33 percent) of the 36 documents concluded that the proposed action—which in all cases was intended to enhance urban density—would reduce GHG emissions. The question of whether any particular upzoning or initiative to increase development in an area of a city will reduce GHG emissions is ultimately an empirical one. However, the small percentage of documents concluding that proposals to increase urban densification will reduce GHG emissions is inconsistent with the thrust of academic research that dense urban areas have lower GHG emissions, and therefore raises questions about the adequacy of the analysis in environmental review documents of the GHG impacts of densification.

Part IV. Analysis and Policy Implications

Recognition of Densification’s GHG Reduction Potential

Overall, our research suggests that the GHG reduction potential of urban densification is, at best, imperfectly reflected in environmental assessments of land use changes in the United States, Australia, and Canada. Notably, three out of four cities that met our demographic criteria do not have formal environmental review requirements that apply to local land use decisions affecting residential development. One city (Perth) failed to produce environmental impact assessments for actions taking place during our control period, despite having such requirements in place.

Interestingly, however, of the eight remaining cities that we surveyed which *did* routinely analyze and report on the potential environmental impacts of proposed land use changes, all

⁴¹ Eighty-one percent of the documents we surveyed addressed the GHG impacts of the proposal for transportation, and 83 percent discussed the impacts for building operations. However, while all 36 documents considered GHG impacts from transportation *or* building operations, only half of the documents considered *both* elements.

⁴² In none of the documents surveyed did the “project area” encompass the city as a whole.

eight analyzed GHGs in at least one action, and all but two cities (Seattle and Sydney) analyzed GHG impacts in every action that we reviewed. These findings suggest that while cities are not likely to undertake formal environmental assessments as part of their land use review process, those cities which do so are likely to analyze GHG impacts. Still, environmental review documents often inadequately analyzed the GHG effects of densification, especially documents from U.S. cities.

U.S. cities generally went into much greater depth in their analyses of potential environmental harms than Australian cities in the documents we surveyed. In fact, environmental review documents for actions in the United States were on average several hundred pages longer than those for actions in Australia. However, the fact that environmental impact assessment reports are lengthier in the United States does not necessarily mean that these reports more comprehensively analyze the climate impact of densification. In fact, despite being on average shorter, Australian jurisdictions were far more likely to conclude that density-inducing actions within city borders would create GHG benefits, consistent with the academic literature on the relationship between density and GHGs in major cities in high GDP countries.

The tendency of U.S. cities to analyze GHG impacts only from within a hyper-localized geographic area, combined with the emphasis state environmental review statutes place on disclosing significant *adverse* impacts,⁴³ might make U.S. cities more prone to conclude that an action will have harmful GHG consequences. By focusing their analysis on determining environmental harms from emissions increases in the project area, U.S. cities might be less likely to take into account broader geographic shifts in the distribution of populations and emissions that would be avoided by encouraging denser urban development.

In fact, jurisdictions in the United States and Australia already widely consider emissions from the building and transportation sectors, the two elements that most directly benefit from densification. However, our findings raise questions about the appropriateness of the geographic scale at which GHG impacts are analyzed. In fact, analyses for most actions were limited to assessing the impacts occurring only within the geographic scope of the project area (a subsection of the city). There were five documents from Adelaide, Australia which both analyzed state-wide impacts and assessed the GHG impacts that would occur outside of the city's own geographic borders due to avoided development. In all five, the state minister was the entity responsible for both proposing the action and preparing the accompanying documentation, not

⁴³ For example, New York State's Environmental Quality Review Act (SEQRA) only requires an EIS to be prepared where there is a determination that the action is likely to result in a "significant *adverse* impact" (SEQRA, § 617.1(d)). Likewise, the California Environmental Quality Act (CEQA) defines "significant effect on the environment" to mean "a substantial, or potentially substantial, *adverse* change in the environment" (CEQA, § 21068). Washington's State Environmental Policy Act (SEPA) only requires an environmental impact to be prepared on for actions "having a probable significant, adverse environmental impact" (SEPA, § 43.21C.031).

the local council.⁴⁴ Each of these environmental review documents from Adelaide also characterized the GHG impact of the action in a positive manner, concluding that the action would reduce GHG emissions.⁴⁵

These findings provide suggestive evidence that higher levels of government may be more likely to consider GHGs impacts on a larger geographic scale, which should also make them more likely to view densification as having beneficial climate impacts. Thus, one policy implication of this research is that higher levels of government may wish to facilitate or mandate cooperation between cities in land use planning, or (for those jurisdictions which lack them) to establish regional or state/provincial authorities for these purposes.

Our findings could be also interpreted to suggest that cities will not properly consider the GHG benefits of density unless they are legally mandated to do so. The finding that cities do not appear to fully recognize the GHG reduction potential of densification, at least through environmental reviews of land use changes, also raises the policy question of whether cities should be encouraged to do so. Thus, one policy implication of this research is that advocates might wish to push for law reforms that would require cities to more thoroughly consider the distributional impacts of urban densification on regional emissions in their environmental reviews. Our research suggests several ways in which environmental assessments might be improved to better capture the GHG reduction potential of densifying cities, whenever an environmental review process is desirable. These include:

- increasing the geographic scope for the analysis of GHG impacts beyond the project area to account for the regional or state-wide impacts of densifying the area of the city; and
- consistently considering the implications of densification proposals for GHG emissions from transportation and buildings outside (and inside) the project area so as to account for emissions that would be avoided (and reduced) through densification proposals.

Our research also tried to assess the extent to which jurisdictions quantify the potential GHG reduction benefits of densification. Thus, when reviewing the 36 documents which considered GHGs, we looked at whether they quantified the emissions avoided outside the city through the proposed densification within the city (question 7). Only two out of 36 documents quantitatively analyzed avoided emissions outside the city's borders; both were from Seattle and only analyzed avoided emissions from transportation. As this finding suggests, the bulk of the consideration of potential GHG reductions from densification was qualitative and did not include quantitative projections of the GHG emissions that would be avoided (or reduced) from densifying the city.

⁴⁴ As reported in our findings above, the documents we reviewed from Adelaide were prepared by the state minister and not the local government.

⁴⁵ Interestingly, two actions from Seattle both conducted GHG analyses on a regional scale and *quantified* extrajurisdictional impacts from avoided development, but only did so for the transportation element. This analysis may have been done in response to the Puget Sound Regional Council's Regional Transportation Plan, which applies to the city of Seattle.

Thus, another option would be to invest in quantifying the potential GHG emission reductions from densifying. As discussed already, very few of the environmental review documents that we reviewed attempted to quantify the emissions that would be avoided by densifying cities. While examining these documents, we noticed there were more efforts to quantify the increases in GHG emissions associated with projected population gains, such as emissions from the construction and operation of new buildings. An interesting policy question is whether it would be worthwhile for cities to invest more in quantifying the GHG emissions that would be reduced through densification, which, as described in Part I, come through reductions in transportation and building-related emissions associated with shifts in the distribution of the population between urban and adjacent non-urban areas.

The benefits of increased quantification would have to be weighed against the downsides, such as the technical complexity and resource costs of quantification. In performing quantitative analysis for avoided emissions, a jurisdiction would not only need to calculate the expected emissions impact for the development it is proposing, but also predict regional growth patterns and calculate potential emissions for development that might occur in the absence of the proposed action. Whether to invest in quantifying the GHG emission reduction potential of densification proposals also depends on the importance of the environmental review process in determining land use regulation. There may be little utility in developing methodologies for quantifying the emission reduction potential if environmental assessments do not influence policy makers much, and densification can be achieved more effectively through other means. We return to the question of how much environmental assessments influence densification when we discuss ideas for future research suggested by our findings.

Moreover, because quantitative analyses are presumably more complex and expensive to conduct, it may not be practical for cities to attempt to quantify avoided emissions on a case-by-case basis through environmental review. Alternatively, local or state governments (or even regional authorities) could attempt to model projected growth patterns based on existing zoning laws and calculate potential emissions increases based on where development could be expected to occur. Using these models, authorities could then potentially develop policies or adopt laws that help to redirect projected growth to areas with lower emissions. While these growth models could serve as a basis for making GHG impact determinations in an environmental review (while also helping to lower the cost of analysis), governments could employ growth models even in the absence of environmental review requirements.

Cross-Country Comparison of Environmental Reviews of Land Use

Our efforts to compare how major cities in the United States, Australia, and Canada consider the GHG reduction potential of urban densification through environmental assessments of land use changes revealed significantly different approaches to assessing environmental impacts of land use changes across these three countries.

While many large U.S. cities are generally not required to assess the environmental impacts of land use changes, the five U.S. cities in our sample with such requirements are required to analyze a proposal's environmental impacts as part of a NEPA-like environmental review procedure. These requirements stem from a distinct legal framework that places conditions on,

but exists independently from, a city's authority to adopt zoning laws.⁴⁶ As mentioned above, these requirements often lead to the production of long, technocratic environmental review documents which, by design, focus on hyperlocal impacts.

In Canada, on the other hand, environmental considerations in the land use process are more attenuated. Rather than require a report analyzing projected impacts for every land use change, the legal frameworks in those jurisdictions require the zoning authority to demonstrate that the proposed land use change conforms to the environmental (and other) objectives articulated in land use plans adopted by provincial and local governments, as well as regional authorities. While each province we surveyed in Canada has an environmental review statute that operates very similarly to those in the United States, these formal review procedures do not apply to local land use actions. Rather, to the extent that a proposal for a zoning change is deemed consistent with, for example, a planning instrument's objectives to increase density within the city as a means for reducing GHG emissions, the proposal would be deemed legally sufficient; formal environmental review reports are neither required nor routinely produced. The lack of state or local requirements to produce reports assessing the environmental impacts of proposed land use changes is why no Canadian cities are among the eight cities whose environmental assessments were analyzed, even though five Canadian cities met our population criteria. However, the lack of legal requirements to produce environmental assessments of land use changes does not necessarily mean that Canadian cities are not taking into account the climate benefits of densification in their planning processes. In fact, several Canadian cities and provincial governments we researched have adopted policies for densifying cities and appear to weigh GHG benefits quite heavily in their official planning strategies.⁴⁷

In between these American and Canadian ends of the spectrum, several Australian jurisdictions require some formal analysis of a proposal's impact on the environment. However, the level of analysis demanded by the environmental review was significantly less than what can be observed in the United States context. As in Canada, most jurisdictions in Australia we surveyed had

⁴⁶ Interestingly, state law in all five of the U.S. cities that had environmental review requirements also had rules or policies in place that require a review of the action's potential impact on GHG emissions.

⁴⁷ For example, Ontario's Planning Act requires that all official plans contain policies that identify goals, objectives, and actions to mitigate greenhouse gas emissions. Toronto's Official Plan sets out a growth policy that specifically contemplates the impact of urban densification on regional GHG emissions. In particular, it adopts a coordinated approach to the redevelopment of urban land to accommodate regional growth, recognizing the concentration of new development in existing urban areas as a means for reducing "the pace at which the countryside is urbanized; ... reliance on the private automobile; ... greenhouse gas emissions; [and the] consumption of nonrenewable resources." As part of this coordinated approach, the Official Plan directs the city of Toronto to work with neighboring municipalities and the Province of Ontario to implement a planning strategy that, among other things, "focuses urban growth into a pattern of compact centres, mobility hubs, and corridors connected by a regional transportation system," "reduces auto dependency," and "increases the supply of housing in mixed use environments to create greater opportunities for people to live and work locally."

separate environmental review statutes in place, which did not apply to local land use actions. But unlike Canada, several of these jurisdictions' state planning statutes created distinct legal requirements for reporting on the environmental impacts of land use changes. As mentioned above, the distinct assessment requirements for land use decisions in Australian planning statutes generated shorter documents than the NEPA-like statutes applied to the five American cities in our final sample.

There are many criticisms of NEPA and NEPA-like environmental review processes in the United States, including their application to land use processes in major American cities, such as New York City (Minelli 2020). One common criticism is that these processes are costly and act as a barrier to beneficial development.⁴⁸ While additional research would be necessary to fully evaluate the approach of some Australian jurisdictions, this method of mandating distinct environmental review requirements into the planning process, rather than through a standalone environmental review statute, provides another option for incorporating climate change considerations into the land use process. An environmental review process focused solely on land use actions could potentially be tailored to address the types of impacts unique to urban environments. But as practices in Canada illustrate, there are other avenues for bringing the GHG reduction potential of densification to the attention of policy makers and stakeholders, such as planning processes and state and local level policies. These alternative practices raise important questions about whether formal environmental review is the best forum for analyzing environmental impacts and incorporating those considerations into land use decisions that affect whole cities or regions, particularly given its institutional orientation to local impacts.

Limitations and Directions for Future Research

Our research was motivated by a sense that cities may not consider the potential benefit that densification may reduce GHG emissions when determining whether to upzone areas within their jurisdictions to facilitate development. Debates about whether to upzone often appear to be dominated by discussions about the best way to moderate housing prices in order to improve housing affordability, while the desirability of increasing housing supply in cities to reduce GHG emissions tends to be neglected. Our findings suggest that cities may be ignoring the opportunity cost, from a climate perspective, of maintaining low density; to the extent that local governments are acting parochially in their environmental assessments, future research might wish to evaluate what in fact is driving this tendency. Our research also raises questions about the appropriateness of the geographical scale in which GHG impacts from densification are assessed. Future research might seek to determine the geo-political scale at which it would be most advantageous to review GHG emissions from such land use actions.

⁴⁸ One possible explanation for why cities in the United States are less likely to include environmental review in their processes for making land use decisions may have to do with the high costs and greater technical sophistication associated with NEPA-like environmental review in the United States. This reality, combined with the high frequency of local land use decisions (such as rezonings) undertaken by local governments, might explain why U.S. states are hesitant to impose formal environmental review requirements on local governments and why many major cities are neglecting to adopt their own.

Our study was limited in that we only evaluated the extent to which government authorities are comprehensively considering the GHG benefits of actions that increased density in their formal environmental review processes. Because of this limitation, we restricted our analysis in the second phase of our research to jurisdictions that routinely produce reports on the potential environmental impacts of proposed land use changes. Because such reports are not required for local land use actions in the Canadian cities we surveyed, nor routinely prepared in the Australian city of Perth, we could not draw any conclusions on how comprehensively these jurisdictions actually consider the emissions reduction potential of densification proposals. Future research might therefore seek to determine the extent to which these jurisdictions comprehensively consider the GHG benefits of density in their statutory plans, and whether the presence of these considerations in official planning instruments has any substantive effect on urban growth patterns.

Moreover, we reviewed a sample of 40 environmental review documents from eight cities, focusing on ones that assess the environmental impacts of proposals that could lead to large residential development. As noted above, this research was the first effort (that the authors are aware of) to analyze the comprehensiveness with which jurisdictions analyze the GHG impacts of land use proposals that increase density in their environmental reviews. Thus, the survey questions we developed represent an initial attempt to come up with metrics for measuring this comprehensiveness. Future research might focus on supplementary or alternative metrics. It might also seek to examine documents from other cities or countries to determine if the trends we observed are more widespread, or if there are other jurisdictions that are better at capturing the GHG reduction potential of densification, and whether lessons might be learned from elsewhere.

A broader question that researchers might examine is the influence of environmental review requirements on densification in high GDP countries. Stated differently, does mandating environmental review of local land use decisions affect urban growth patterns? Building on our finding about how environment assessment differs in the United States and Australia, it also would be interesting to know more about the relationship between different types of environmental review processes—such as detailed, NEPA-like environmental review as opposed to the less technocratic Australian approach—and densification. It is possible that jurisdictions might be able to achieve greater urban densification without detailed review if there is sufficient political will; although detailed environmental review might still serve other valuable societal purposes. Thus, a potential question for future research is: among the different land use and planning strategies, which ones are more effective at promoting densification? Research into the factors associated with densification might yield insights into the legal and policy tools that should be pursued to promote densification.

Conclusion

Cities are increasingly on the forefront of progressive climate action, and many have developed plans and strategies to reduce their contribution to global climate change. The choices cities make about how land within their borders is used can play an important role in their efforts to achieve these goals. By concentrating large populations into small geographic areas, cities in high GDP countries have been shown to have achieved overall greater resource efficiency and lower per capita GHG emissions relative to low-density non-urban areas. Therefore, from a climate perspective, both state and local governments should be making efforts to combat urban sprawl and promote the concentration of new development in existing cities. However, our research suggests that, somewhat ironically, cities are ignoring the climate costs of maintaining low urban density in their environmental reviews of land use changes.

Table 9: Largest cities in each state in the United States (limited to cities with populations of greater than 400,000)

UNITED STATES		
New York*	New York	8,336,817
Los Angeles*	California	3,979,576
Chicago	Illinois	2,693,976
Houston	Texas	2,320,268
Phoenix	Arizona	1,680,992
Philadelphia	Pennsylvania	1,584,064
Jacksonville	Florida	911,507
Fort Worth	Texas	909,585
Columbus	Ohio	898,553
Charlotte	North Carolina	885,708
Indianapolis	Indiana	876,384
Seattle*	Washington	753,675
Denver	Colorado	727,211
Boston*	Massachusetts	692,600
Nashville-Davidson	Tennessee	670,820
Detroit	Michigan	670,031
Oklahoma City	Oklahoma	655,057
Portland	Oregon	654,741
Las Vegas	Nevada	651,319
Louisville/Jefferson	Kentucky	617,638
Baltimore	Maryland	593,490
Milwaukee	Wisconsin	590,157
Albuquerque	New Mexico	560,513
Atlanta	Georgia	506,811
Kansas City	Missouri	495,327
Omaha	Nebraska	478,192
Virginia Beach	Virginia	449,974
Minneapolis*	Minnesota	429,606

Source: U.S. Census Bureau, Annual Estimates of the Resident Population for Incorporated Places of 50,000 or More, Ranked by July 1, 2019 Population: April 1, 2010, to July 1, 2019.

* Cities included in our survey of environmental review documents.

Table 10: Largest cities in each state in Australia (limited to cities with populations of greater than 400,000)

AUSTRALIA		
Sydney*	New South Wales	5,312,163
Melbourne*	Victoria	5,078,193
Brisbane	Queensland	2,514,184
Perth	Western Australia	2,085,973
Adelaide*	South Australia	1,359,760

Source: Australia Bureau of Statistics, Regional Population Growth, Australia, 2018–2019.

Note: The Australian Bureau of Statistics defines cities in a number of ways, including Greater Capital City Statistical Areas (GCCSAs) (for capital cities excluding Canberra), Significant Urban Areas (for other cities not otherwise included in a GCCSA), and Local Government Areas (known as “cities proper”). The cities identified in this table are all considered GCCSAs.

* Cities included in our survey of environmental review documents.

Table 11: Largest cities in each province in Canada (limited to cities with populations of greater than 400,000)

CANADA		
Toronto	Ontario	5,429,524
Montréal	Quebec	3,519,595
Vancouver	British Columbia	2,264,823
Calgary	Alberta	1,237,656
Winnipeg	Manitoba	711,925

Source: Statistics Canada, Population and dwelling counts, for Canada, provinces and territories, and population centres, 2016 and 2011 censuses – 100% data.

Table 12: Environmental review documents surveyed

Title of Project / Action	Type of Document*	Year
UNITED STATES		
New York, New York		
East New York Rezoning	EIS	2016
Downtown Far Rockaway Rezoning	EIS	2017
East Harlem Rezoning	EIS	2017
Inwood Rezoning	EIS	2018
Jerome Avenue Rezoning	EIS	2018
Los Angeles, California		
Granada Hills-Knollwood Community Plan Update	EIR	2015
Sylmar Community Plan Area Update	EIR	2015
West Adams-Baldwin Hills-Leimert New Community Plan	EIR	2016
San Pedro New Community Plan Update	EIR	2017
Southeast Los Angeles Community Plan Update	EIR	2017
Seattle, Washington		
Seattle Comprehensive Plan Update	EIS	2016
Citywide Implementation of Mandatory Housing Affordability (MHA)	EIS	2017
Accessory Dwelling Units	EIS	2018
Downtown Heights and Density Changes	EIS	2019
Uptown Urban Center Rezoning	EIS	2019
Boston, Massachusetts		
Harrison Albany Block	EIS / PIR	2016
Back Bay/South End Gateway Project	EIS / PIR	2017
L Street Station Redevelopment	EIS / PIR	2018
Alston Yards	EIS / PIR	2019
Suffolk Downs Redevelopment	EIS	2019

Title of Project / Action	Type of Document*	Year
Minneapolis, Minnesota		
L&H Station	EAW	2015
Ritz Block	EAW	2015
Superior Plating Site	EAW	2015
Malcolm Yards Mixed Use Redevelopment	EAW	2018
311 2nd St SE	EAW	2018
AUSTRALIA		
Sydney, New South Wales		
Amendment to Liverpool LEP 2008: Liverpool City Centre	Planning Proposal	2015
Amendment to Parramatta LEP 2011: Melrose Park North	Planning Proposal	2016
Amendment to Blacktown LEP 2015: Blacktown CBD	Planning Proposal	2017
Amendment to Parramatta LEP 2011: Parramatta CBD	Planning Proposal	2017
Amendment to Blacktown LEP 2015: Riverstone Town Centre	Planning Proposal	2018
Melbourne, Victoria		
Amendment C186 to Casey Planning Scheme	Explanatory Report	2014
Amendment C187 to Whittlesea Planning Scheme	Explanatory Report	2017
Amendment GC28 to Whittlesea and Mitchell Planning Schemes	Explanatory Report	2017
Amendment C106 to Mitchell Planning Scheme	Explanatory Report	2019
Amendment GC81 to Port Phillip Planning Scheme	Explanatory Report	2019
Adelaide, South Australia		
Playford Urban Growth Areas (Parts 2 - 4)	DPA	2014 - 2015
Port Adelaide Centre Renewal	DPA	2015
Glenside Mixed Use Zone Policy Review	DPA	2016
Kilburn and Blair Athol	DPA	2017
Bowden Mixed Use	DPA	2018

Source: Authors

* Abbreviations:

CBD – Central Business District

DPA – Development Plan Amendment

EAW – Environmental Assessment Worksheet

EIR – Environmental Impact Report

EIS – Environmental Impact Statement

LEP – Local Environmental Plan

PIR – Project Impact Report

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