Name (first and last)	Address of residence or property owned	Meeting date	Agenda Item (Property address or description of agenda item)	Position on Agenda Item (as applicable)	How would you like to make your public comment?	If you are providing a written comment, please leave here:	Are you representing yourself as an individual or speaking on behalf of a group?	Please name the group of people for whom you are the designated speaker.
Frank Zoltan	2526 Hurd Ave	11/20/2024	Comprehensive	Undecided	Written commen	Hello, I have viewed he comprehensive plan, and I am trying to understand the implications to land use/zoning. We live on Hurd Ave. The plan calls for half our street to be light residential and the other half to be moderate. I have reached out to my alderman with questions, but he as not able provide insight, and referred me to this forum. Can someone please advise on details/requirements for how this would be carried out? I can envision taking R1 to up to R4, but I don't see how you zone the smallest lots on the street to "moderate". Is the idea that lots can be pooled to make a larger development? or how do I interpret what moderate means for a single 30 foot wide lot?		
Molly Zoltan	2526 Hurd Ave	11/20/2024	2526 Hurd Ave	Opposed	Written commen	Hello, I feel that the Evanston Comprehensive plan is being rushed through without proper consideration, for purely political reasons. If this is a good idea, it needs to be vetted and the residents need to be a part of it, not rushed through before election cycles. If there are good ideas, they will be good ideas in April. Right now this plan is full of errors. It has not been legally vetted. This is a huge initiative, where the devil is in the details. As such there needs to be the proper amount of due process.		
Matthew Rich	1805 Cleveland	11/20/2024	Comprehensive	In favor	Written commen	Evanston is in the midst of a housing affordability crisis that is having trickle down effects across our community, most notably in the declining enrollment of District 65 as families are unable to move or stay here. I urge the Land Use Commission to use every tool in its toolbox to enable the construction of new housing to keep our community vibrant and welcoming. This includes approving the Envision Evanston 2045 comprehensive plan, especially streamlining the approval and permitting processes.		
Jennifer Packma	2744 Crawford A	11/20/2024	2744 Crawford A	Opposed	Written commen	The most reputable studies show upzoning does not increase affordable housing. https://www.urban.org/research/publication/land-use-reforms-and-housing-costs This science is being studiously ignored. Furthermore, page 17 of the draft indicates that the Envision team believes we need more affordable housing because fewer families with small children are moving here due to of affordability issues. They draw this conclusion from the reduced enrollment in D65 schools. But according to US Census data there are not fewer children in the city, just fewer attending D65. https://evanstonnow.com/families-say-no-to-d65/ The most ludicrous claim the Envision group makes to support upzoning is that because the median age of Evanstonians has increased from 34 to 37, we are at risk of having insufficient people to replenish the workforce (page 17). They seem to have failed to notice that we are 8 square miles in the middle of a 10,000 square mile metropolitan area. Many people will point out the risks associated with upzoning our entire city. My point is that the professed need for upzoning appears to be based on erroneous or irrelevant data. P Most importantly, there don't seem to be any benefits at all to balance that risk.		
Frank Zoltan	2526 Hurd Ave	11/20/2024	2526 Hurd Ave	Opposed	Written commen	Hello, I was somewhat undecided when I left my last comments, not knowing there was a meeting on the 13th. I wanted to see what details, data, etc would be unveiled at the meeting on the 20th. So, I apologize, but this is simply absurd. There is nothing here that points to how we derive affordable housing without completely ignoring every aspect that zoning is meant to provide. There are plenty of opportunities to develop all the aspects in the plan, with clear, thought out parameters, and with in certain areas. Not do what ever you want anywhere in the name of density, that will not produce affordable units. Thanks, Frank		
John Cooper	3614 Hillside Ro	11/20/2024	Envision 2025	Opposed	Written commen	I live at 3614 Hillside in a Cul de Sac. There are six houses circling the cul de sac. There might be one or two street parking places at most. Four of the houses have no street parking because of the concentration. I imagine this is the case at Hillside lane also. Could a developer build one or more four flats in the cul de sac and what would the parking space requirements be? Even now, there is NO or little room for visitors. While I appreciate and join with my fellow Evanstonians about diversity and helping with affordable housing, it seems like diversity does not include support of people who want single family homes? While zoning can be misused or hamper some things, it is one way to limit corporate developers - who have more leverage than single families - from driving the single family market to other suburbs. Thanks for Listening, John		
Lynn Gendlemar	806 Milburn Stre	11/20/2024	806 Milburn Stre	Opposed	Written commen	My husband and I are strongly opposed to any tampering with the R-1 (Single family housing) Zoning Code. It will ruin the beautiful neighborhoods of Northeast Evanston. There are many old and vacant properties all over the city that can be converted into 4-flats or other forms of multi-unit housing. Please don't sacrifice our neighborhood to promote an agenda that is being advanced by a minority of the City Council and administration. Thank you. Lynn Gendleman		
Kristine Lofquist	2666 Gross Poi	11/20/2024	Comprehensive	In favor	In person		Self	
Luke Harris-Ferr	1425 Washingto	11/20/2024	Comprehensive	In favor	Written commen	Dear Land Use Commission, thank you for taking the time to hear about the new comprehensive plan and zoning structure. I appreciate the time you are taking to hear from the Evanston community, but I was rather disappointed as I listened in to last week's meeting. The overwhelming amount of concern expressed by this commission for new zoning ordinances is troubling. Evanston is in a housing crisis right now. The lower classes are those feeling the brunt of this housing crisis. I heard that a neighborhood's 'character and fabric' held a higher value than affordable, safe, and livable housing for all. Honestly, I wish the zoning structure was changed more as the changes I see proposed are rather minor. Four flats could match the height of some of the northern Evanston houses, but of course, we can't mix incomes and neighborhoods like that, right? When I heard your concerns, I simply heard a desire to keep things the way they are and maintain the status quo. The status quo is not working for a large majority of Evanstonians with people moving away or not being able to reside within this city due to its housing limits and prices. Maintaining the status quo and outdated zoning ordinances will continue to segregate Evanston even more between rich and poor, people of color and white, those with means, and those without. Radical change is needed now to help change the fabric of our city, to make it more inclusive, and to create sustainable and affordable housing. I hope that you will value the livelihood of the working classes over the look and curb appeal of our rich neighborhoods. It is past time that we revise and overhaul the zoning ordinances, and I hope you will be a voice of change rather than a hindrance. Thank you, Pastor Luke Harris-Ferree		
Sergio de los Re	2206 Forestview	11/20/2024	Comprehensive	In favor	In person		Self	
Peter Kelly	1640 Maple, Un	11/20/2023	Hearing regardir	Undecided	In person		Self	
David Graber		11/20/2024	Envision 2045	In favor	In person		Self	

Dorit Adler	1720 Maple Ave	11/20/2024	Comprehensive	Opposed	Written commen	I'm sorry that I'm unable to attend in person or by Zoom and appreciate the opportunity to send these comments to the Commission. Briefly, I'm a retired MD, MPH/Emerita Professor from the University of Michigan where I served on the faculty for nearly 30 years. I moved to Evanston in August, 2022, to live close to family who live Chicago. I specifically chose Evanston rather than Chicago having long experienced the significant benefits of college town life with all that it offers eg education, arts and culture, diversity, and a huge range of stimulating activities for all ages and groups, and much safer than Chicago. I applaud the Commission's wide range and very important issues addressed in the Vision 2045 Draft, especially with emphasis on health, safety, education, economy, and housing. Having carefully read the Draft, I do note some internal contradictions which I feel are significant and hope that the Commission will see fit to modify the Draft in order to consistently reach the laudable goals set. Preserving Evanston's sense of place, enhance public spaces, and mitigate climate impact are repeatedly mentioned and the subjects to which I will limit my comments. I strongly oppose the Page 29 statement that "There should be a lot of tall buildings in the central downtown area...." This would serve the exact opposite effect that the Vision hopes to achieve. High rises would further block the tree canopy, and gorgeous lakefront views. Numerous downtown high rises would result in a more claustrophobic atmosphere, mimicking that of large city downtown areas. I don't believe that Evanston wants to have the same feel as downtown Chicago, one of the strong reasons that I and many others chose Evanston. I believe that the goals noted in the report could likewise be accomplished by building much lower buildings so that all aspects (eg increasing housing, encourage people to come downtown, etc.). The beauty and significant benefits of the immediate proximity of Lake Michigan is unmatched when combined with everything else that Evanston offers. City residents and visitors can experience this unique opportunity including the beauty of so many older and historical homes and buildings. None of the latter are extremely high and would be dwarfed, even from a relative distance. Enhancing the already existing public transportation access to Chicago also included in the Vision and an important reason that I and many others have chosen to live/work here, allow one to take advantage of all that Chicago offers while being able to return to our more peaceful and beautiful homes and businesses, known to be good for the body and soul, which should not be lightly dismissed at this time when mental health issues have become so prevalent in our country including so many young people. To briefly comment on the climate change impact, I would strongly encourage the Commission to read in detail the excellent article by Saint, R and Pomponi, F Oct 27, 2021 entitled "Cities and climate change: why low-rise buildings are the future, not skyscrapers," in which they concluded from scientific data that " Our recent study, which examined whether building denser and taller is the right path to sustainability, bursts this myth: we found that densely built, low-rise environments are more space and carbon efficient, which high-rise buildings have a drastically higher carbon impact." I will end in the interests of space and time. Thank you for your time, attention, and interest in preserving all of Evanston's important features while looking to the future to further enhance these. Respectfully, Dorit Adler		
Leslie Shad	1110 Judson Av	11/20/2024	Envision Evanst	Undecided	Written commen	This is to provide comments on the Envision Evanston comprehensive plan and the Parks Strategy document on behalf of Natural Habitat Evanston, a community group of 1,300 encouraging sustainable yards, and a program of Climate Action Evanston. The city deserves thanks for all the work and thought that has gone into these plans, which start to sketch such a hopeful vision for Evanston. Envision Evanston o Expand natural areas. Designate additional city-owned open spaces for conversion to naturalized landscapes under stewardship, based on current model of stewards and volunteers. o Transition to ecological landscape management and expand low-mow and no-mow green zones in park areas not devoted to active sports, picnic areas or other planned activities. o Eliminate Light Pollution and use amber-red spectrum lights (not blue-white). Public lighting off 10pm-6am, per the current policy, except emergency lights. Shade and focus light to where it is needed. No unnecessary or purely ornamental lighting. Use the lowest brightness required for the purpose. o Recanopy: set a goal to replant at least 125% of public trees removed annually until Chicago Regional Trees Initiative or other defined target for Evanston is reached. o Protect big trees that define Evanston and provide maximum ecological benefits. Comments like the below are unclear and could be applied to remove big trees and plant small. Effectively manage the tree canopy to optimize the benefits of the urban forest. o Assure sustainable landscaping is included in all aspects of city projects and approvals by hiring and training adequate staff well-educated in natural areas and native plants. o Habitat: Be more specific and forward-thinking in the plan text. Comments like this are difficult to interpret as the landscaping industry is in transition and turmoil with climate change and awareness of biodiversity losses: Protect and preserve habitat for native flora and fauna, using best practices as recognized by industry professionals. (page 68) o Consider habitat for a diversity of species, including, but not limited to, humans, when considering changes to requirements for the built environment and other public and privately owned spaces, i.e., design for biodiversity: birds, bat, insect habitat, safe passage and forage. Parks Strategy – should this be part of Envision Evanston? • Process for Lakefront hardscape, and for natural areas. The lakefront is one of Evanston's most precious assets. A public process should be defined for adding any hardscape to the lakefront. Hardscape in naturalized areas also should follow a defined, public process. This should be included in the Envision Evanston document. • Update to include stewards group. There is a stewards group that meets and coordinates regularly. The stewards are a valuable resource for the city, with intimate familiarity with their sites, knowledge and skills in restoration ecology, and communication networks. They also provide volunteer labor and even financial resources. The city and stewards should thoroughly collaborate to implement the plan. • Increase and expand natural areas. The plan recognizes that people want more natural experiences. Identify opportunities to acquire lands, e.g., Higgins Prairie near Lovelace, for educational opportunities. • Steward registration, training and management Pages 74, 98, section 2.3. A full-time position is not needed for the volunteer program. • Strategically leave dead snags for woodpeckers and other wildlife. Consider labels to explain the habitat value of strategic snags. (Plan includes focus on removal of dead trees without consideration of retaining some snags that are not dangerous. Pages 121, 122, 126, 127, 130, 133, 134, 140, 147, 151, 158.) • Training of teens (p 66) might be organized with stewards. • Aim for all-native plantings. Native plants support our native insects, the underpinning of the food web. There is little testing on what non-native or hybrid plants provide this ecological function and it cannot be assumed. The statement at page 71 is unclear and could permit plantings of little or no biodiversity benefit, and on its face allows exotic plantings: In all City plantings, use native or locally adapted plant species where possible. (page 71) • Related to this: o "Native" will need clarity. It might reasonably include North American native species mixed in from the southern US in view of rising temperatures. o Push planning: purchasing availability problems should be avoided with intentionality. The plan should push the city to plan its purchases and contract in advance for trees and other plants, reducing or eliminating the rationalization that non-natives are required because natives are not immediately available. • The 'no management' notations on many park maps needs clarity in the plan. All property profiles need management, particularly turfgrass, so the intention on the maps is unclear. o Lovelace has groves that are developing savanna profiles. In the strategy maps they are indicated as 'no management', but the groves should be expanded and enhanced. o Twiggs/Butler/Beck maps – much of Twiggs/Butler/Beck is indicated as no management, but there are abundant opportunities for groves and forests or savanna. This would be a missed opportunity. o Harbert. Turfgrass marked 'no management' should be converted to naturalized savanna where there are no programmed activities. This is true of all the parks.		

Leslie Shad	1110 Judson	11/20/2024	Envision Evanst	Undecided	Written commen	Revised comment - clarified ornamental lighting and native planting comments, and quotes did not transmit correctly so using quotation marks below on excerpts from Envision Evanston and Parks Strategy. This is to provide comments on the Envision Evanston comprehensive plan and the Parks Strategy document on behalf of Natural Habitat Evanston, a community group of 1,300 encouraging sustainable yards, and a program of Climate Action Evanston. The city deserves thanks for all the work and thought that has gone into these plans, which start to sketch such a hopeful vision for Evanston. Envision Evanston o Expand natural areas. Designate additional city-owned open spaces for conversion to naturalized landscapes under stewardship, based on current model of stewards and volunteers. o Transition to ecological landscape management and expand low-mow and no-mow green zones in park areas not devoted to active sports, picnic areas or other planned activities. o Eliminate Light Pollution and use amber-red spectrum lights (not blue-white). Public lighting off 10pm-6am, per the current policy, except emergency lights. Shade and focus light to where it is needed. No unnecessary or purely ornamental lighting unless it also turns off at night. Use the lowest brightness required for the purpose. o Recanopy: set a goal to replant at least 125% of public trees removed annually until Chicago Regional Trees Initiative or other defined target for Evanston is reached. o Protect big trees that define Evanston and provide maximum ecological benefits. 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Marc	2626 Hurd Aver	11/20/2024	Rezoning of R-1	Opposed	Written commen	Opposed to rezoning of R-1 allowing multi-unit structures on lots currently zoned R-1. This proposed "quick fix" to real and perceived future problems changing the character and benefits of single-family neighborhoods is detrimental to both the homeowners as well as the city at large. Regardless of socio-economic status there is a benefit promoting single family ownership. The city should be exploring how to help provide "affordable" single family ownership as opposed to solving that issue through increased density and all of its accompanying problems. Also, it is imperative that any decision regarding such fundamental changes be postponed until after the April 2025 elections allowing those seeking public office to state their positions on this issue and the citizens of Evanston to weigh-in at the ballot box.		
Jennifer Cole	1720 Maple Ave	11/20/1924	Comprehensive	Undecided	Written commen	While I support the broad sustainability goals of the Envision Evanston 2024 plan, I do not agree that building more high-rise residential buildings downtown is a good way to achieve those goals. High-rise buildings impose more environmental hazards and costs than lower buildings (6 stories or less). High-rise buildings also increase traffic and with the added traffic of City Hall in their new downtown location and other developlments (e..g, Northlight Theater) this will add to vehicular congestion and create unsafe roadways for pedestrians and cyclists. This is particularly concerning for seniors and those with disabilities, populations who are also represented in downtown residential buildings in increasing numbers.		
Test	Test	11/20/2024	Test	Undecided	In person		Self	
Charisse Kosova	1720 Maple Ave, 1440 Evanston		Additional high r	Opposed	Written commen	Additional high rise buildings would change the character of Evanston and affect property values for current owners in ways that residents will not find desirable. It defeats the goal of sustainability, contrary to what developers and consultants are advising the City. While higher density is good, taller structures are not. Comparing buildings with 6 or less stories buildings to those with 20 or more stories, researchers find: am opposed to additional high rise buildings in Evanston's center because: Electricity use, per square meter of floor area, is nearly two and a half times greater · Gas use increases by around 40% (with electrification, this would translate to greater electricity use for heating). · Overall, the total carbon emissions from gas and electricity from high-rise buildings are twice as high as in low-rise. · Concrete has a carbon footprint that is far greater than that of brick or cement. · A taller structure also requires stronger foundations and proportionally more steel per square meter of floor space.		
Michael Lohr		11/20/2024	Envision Evanst	Opposed	Written commen	The draft Envision Report is full of contradictions and statements without foundation or data. The draft repeatedly talks about a gap between single family homes and large rental complexes, and yet the report itself states that nearly 20% of the housing stock in Evanston is 2-4 unit buildings (even that data is contradicted in the report itself). The report also defines "moderate size residential" as including smaller lots and yet stating that there is room for another house on such lots! Really, what kind of density is the drafter of the report looking for? Why not just build nothing but apartments? The report further states that "community members are being displaced in Evanston," while at the same time the population of Evanston is increasing across all income levels. How can this be? This report was clearly written with a predetermined outcome in mind and fully intended to get to a desired result regardless of public comment or participation.		

Craig McC	2507 Princeton	11/20/2024	Envision Evanst	Undecided	Written commen	My concerns with Envision Evanston 2045 are as follows: The speed at which it is moving, and the limited feedback that has been obtained so far. Other than a recent meeting in Ward 6 that our alderman arranged, and that city staff attended, some of us have not had an opportunity to provide feedback in person as the meetings that were being held seemed to only be during the week on a workday. It is not clear what the compelling reason is for the new plan and its associated zoning update to be passed before the next city election cycle. In fact, a change of this magnitude really ought to wait until after the election so that voters have an opportunity to vote based on their candidates position with respect to this major update to the city plan and zoning. On the latest draft zoning map, it looks like the “4 flat on any lot” that was mentioned in one zoom call I attended is not part of that, however there appear to be some potential changes from R2 to R4 for a few properties in our neighborhood. But with the color coding, it is really not clear. It would be helpful if a better color-coding system was used that clearly identified where major changes are occurring, such as when a currently R2 property is becoming R4. Or draw redlines around where changes are happening. Affordable and / or attainable housing is a problem that Evanston is too small to try to solve on its own. Most of the nearby suburbs are even more expensive than Evanston. And just because rental apartments get built, or existing homes get sub-divided does not mean they necessarily become affordable or attainable. One need only look at the E2 apartments along Emerson as an example. A studio starts at $2,500 per month. 2 bedrooms run in the $4,000 per month range, and 3 bedroom flats or townhouses (which there are townhouses fronting along Emerson) run in the $6,000 to $7,500 range. Or how about the duplex along Central St where the lower unit is for rent for $6,000 per month and the upper unit was recently listed for $8,000 per month. The 2045 plan shows renderings of what building might look like in an updated plan. And those renderings are attractive. Unfortunately, they are not necessarily reality because where the zoning density is increased, what often happens is that existing single-family homes become multi-family dwellings. One of the items that Evanston ought to try to address through the plan is to put a moratorium on parcels currently on the tax roll moving off the tax roll when the ownership shifts to non-profit. Evanston is so expensive, and each time an additional property moves off the tax rolls, it gets more expensive for those of us that remain. I have more concerns about the updated plan, but I'll leave it at those for the moment.		
David H Cherry	2664 Sheridan	11/20/2024	2045	Opposed	In person		Self	
Matt Cotter		11/20/2024	II.A - Envision Evanston 2045		In person		Group	Evanston Environment Board

City of Evanston

Meagan Jones <mmjones@cityofevanston.org>

Request for Continuance of Public Comment LUC 11/20 hearing

PETER KELLY <pmksbk@comcast.net> Tue, Nov 19, 2024 at 9:09 PM
To: "mmjones@cityofevanston.org" <mmjones@cityofevanston.org>
Cc: "jnieuwsma@cityofEvanston.org" <jnieuwsma@cityofevanston.org>

I will separately submit an online request to testify during tomorrow's Land Use Commission hearing. My remarks will be presented in two parts:

1.The first part will express support for the focus on policies intended to increase the availability of starter homes and the availability of owner occupied homes or condos for Evanstonians seeking to downsize.

2. I will mere allude to my second point, the importance that the LUC and the City Council treat downtown as not just an economic engine and density target, but also as a neighborhood. Because the only Envision Evanston pre-meeting geared to downtown residents is not scheduled until December 3rd, I request a continuance pursuant to Section 6 of the LUC Rules so my detailed remarks supporting the unique interests of downtown residents can include insights gathered during the December 3rd meeting hosted by the three council members whose wards include downtown.

Peter Kelly
1640 Maple
Unit 1608
pmksbk@comcast.net

City of Evanston

Meagan Jones <mmjones@cityofevanston.org>

Fwd: Comments on Draft Comprehensive Plan

1 message

Stephanie Mendoza <smendoza@cityofevanston.org> Wed, Nov 20, 2024 at 2:29 PM
To: Meagan Jones <mmjones@cityofevanston.org>

Public Comment

Stephanie Mendoza
City Clerk
City Clerk's Office
City of Evanston

Pronouns: (She, Her, Hers)

2100 Ridge Ave. | Evanston, IL 60201 | O:(847) 448-8189
smendoza@cityofevanston.org | cityofevanston.org

City of Evanston
OFFICE OF THE CITY CLERK

---------- Forwarded message ---------
From: **vaishali Yajnik** <yajnikvaishali@gmail.com>
Date: Wed, Nov 20, 2024 at 1:24 PM
Subject: Comments on Draft Comprehensive Plan
To: <publiccomment@cityofevanston.org>

For distribution to the Land Use Commission Members at the meeting on November 20, 2024

Dear Land Use Commission Members,

As the City embarks on this important project, I request that the following comments be considered.

After living in a single family residential neighborhood in northwest Evanston for 40 years and raising our family, my husband and I have moved to downtown Evanston to enjoy our retirement years. My comments below mainly pertain to the downtown area since any proposed changes would impact our well being.

Evanston's diverse population and a mix of urban/suburban character has been one of the most attractive feature that made us move to Evanston 40 plus years ago. Evanston is a mix of several single family neighborhoods with mid rise structures dispersed throughout the city and some tall buildings in the downtown area. People who don't want to live in the city of Chicago but still enjoy its proximity to the city live here and enjoy its mixed use environment. It is this mix of residential development that residents enjoy and should be preserved.

The Envision 2045 Comprehensive Plan designates tall buildings with higher density in the downtown area. I believe that Evanston does not need any more tall buildings. The downtown area should be developed as mixed use developments with retail and institutional uses at the street level and 6 to 8 stories of residential above. This type of mixed use development will preserve the character and will continue to attract more residents to move to downtown, thereby increasing the density to a reasonable level.

Evanston has been very progressive in sustainability. Research data has shown that taller structures are **not** sustainable in energy use. In addition, the proliferation of high rise towers in downtown will drastically change the small walkable city character of our city which has traditionally attracted many urban professionals, young families and retirees to our community. The tall structures will create wind tunnels, deep shadows and canyon type effects.

It is my understanding that the mixed use developments in downtown would have no height limit (height would be established as part of the PUD process?) This lack of height restriction is very discomforting to existing residents. And, it does not provide proper guidance to the developers either. To my knowledge, all tall residential structures that have been proposed in the past few years have gone through several revisions to address concerns relating to height and taken several public hearings and many years to get approval. The purpose of the comprehensive plan and land use regulations is to provide proper guidance to both the residents as well as the developers so that there is less ambiguity and more certainty.

In conclusion, I would like to add that I am stating my comments not only as a concerned resident of Evanston, but also as a former architecture & planning professional who has worked in the Lake County (Illinois) Planning and Development Department for 30 plus years prior to retirement.

Thank you.
Sheel Yajnik

Sent from my iPad

City of Evanston

Meagan Jones <mmjones@cityofevanston.org>

Initial City of Evanston Environment Board Input to draft EE45 Plan

2 messages

Michelle Redfield <evanston.michelle@gmail.com> Tue, Nov 19, 2024 at 12:06 PM
To: mattrodgers67@comcast.net, Meagan Jones <mmjones@cityofevanston.org>
Cc: Cara Pratt <cpratt@cityofevanston.org>, Steve Ruger <sruger@cityofevanston.org>, Matt Cotter <mcotter222@gmail.com>, Katarina <katarinatopalov@gmail.com>, gul.agha@gmail.com, lstowe@cityofevanston.org, Paula Scholl <paula.l.scholl@gmail.com>, James Cahan <jcahan@mac.com>, Jonathan Nieuwsma <jnieuwsma@cityofevanston.org>, anushakumar2026@u.northwestern.edu, jsedinberg@eths202.org

Dear Matt and Meagan,
Hope your week is getting off to a good start!
Please find some initial input to the Draft Envision Evanston 2045 Comprehensive Plan in advance of Wednesday's Land Use Commission meeting.
This has been developed in large part based on the input and review by the Environment Board and our CARP Implementation Task Force Subcommitee.
We are hoping that this initial input from the Environment Board will be helpful in aiding your discussions.
Thank you for this opportunity to engage in this exciting step of the EE45 process.

Feel free to reach out to Matt or me if you have any questions!

--
Michelle L. Redfield, P.E.
847.858.6844
evanston.michelle@gmail.com

Please consider the environment before printing this e-mail.

EEB letter to LUC 19 Nov 2024.docx
21K

Gul Agha <gul.agha@gmail.com> Tue, Nov 19, 2024 at 12:51 PM
To: Michelle Redfield <evanston.michelle@gmail.com>, Matt Cotter <mcotter222@gmail.com>
Cc: Meagan Jones <mmjones@cityofevanston.org>, Cara Pratt <cpratt@cityofevanston.org>, Steve Ruger <sruger@cityofevanston.org>, lstowe@cityofevanston.org

Michelle and Matt,

Thanks for the write-up. I agree that it captures what was agreed. One thing missing is something I brought up at the meeting: it is important to consider the climate impact of buildings. On p29, the Draft Plan states: "There should be a lot of tall buildings in the central downtown area, while the edges should transition to shorter buildings as they approach nearby residential neighborhoods." As we discussed, while higher density is better for the environment, what I have learned is that taller structures are not. I think there was consensus that we should mention that we support *high-density low-rise* development, not tall buildings. Here are a couple of links of reports on a study which shows that the difference in carbon impact is large:

High-rise buildings much more energy-intensive than low-rise | news.myScience / news / news 2017
Tall buildings are more energy-hungry than low-rise, research finds - Global Construction Review

Comparing buildings that are 20 stories or more with those 6 stories or less, researchers found that *electricity use, per square metre of floor area, is nearly two and a half times greater in buildings of 20 or more stories than in low-rise* *buildings of 6 stories or less*. *Gas use also increases by around 40%*. Overall, the total carbon emissions from gas and electricity from high-rise buildings *are twice as high as in low-rise*. The team looked at both residential and office buildings.

Moreover, construction is a huge contributor to climate change. Concrete has a carbon footprint that is far greater than that of brick or cement. A taller structure also requires stronger foundations and proportionally more steel per square meter of floor space as each floor has to support far greater weight above it. Thus climate researchers argue for greater density through a larger number of low-rise buildings.

I am also attaching the technical paper for another study which shows the same results. Please let me know if you have any questions. (I've bcc'ed everyone else on the list).

Best,
Gul Agha
[Quoted text hidden]

Decoupling density from tallness.pdf
3149K

EVANSTON ENVIRONMENT BOARD INITIAL INPUT TO ENVISION EVANSTON 2045 DRAFT COMPREHENSIVE PLAN

November 19, 2024

To: Evanston Land Use Commission

CC: Meagan Jones, Cara Pratt, Stephen Ruger, Luke Stowe, Evanston Environment Board

From: The Evanston Environment Board

Subject: Initial Evanston Environment Board feedback and recommendations to the first Draft of the Comprehensive Plan

The Environment Board appreciates the opportunity to provide this initial feedback and related recommendations and suggestions regarding the Envision Evanston 2045 Draft Comprehensive Plan (Plan) in advance of the November 20, 2024 Land Use Commission meeting. We provide this initial feedback based on conversations with members of the Land Use Commission and based upon the Board's unique and extensive experience in the area of sustainability and shepherding the City of Evanston's Climate Action and Resilience Plan (CARP). We trust that these insights will assist in achieving a more sustainable and environmentally equitable Evanston in 2045.

Firstly, we would like to commend the integration of sustainability and CARP throughout the Draft document. In particular, the Vision of Evanston in 2045 on Page 6 of the Draft Plan does an excellent job of weaving in sustainability and CARP goals and objectives in many respects. There is also good content in the Transportation Section and in the discussions of storm water management and nature.

With the objective of envisioning the City of Evanston as a leader in the areas of sustainability, climate action and resilience and environmental equity, we are providing our initial comments for the Land Use Committee to take into consideration during your review of the Draft Plan. We reserve the right to provide additional feedback and input throughout the public comment period.

In order from more general to more specific comments, we have outlined the following suggestions for the Committee's consideration:

Certain portions of the language in the document are somewhat vague. It would be advantageous to cross-reference relevant sections (possibly through hyperlinks) for clarity and coherence. For example, the sections on parks, open spaces, and placemaking could benefit from further development.

The document should be more prescriptive throughout. For example, in the section on Transit, there should be greater specificity in the policies and actions, particularly regarding expansion and amendments. Two other areas that could similarly benefit are Parks and Open Spaces and Placemaking.

Natural Resource growth and enhancement should be integrated more fully into the Draft Plan and not only be considered a section on its own (Parks and Greenspace). Where it is integrated, we should also be more proactive and aspirational – where we talk about "preserving" or "maintaining" we should instead envision to not only maintain natural resources but to preserve, enhance and grow natural resources in our community (P.9 – Prioritize Environmental Sustainability section). Further, the entire section on Land Use strategy including the Introduction has no mention of natural resources, green space, ensuring Evanston's tree canopy is preserved, enhanced and expanded. Land Use encompasses both the built environment and the unbuilt environment, namely Natural Resources. There should be another entire section (12) added to the Land Use Section that outlines how we envision integrating more natural spaces into our built environment (e.g., larger setbacks with vegetation and trees, green roofs, more permeable surfaces, etc.

The Parks and Green Spaces section is extremely lacking and very generic, especially in comparison to the two preceding sections. As it stands, the document does not fully address the comprehensive value of urban forests and green spaces. This section should be completely re-considered and revised. There is nothing specific to Evanston in this section, no reference to the lakefront, McCormick Park, the Ecology Center, etc. The portion regarding public bathrooms seems out of place and should be moved to Land Use/ Infrastructure section. Also, there is confusion regarding how the draft "Parks and Green Spaces Strategic Plan" has been considered. We recommend that the final Strategic Plan for parks and green spaces be integrated into the Comprehensive Plan.

In the Environment Section the Policy Statements and the numbered Policies and Actions are not sufficiently proactive or aspirational. At every turn, we should be doing much more than managing or maintaining – we should be enhancing, growing, and expanding, etc. As written, it sounds more like a recitation of the status quo, rather than a vision for 2045. This is not in keeping with our history of proactive climate action and sustainability initiatives.

The comprehensiveness of the plan would be enhanced by allowing a thorough review of key environmentally-related documents, including the Stormwater Management Plan, Parks and Green Space Strategic Plan, provisions for the circular economy. Incorporating these documents into the process would enhance the comprehensiveness of the overall strategy.

The document fails to provide a historical context or specific themes related to rectifying environmental injustices. The discussion of environmental justice is presented in a general manner, without focusing on the specific background of Evanston. As an example, there is no reference to the Church Street Waste Transfer Station, its proximity to the residential area and the poor air quality issues that it causes. In fact, the station is depicted on one of the maps merely as a "business area." The environmental justice should be a part of the Land Use chapter and cross referenced to the Environment chapter.
In reference to our letter dated July 22nd to the Envision Evanston Team (which was also shared with the LUC), we provided a comprehensive list of ordinances, resolutions, and master plans related to climate change and sustainability that have been enacted by the city since the previous Year-2000 Comprehensive Green Plan (CGP). This list also includes additional plans and ordinances expected to be introduced in the near future. These documents should serve as primary inputs for the development of the Envision Evanston 45 (EE45) plan, with the Climate Action and Resilience Plan (CARP) serving as the foundational framework for EE45's climate and sustainability objectives. Ideally, these documents should be referenced throughout the Plan and, at a minimum, referred to in the plan as primary inputs and included as an appendix.

Finally, provisions for promoting a circular economy should be supported and include initiatives such as exploring collaboration agreements among a network of local businesses for the sharing of materials, identifying opportunities for the reuse of material by-products, implementing waste reduction strategies, and utilizing cooperative purchasing agreements to acquire environmentally preferable products at reduced costs. At a minimum, we recommend including descriptions of these activities and references to circular economy on Page 8 in the Strengthen the Local Economy Section.

Thank you in advance for your consideration of these comments from the City of Evanston Environment Board. We would be happy to meet with the Land Use Commission at your earliest convenience to further discuss these suggestions or offer any additional support. We look forward to continuing our shared work in the service of our community.

Very Sincerely,
Michelle Redfield and Matthew Cotter
Co-Chairs, City of Evanston Environment Board

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Decoupling density from tallness in analysing the life cycle greenhouse gas emissions of cities

Francesco Pomponi[1,2✉], Ruth Saint[1], Jay H. Arehart[1,3], Niaz Gharavi[1] and Bernardino D'Amico[1]

The UN estimate 2.5 billion new urban residents by 2050, thus further increasing global greenhouse gases (GHG) emissions and energy demand, and the environmental impacts caused by the built environment. Achieving optimal use of space and maximal efficiency in buildings is therefore fundamental for sustainable urbanisation. There is a growing belief that building taller and denser is better. However, urban environmental design often neglects life cycle GHG emissions. Here we offer a method that decouples density and tallness in urban environments and allows each to be analysed individually. We test this method on case studies of real neighbourhoods and show that taller urban environments significantly increase life cycle GHG emissions (+154%) and low-density urban environments significantly increase land use (+142%). However, increasing urban density without increasing urban height reduces life cycle GHG emissions while maximising the population capacity. These results contend the claim that building taller is the most efficient way to meet growing demand for urban space and instead show that denser urban environments do not significantly increase life cycle GHG emissions and require less land.

npj Urban Sustainability (2021)1:33 ; https://doi.org/10.1038/s42949-021-00034-w

INTRODUCTION

Population and urbanisation are increasing with an estimated additional 2.5 billion people living in urban areas by 2050[1]. The built environment is the greatest cause of carbon emissions, global energy demand, resource consumption and waste generation[2]. In the European Union (EU), it accounts for 50% of all extracted materials, 42% of the final energy consumption, 35% of greenhouse gases (GHG) emissions and 32% of waste flows[3]. Therefore, achieving optimal use of space and maximal efficiency in buildings is fundamental for the transition to sustainable built environments and to progress towards national and international climate targets.

The design of urban environments has not rigorously considered life cycle GHG emissions (LCGE hereon), focusing instead on reducing the operational energy demand and the carbon emissions associated with the energy used to operate buildings. Operational energy use occurs while the building is in service, and includes heating and cooling, lighting, and other plug loads. The use of operational energy contributes to the LCGE of a system as the energy grid is not carbon free, thus conversion factors can be applied to convert between units of energy used and carbon dioxide equivalent (CO_{2e}), the metric of LCGE. LCGE includes these operational emissions as well as the embodied emissions of the entire system. Embodied energy and CO_{2e} emissions are the hidden, "behind-the-scenes" energy and emissions that are used or generated during the extraction and production of raw materials, the manufacture of the building components, the construction and deconstruction of the building, and the transportation between each phase[4]. As operational efficiency grows, so does the share of embodied impacts on the whole-life balance, thus reinforcing the need for sustainability analyses of buildings and cities to be underpinned by a life-cycle-based approach[5,6]. In other words, operational energy and carbon savings should not be made at the expense of the embodied impacts, and a holistic approach focused on reducing LCGE should be the primary aim.

Apart from a few studies focusing on urban morphology and energy demand[7,8] in the built environment, there has been a growing belief that building taller and denser is better, under the idea that tall buildings make optimal use of space[9], reduce operational energy use and energy for transportation[10,11], and enable more people to be accommodated per square metre of land[12]. However, this is only partly true. As buildings grow taller they need to be built further apart; for structural reasons, urban policies and regulations, and to preserve reasonable standards of daylight, privacy and natural ventilation[13]. Furthermore, for a fixed amount of internal volume (e.g. expressed in terms of floor area times the inter-storey height) an increase in the building's tallness corresponds to an increase of the building slenderness and hence to a reduction of its compactness which is detrimental to space optimality[14]. Urban density is commonly defined as the ratio of built land area (i.e. building footprints) to total land area yet this metric does not capture building height.

Height has been captured in urban density metrics by summing the total floor space of an urban environment and dividing by the total land area[15]. To date, however, no method exists to (i) analyse density and tallness of urban environments independently of each other or (ii) evaluate their influence on the LCGE of urban environments. These are the two main objectives of this paper. To decouple the two (i.e. density and height) we propose an additional metric for describing urban environments through a 'tallness' factor, or the average height of an urban area. This informs a method that includes a model to generate synthetic, yet realistic, parametric urban environments based on a number of input variables, as detailed in the Methods section. To embed such realism, we collected primary data on real urban environments since building regulations vary greatly across any one country, due to the devolved powers of local authorities in matters of urban planning. Therefore, picking any single value for building

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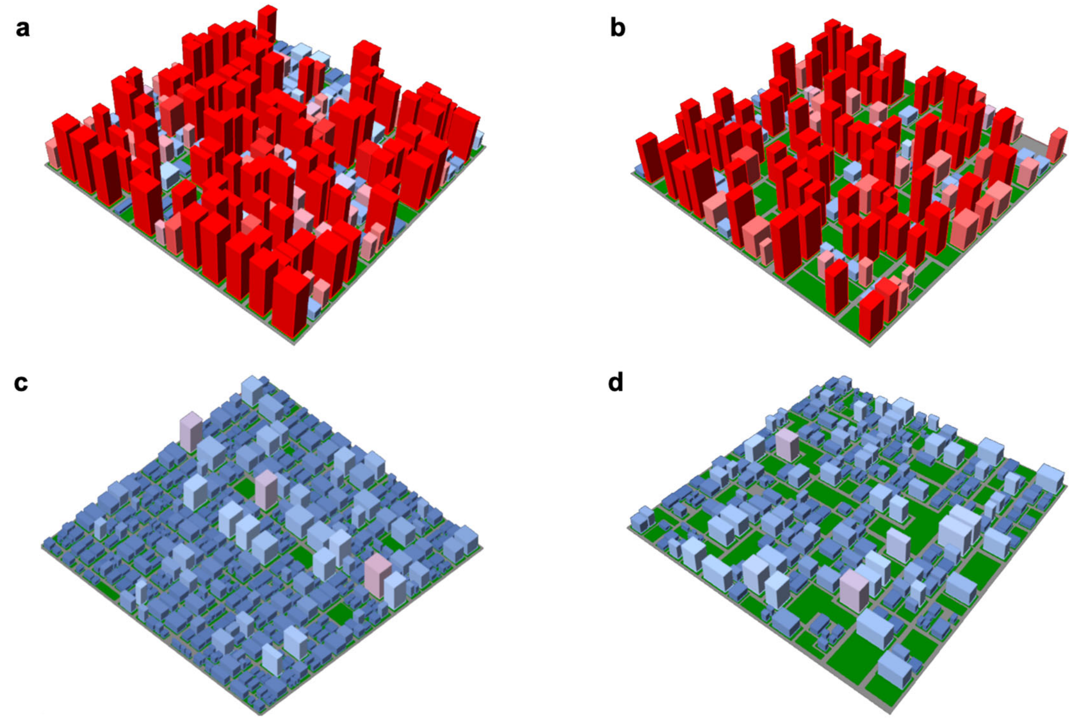


Fig. 1 Illustration of the different of urban typologies classified in the present analysis. **a** HDHR, **b** LDHR, **c** HDLR, **d** LDLR. The height of each building is mapped to the colour with blue as low heights and red as high heights.

footprint, sizes, number of storeys, distance with adjacent buildings, etc. could bias our results. As an alternative, we surveyed 25 addresses in the UK (in the cities of London, Edinburgh, Glasgow, Manchester, Leeds, Sheffield and Birmingham) to measure these key building characteristics and neighbourhood constraints. The choice of the addresses we surveyed was due to proximity to the authors to ensure a good coverage of the key inputs to our analysis and the possibility of site visits where needed. In the attempt to avoid a sole UK focus of our study, we verified these primary collected data against spot checks in the European cities of Berlin, Oslo, Stockholm and Vienna, obtaining good agreement.

For each of the 25 addresses we surveyed, we extended our analysis to 1 km^2, with each building at the centre, and collected the following data: number of blocks, number of green spaces, average block perimeter, average block area, average green space perimeter, average green space area, average street width, average main road width, average distance to surrounding buildings, and width and depth of the building plot (including gardens, driveways, etc.). These inputs ensure the synthetic urban environments stem from real-world observations. For each urban environment we assess, at the building level, both embodied and operational emissions to inform a whole-life set of results. While our model and method are applicable irrespective of the geographical context of analysis, the results of their application—while aimed at a broad European context—remain rooted in UK primary data. The results for such context are shown in the next section.

RESULTS

Density and tallness of urban spaces

Urban environments are diverse, arguably unique, and the product of many factors such as the landscape, culture, economy and history. Yet, a common theme throughout urban environments is the types of buildings that comprise them. These can be categorised as non-domestic low-rise (NDLR); non-domestic high-rise (NDHR); domestic low-rise (DLR); domestic high-rise (DHR); and terraced or semi-detached houses (House)[16,17]. Full details are given in the Supplementary Information (specifically Supplementary Methods 1, Supplementary Table 1 and Supplementary Methods 3). The layout and combination of these different building types contribute to both the density and height of an urban space[13,18–20].

In this study, we offer a LCGE analysis of urban environments by decoupling and analysing both tallness and density. Through our method, we parametrically simulate 5000 urban environments under two scenarios and perform a cradle-to-grave process-based life cycle assessment on each to evaluate the LCGE. Scenario 1 considers fixed populations of 20, 30, 40 and 50 thousand people with varying land area, while Scenario 2 considers a fixed land area of 1 km^2 with varying populations potentially supported. We compare the LCGE of each urban environment to evaluate if taller and denser environments yield greater efficiency in terms of accommodated population, land use, energy demand and GHG emissions. This multi-criteria approach provides a more holistic picture of the LCGE of urban environments and can inform better policies and practice related to urban design and planning.

While a large variety of urban typologies could be defined with respect to density and height, we define four typologies for discussion herein: high density, high-rise (HDHR); low density, high-rise (LDHR); high density, low-rise (HDLR); and low density, low-rise (LDLR). Examples of these urban environments are visualised in Fig. 1. An area of midtown Manhattan in New York City, USA, is an example of a HDHR urban typology with a density factor of approximately 54.5 and a tallness factor of 54.2. Central Paris is an example of a HDLR urban typology with a maximum density factor of 62.6 and tallness factor of 7.5. LDLR urban typologies are commonplace in suburban metropolitan areas, or urban "sprawl," while LDHR environments have been envisioned by many urban planners, notably by Le Corbusier's design of the "Radiant City"[21]. Details around the determination of the cut-offs for each urban typology (Supplementary Discussion and Supplementary Methods 1) as well as the procedural flowchart of the algorithm behind our model are given in the Supplementary Information (Supplementary Methods 2).

For each of the five types of building considered herein, the LCGE results are presented in Table 1, separated by life cycle stage as defined by BS EN 15978:2011[4]. As expected, the structural system of each building contributes significantly to the cradle-to-gate emissions. With a 60-year lifespan assumed for all buildings[22], the operational impacts represent between 77–83% of the LCGE. Non-domestic buildings typically have higher LCGE than domestic buildings, while high-rise buildings have greater LCGE than low-rise buildings which is consistent with findings from other studies[5,23,24]. These LCGE results for different building types feed into the 5000 parametrically simulated urban environments which are explored under the two previously defined scenarios.

Scenario 1: fixed population

Figure 2a illustrates the LCGE of all simulated urban environments for the four population scenarios: 20, 30, 40 and 50 thousand people, while Table 2 shows key results for LCGE and land area (averages and standard deviations) for each population cluster. Across all four populations, the LCGE increases as tallness increases, independent of the amount of land required to house the population. In contrast, the density of buildings has little impact on LCGE; for each population, low- and high-density typologies result in similar LCGE results. If the simulated environments are separated into their height–density typologies, we find that between the LDLR and HDLR typologies, there is a decrease in the average LCGE as population increases: 10% decrease for a 20k population, 16% for 30k, 19% for 40k and 15% for 50k. A key difference between LDLR and HDLR typologies is the built land area required to accommodate the same number of people. HDLR typologies require 49–56% less land than LDLR, resulting in lower LCGE impacts and less demand for land. Percentages in the discussion of the results always refer to comparison across the averages reported in Tables 2 and 3.

High-rise buildings have much higher LCGE than low-rise buildings, as shown by the large bubbles in Fig. 2. Thus, building taller has a significant impact on the LCGE of an urban environment when the number of people is kept constant. For a 20k population, moving from a HDLR (small purple bubbles) to a HDHR (large purple bubbles) typology results in a 140% increase in LCGE; for 30k, 40k and 50k populations, the difference is 154, 143 and 132%, respectively. Compared with the difference between LDLR and HDLR typologies presented above, this shows the much greater impact of building taller over building denser.

From Table 2 it is possible to see that, for all the fixed populations, HDLR buildings minimise LCGE. HDHR is the worst-case scenario for all populations, ranging from a 27 to 77% increase in LCGE when moving from a 20k to a 30k and 50k population, respectively. However, the impact on LCGE with increasing populations is higher for the other urban typologies, despite absolute LCGE being much higher. For a LDLR scenario, doubling the population, i.e. from 20k to 40k, results in an 81% increase in LCGE; moving from 20k to 50k gives a 94% increase. In terms of increasing impacts with greater populations, LDHR shows the highest differences; 112% LCGE increase moving from 20k to 40k and 145% moving from 20k to 50k. This suggests that the land required, and thus the land use change emissions factor, to accommodate higher populations plays a role in LCGE. This is reflected in the larger land areas required when building low-dense typologies for higher populations; in a LDHR scenario, moving from 20k to 30k results in a 53% increase in land area and from 30k to 40k and 50k populations, the difference is 115 and 152%, respectively. However, the small absolute LCGE increase does not reflect the large increase in land required suggesting the relatively insignificant impact land use change has on LCGE.

Table 1. Embodied carbon coefficients (ECC) and operational carbon coefficients (OCC) used to determine a LCGE coefficient for each building type, normalised per square metre of floor area.

	ECC (A1-A3 Structure)[25] $kgCO_2e\ m^{-2}$ FA	ECC (A1-A3 Façade)[26] $kgCO_2e\ m^{-2}$ EA	ECC (A1-A3 Roof)[27] $kgCO_2e\ m^{-2}$ BF	ECC (Stage A4)[6] $kgCO_2\ t^{-1}\ km^{-1}$	ECC (Stage A5&C)[6] $kgCO_2e\ m^{-2}$ FA	OCC (over 60 years)[a] $kgCO_2e\ m^{-2}$ FA	LCGE $kgCO_2e\ m^{-2}$ FA
Non-domestic low-rise	180	72	21	0.19	221	2460	**2953**
Non-domestic high-rise	250	168	21	0.19	221	2460	**3120**
Domestic low-rise	180	76	33	0.19	221	1898	**2426**
Domestic high-rise	250	61	33	0.19	221	1898	**2462**
Terraced/house	90	84	36	0.19	221	1491	**1925**

[a]Derived from operational energy estimates for non-domestic buildings[28] and domestic buildings[29].
Units are given below each element considered; structure, façade and roof ECCs all refer to Stage A1-A3 (i.e. from raw material extraction to manufacturing generally referred to as cradle-to-gate). A4 refers to transportation to site and A5 to construction activities in line with the EN 15978 terminology on a building's life cycle stages. *FA* floor area, *EA* envelope area, *BF* building footprint.

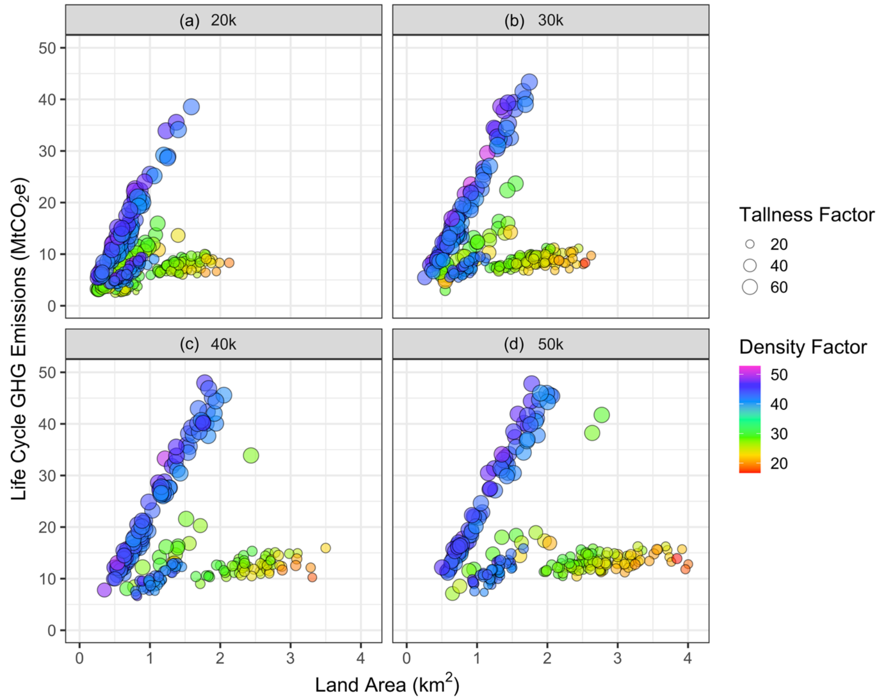


Fig. 2 LCGE versus built land area for fixed populations. Results presented for 20 (**a**), 30 (**b**), 40 (**c**), and 50 (**d**) thousand people.

Table 2. Summary of the LCGE and built land area with fixed populations for the four scenarios.

		LDLR		LDHR		HDLR		HDHR	
		Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.
20k	LCGE ($MtCO_2e$)	6.82	2.08	7.44	3.46	6.12	1.52	14.68	7.07
	Land area (km^2)	1.32	0.41	0.62	0.29	0.67	0.14	0.65	0.26
30k	LCGE ($MtCO_2e$)	8.69	1.21	11.20	4.75	7.32	1.18	18.60	9.79
	Land area (km^2)	1.82	0.34	0.95	0.35	0.84	0.12	0.81	0.36
40k	LCGE ($MtCO_2e$)	12.37	1.49	15.8	6.20	9.98	1.83	24.25	10.88
	Land area (km^2)	2.48	0.41	1.33	0.42	1.11	0.19	1.07	0.44
50k	LCGE ($MtCO_2e$)	13.2	1.38	18.2	9.94	11.2	1.83	26.01	11.4
	Land area (km^2)	2.81	0.49	1.56	0.65	1.24	0.17	1.16	0.46

The distribution of building types across the four population models is shown in Fig. 3. For the higher populations (40k and 50k), proportionally more domestic buildings are selected in order to accommodate the need for more residences. This need is particularly illustrated through the 50k population model in which domestic low-rise buildings dominate any other building type across all simulations.

When LCGE is normalised per building type, non-domestic buildings have the highest share of the impact at 75% (62% for non-domestic high-rise and 13% for non-domestic low-rise), so their inclusion in the urban scenario inherently increases LCGE. Domestic buildings account for the remaining 25% with the following split: 17% for domestic high-rise and 4% for both domestic low-rise and terraced/house. This split in LCGE impact aligns with the results presented in Table 1. As expected, non-domestic buildings are responsible for the largest portion of LCGE due to having higher operational emission intensities. This value will become less significant as a driver for higher non-domestic impact in future years due to the decarbonisation of the grid and reduced reliance on fossil fuels[25]. Therefore, the next hotspot to address from a LCGE perspective is the structural system of buildings, which is largest in high-rise buildings, both domestic and non-domestic. Beyond that, the largest difference is seen in the façade; non-domestic high-rise buildings have at least twice the impact of the other four building types, due to the heavy material intensity of steel and glass[26,27].

In terms of land area, the difference between LDHR and HDHR urban typologies is not as stark as the low-rise scenarios. The LDHR scenario requires between 17–34% more land for a 30k population and 50k population, respectively. Essentially, more people require more space, but high-rise buildings require a similar land area compared to low-rise buildings with varying density. This is due to the space required when building taller; buildings must be further apart for structural reasons, urban policies and occupant comfort. Therefore, building taller to accommodate a growing population not only does not save space but also significantly increases LCGE. A note here might be on whether the additional empty space between high-rise buildings is transformed into urban greenery that can sequester carbon. Evidence in support of this can be found in the work of Zirkle and colleagues[28], who modelled carbon sequestration in home lawns in the US finding a technical sequestration potential ranging from 25.4 to 204.3 g C m^{-2} $year^{-1}$. Their work covers different US zones with their own climates, ranging from cases

Table 3. Summary of the LCGE and population accommodated with a fixed land area for the four urban typologies.

	LDLR		LDHR		HDLR		HDHR	
	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.	Average	Std. dev.
LCGE ($MtCO_2e$)	7.11	0.60	15.10	3.02	8.79	1.16	24.98	2.69
Population (thousands)	21.04	5.19	42.69	12.70	46.66	12.65	57.80	18.98
LCGE per capita	0.34	0.12	0.35	0.24	0.19	0.09	0.43	0.14

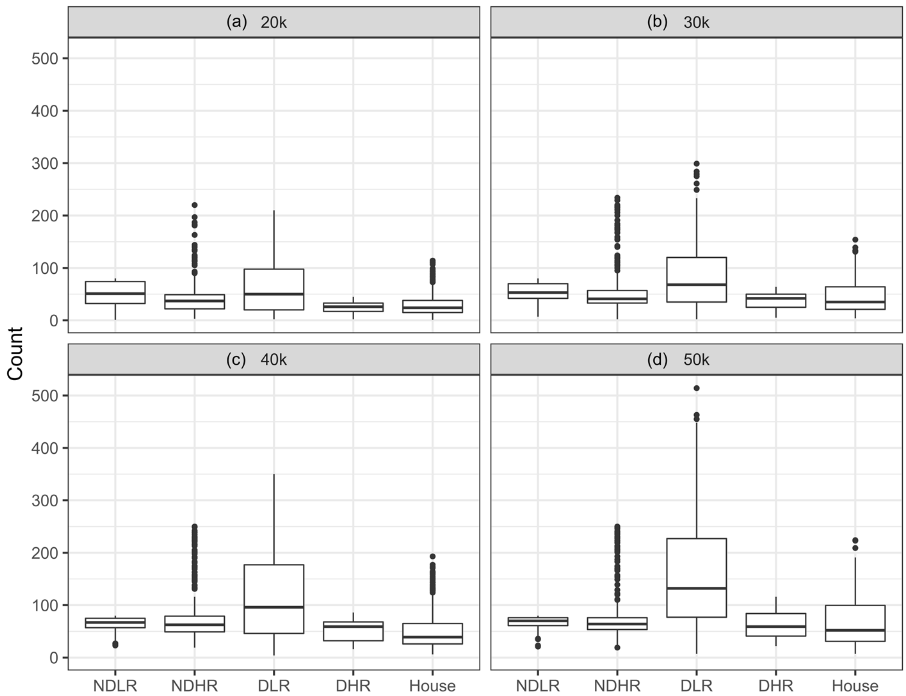


Fig. 3 Count of building types for each simulated urban environment across the four population models. Results presented for 20 (**a**), 30 (**b**), 40 (**c**) and 50 (**d**) thousand people. Quantitative comparison between the typologies in our synthetic environments and those observed in real urban environments—showing good agreement—is offered in the SI (Supplementary Fig. 3).

(arid southwest) where the lawn management (energy, irrigation, fertilisers, etc.) can offset the net carbon sequestration to others (northeast) where best practices for lawn management show a significant and promising net carbon sequestration potential. We are therefore unable to immediately translate such values into inputs to our model to capture carbon sequestration of urban greenery, but this undoubtedly is an important point for future work.

Figure 4 presents the LCGE as a function of the tallness and density factor for each fixed population. This visual representation shows that LCGE increases with increasing height and that high-rise buildings are more commonly paired with high density typologies. Furthermore, this representation illustrates that the LCGE of different densities is less stratified than for building height, reinforcing the finding that building height has a significant impact on LCGE, while density does not.

Scenario 2: fixed land area

Figure 5 illustrates the LCGE for different combinations of density and height for a fixed land area of 1 km^2. This plot is more variable and does not show the same trends that were identified in Fig. 2. There is a pattern whereby LDLR (small red bubbles) exhibit the lowest LCGE and HDHR (large purple bubbles) have the highest. Therefore, in this scenario, LDLR is the best-case in terms of minimising LCGE and HDHR is the worst. However, LDHR can accommodate 103% more people than a LDLR scenario and HDLR and HDHR scenarios can accommodate 122–175% more, respectively. On average, more than twice as many people can be accommodated in a HDLR scenario for a similar LCGE, with 21k people at 7.11 $MtCO_2e$ for LDLR and 47k people at 8.79 $MtCO_2e$ for HDLR. Thus, HDLR would offer a better solution; invest 24% more carbon to accommodate 122% more people. With high-rise scenarios, LCGE significantly increases compared to LDLR; 112 and 251% more LCGE in LDHR and HDHR scenarios, respectively. Therefore, the carbon investment does not seem justified. Changing the density from low to high has little impact on the LCGE in low-rise scenarios, as shown in Table 3. However, moving to high-rise structures results in a significant impact on LCGE with a 184% increase moving from HDLR to HDHR.

DISCUSSION

With an aim to evaluate the widespread belief that building dense and tall is the only way to accommodate a growing urban population, we developed and employed a method to separate density from tallness in urban environments and establish the extent to which each influences the LCGE of cities. Indeed, the difference between varying urban scenarios and across varying populations had yet to be quantified from a LCGE perspective. We found that while tallness does significantly increase the LCGE, density does not, and we here suggest that there is an alternative

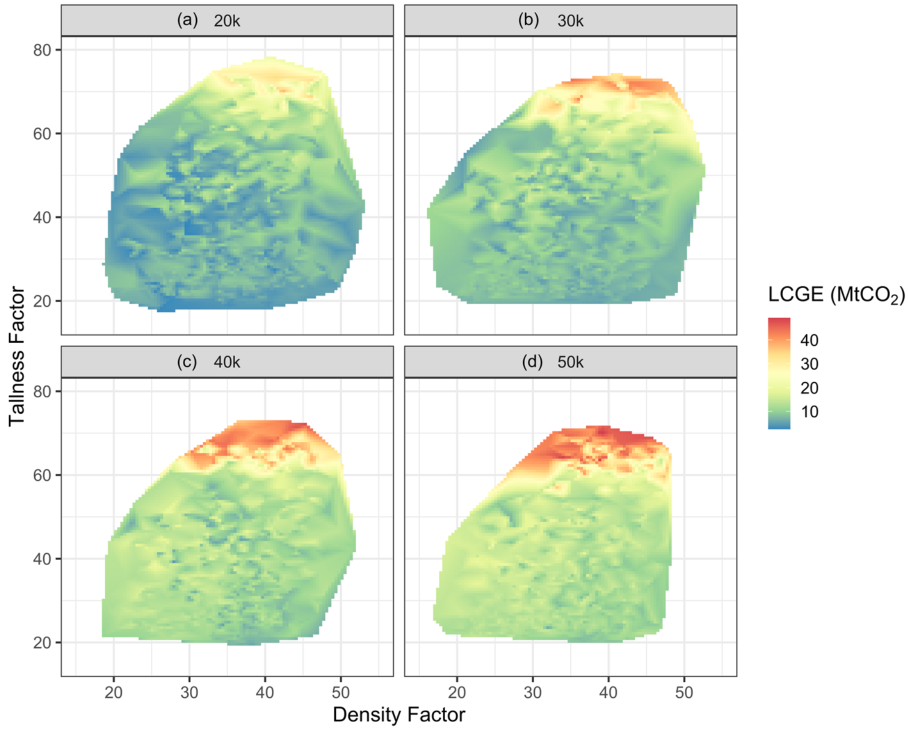


Fig. 4 Colour maps for the fixed population conditions under investigation. Results presented for 20 (**a**), 30 (**b**), 40 (**c**), and 50 (**d**) thousand people. A spline interpolation is used to interpolate between each simulated urban environment.

low-rise pathway for urban development that can meet the growing demand for urban floor area. While not explored in detail, it is worth considering that low-rise urban environments also allow to choose from more construction materials than the handful of elite materials that govern and dominate our high-rise built environments (i.e. steel, reinforced concrete, aluminium and glass).

Specifically, in terms of LCGE impacts, HDLR urban typologies are the best-case scenario for a fixed population. This can even be argued to be the case for a fixed land area, despite a higher absolute LCGE output than the LDLR typology, due to the much greater number of people that can be accommodated. For the case of fixed populations, it may be surprising that LDLR typologies do not have the lowest impact. However, due to the larger land areas required to accommodate the same population, the land use change factor pushed the impact past that of HDLR though there is only a relatively small difference between them (10–19%). Given the growing pressure and competing demands on land as a resource it is however only reasonable to assume it is used as efficiently as possible, and this is what HDLR urban typologies do. The worst-case scenario for a fixed land area is the HDHR typology, as population does not constrain the number of buildings or type that can fit within the 1 km^2 boundary. For the fixed population conditions, the worst-case scenario is also HDHR (followed by LDHR) suggesting that there seems to be no supporting evidence behind the necessity for high-rise urban environments.

While simulation based, our synesthetic urban environments (i) stem from primary data collected in real-world neighbourhoods (Supplementary Methods 2 and 3 and Supplementary Note) and (ii) match well with the features revealed by analysis of today's cities (Supplementary Method 1 and Supplementary Fig. 3). As such they can effectively support both better urban policies and more environmentally sustainable urban design and planning. For instance, when new mixed-use neighbourhoods are being developed or redeveloped, our method and model can offer important insights to inform policies in order to meet the desired targets (e.g., population to be housed and/or non-domestic floor area to be achieved) while reducing LCGE. Similarly, in parts of the world where new cities are being built from scratch (e.g. China) or where this could happen in the near future (e.g. Africa) our research could support urban planning and design. Significantly, the EU/UK geographical context of our work only affects the underlying data and not the model and method which could feed off machine-readable data representative of any country in the world.

Future potential applications of the model and method could investigate 'optimal' values for urban density and tallness given specific constraints or support the development of a dynamic modelling element that interacts with the analysis of density and tallness. In addition, the results of this study suggest that there is no merit to the claim that building denser and taller is more sustainable. By building dense, low-rise urban environments, the same populations can be accommodated for drastically lower carbon costs and without having to significantly increase land use.

Limitations and recommendations

The model limitations are covered in detail in the accompanying Methods section. To capture the stochastic nature of urban areas, a simulation-based methodology is used. A limitation of this approach is that the model selects building types based on the plot size and desired height. Although we checked that, overall, our share of domestic vs. non-domestic building types match that of real urban environments, a fully simulation-based approach could present simulation bias. Further, while we based our input variables selection on extensive data collection of real urban environments (e.g. distance between neighbouring buildings), these input variables could all be subjected to sensitivity analysis to further unravel the extent of the role they play in determining the LCGE of urban environments. An element where this would become particularly useful is to adopt a continuous distribution of buildings' heights to choose from. This would remove the simplification between low-rise and high-rise that we introduce in this research to be able to

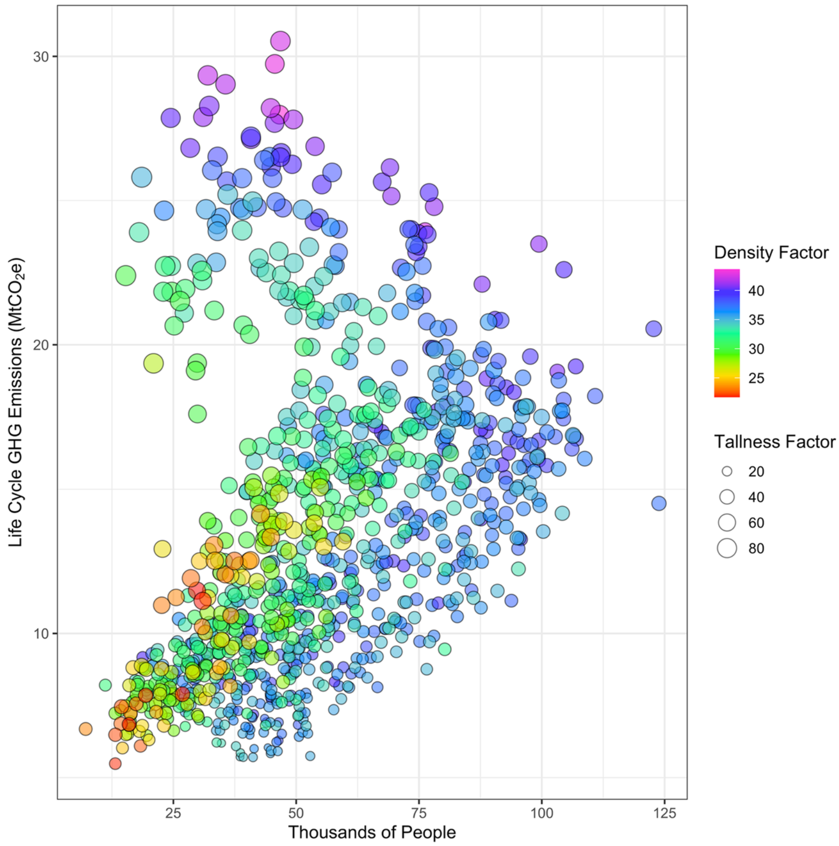
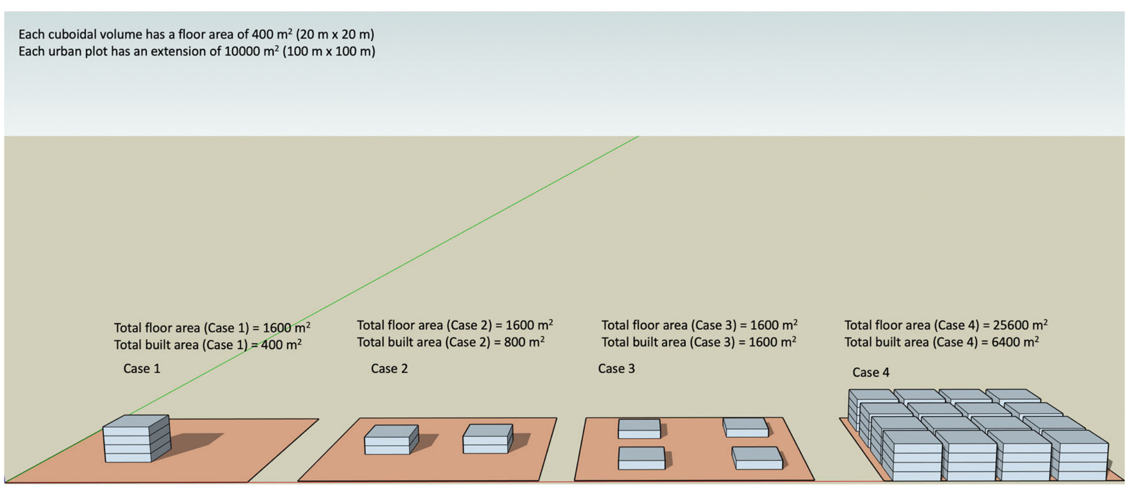


Fig. 5 Density, tallness, and life cycle GHG emissions. LCGE versus number of people accommodated for a fixed land area.



Density approach	Formula	Density (Case 1)	Density (Case 2)	Density (Case 3)	Density (Case 4)
Adopted in this research	$Df = \frac{\sum_{i=1}^{n} A_i}{A_{Land}} * 100$	$\frac{400}{10000} \cdot 100 = 4\%$	$\frac{800}{10000} \cdot 100 = 8\%$	$\frac{1600}{10000} \cdot 100 = 16\%$	$\frac{6400}{10000} \cdot 100 = 64\%$
Existing in the literature (e.g.[15])	$Df' = \frac{\sum_{i=1}^{n} A_i \cdot s_i}{A_{Land}} * 100$	$\frac{1600}{10000} \cdot 100 = 16\%$	$\frac{1600}{10000} \cdot 100 = 16\%$	$\frac{1600}{10000} \cdot 100 = 16\%$	$\frac{25600}{10000} \cdot 100 = 256\%$

Fig. 6 Metrics of urban density. Comparison between floor-area-based metric of urban density and land-occupation based metric (adopted by the authors).

compare the two. Furthermore, to aggregate the embodied GHG emissions values for the substructure and roof, generalisations were made based on average values obtained from literature. Additionally, for land use, land-use change and forestry (LULUCF) we adopt conventionally agreed factors from the leading database ecoinvent. The land use change method adopted and the assumptions of the previous use of land also warrants further research to increase the understanding of the importance of this variable.

These limiting assumptions were necessary based upon the urban scale scope of this study. Providing additional levels of detail at the building scale would greatly improve the accuracy of the analysis and can be refined in future works. Employing a cradle-to-cradle approach to consider resource reuse, the impact of retrofitting existing building stock over rebuilding; the inclusion of transportation impacts; adding a dynamic time component to investigate material inflows and outflows; and including a detailed time-related analysis of carbon sequestration potential offered by urban greeneries in the simulated environments—are all valuable and important avenues for future work to build on this study and expand its relevance while reducing its limitations. This study therefore acts as a stepping-stone to provide a strong foundation from which extensive future work can be born.

When considering LCGE, which encompasses both embodied and operational GHG emissions, the results provide further insight to dispel the growing belief that taller and denser is better. These findings support the growing claim to resolve the unnecessary opposition between embodied versus operational and re-unite them both into the physical unity of a built asset. For example, it has been argued that the environmental impact of the operational phase of cities can be alleviated by green plant coverage, i.e. vegetation façades[29]. However, to support such an additional load there needs to be more materials in the building structure thus increasing the embodied impact. Additionally, vegetation covering the façade may offset carbon emissions, but it also shades the entire façade increasing the need for mechanical means of ventilation, daylighting and heating.

Sustainability is a three-legged stool comprising the economy, the environment and society: to be truly sustainable all three must be in equilibrium. Therefore, interdisciplinary considerations that need to be addressed when progressing this work include, for instance: occupant comfort; the urban heat island effect; competing land use; the carbon sequestration effect of green spaces; urban policies; resource consumption; how the urban environment affects crime; etc. Cities are the central hub of modern society and to address these multi-faceted issues a highly multidisciplinary approach seems the only appropriate way forward.

METHODS

Life cycle assessment methodology

To determine LCGE, carbon coefficients for the different life cycle stages and building components were found from existing literature. Table 1 outlines these results and the embodied and operational carbon coefficients for the five building types considered. A cradle-to-grave life cycle assessment was conducted for this study, accounting for the 100-year global warming potential (GWP100) measured in kilograms of carbon dioxide equivalent ($kgCO_{2e}$). Here, carbon impact and LCGE are used as shorthand for GWP100. Resource reuse or recycling was excluded since it is beyond the scope of the study. With respect to building components, the core structure, building façade and roof were included while the foundations for all building types were excluded. The lifespan for each building type was assumed to be 60 years, after which the buildings are assumed to be demolished and materials sent to landfill. To accommodate for a decarbonising energy mix, a steady decarbonisation rate of 6.4% per year was applied as this is the rate required to limit global warming to 2 °C[30]. For the models with fixed populations, a land use change factor, 0.08 $kgCO_{2e}$ per m^2, was added to account for the changing land area. This factor was taken from ecoinvent[31] and is specific to construction processes. The focus of this analysis is limited to a UK and European context to reflect the regional variations of lifecycle inventories, which are highly dependent upon the region in which the data is collected[32].

Twenty-five case studies were used to generate primary data on the building parameters which were utilised as inputs to the parametric model. Buildings in the UK were chosen to collect primary data due to physical proximity and possibility of accurate measurements and site visits when needed. These collected data were then used to cross-check other buildings in Berlin, Oslo, Stockholm and Vienna to make our analysis relevant to the broader Europe (full details in Supplementary Methods 1 and Supplementary Note). To determine the LCGE of the built forms, in $kgCO_{2e}$ per m^2, embodied carbon coefficients (ECCs) for different construction materials and the different life cycle stages were found from existing research and emissions databases[6,31,33–35]. These values were then multiplied by the normalised material intensities found during primary data collection to arrive at the LCGE impact of each building type. Full details are available in Supplementary Methods 3.

The embodied carbon of the façade was calculated from the envelope area and the roof from the building footprint; the ECC of each buildings' structure was taken directly from the literature[36]. The life cycle was considered from Stages A–C, cradle-to-grave, and the operational carbon coefficients were derived from operational energy estimates provided by DECC and DBEIS[37,38].

Parametric model

A bespoke parametric model was developed for this work that allowed the density and height of building plots to be stochastically selected from predefined ranges (Supplementary Methods 2). The ranges were informed by the case studies for the five building types considered in this work. The benefit of this randomisation lies in the variety of realistic built forms that can be developed, computed and assessed. Likewise, block size and street sizes were captured from the case studies. Existing buildings in urban environments were surveyed and data were collected for a number of building characteristics (e.g. population density, storey height, perimeter, building footprint, etc.) and neighbouring constraints (e.g. blocks and green spaces in 1 km^2, road widths, distance from neighbouring buildings, etc.). Full information on the buildings surveyed and data collected for each neighbourhood is given in the supplementary information (Supplementary Methods 3 and Supplementary Note). Two street sizes were included, main and secondary streets. To calculate the potential population supported by each simulation (for the fixed area case), the floor area per person for each type of building was used. These values are based on the average floor area per person for owner occupied and social housing domestic dwellings (46 m^2 and 36 m^2, respectively)[39] and office space required per person (8–13 m^2)[40].

To simulate the fixed area urban typologies (Scenario 2), 1000 buildings were simulated with random sizes based upon the representative case study buildings for each of the five building types. Next, the land area is divided into blocks with varying dimensions. Main streets were generated between blocks with widths randomly selected from 13, 14 or 16 m, based on the case studies. Each main block is then divided into smaller lots of land based upon the specified density factor which determines the density of the model. Plots that do not have access to streets are turned into green space. Each plot is then iterated over to place a random building with the target tallness factor of the model into each plot. The criteria for placement are that (i) each building has an area of free space surrounding it, (ii) the height of the building is the closest (typically within a five-metre range) to the target height factor of the model, and (iii) the space between adjacent buildings is 10 m if high-rise whereas low-rise buildings can attach to each other. Plots where no representative buildings could fit were turned into green space. Once an urban typology is simulated based on the specified tallness and density factor, the LCGE is computed for that typology. A flowchart to further support the understanding of the logic behind the model is offered in the supplementary material (Supplementary Methods 2).

To simulate the fixed population urban typologies (Scenario 1), 1000 buildings were simulated for each population as described by Scenario 2. A large land area (4×4 km, based on analysis of large urban environments such as London, New York City and Shanghai) was generated and divided into blocks of varying dimensions. Blocks, streets and green spaces are generated in the same manner as Scenario 2, for a 400×400 m grid. The number of possible inhabitants was calculated based on the floor area of the residential buildings divided by the floor area per person required for each building type. Using a recursive algorithm, the initial grid (400×400 m) is increased by 50 m on each side if the number of people is less than the target number of people for the simulation. Buildings are again sampled, and the total population supported recalculated. Once a tolerance of 50 people is achieved, the model calculates the LCGE of the urban typology. The code used to generate this simulation can be accessed through a GitHub repository linked in the Data Availability section.

The carbon impact of green spaces and transport infrastructure were not included as it is beyond the scope of this study. However, a one-way

ANOVA was conducted to determine the impact of increasing density on road area. A one-way ANOVA was also carried out to determine the impact of building height and density on LCGE, to reduce any uncertainty in the interpretation of the findings. Three hypotheses were tested: (1) Impact of building height on LCGE: H_0 = increasing height does not impact LCGE; H_1 = increasing height does impact LCGE. (2) Impact of density on LCGE: H_0 = increasing density does not impact LCGE; H_1 = increasing density does impact LCGE. (3) Impact of density on road area: H_0 = increasing density does not impact road area; H_1 = increasing density does impact road area. The null hypothesis is rejected for the case of building height; increasing height does significantly impact LCGE. For the case of density and LCGE, the null hypothesis is not rejected; increasing density does not impact LCGE significantly. Likewise, the null hypothesis is not rejected for the impact of road area. The output of each urban typology is the overall density, average height and total LCGE of the stochastic simulation.

Urban density metrics

Urban density is usually referred to as number of people per unit land area inhabiting a given urbanised location. When dealing with urban forms, different approaches exist such as dwellings per hectare or a height centred approach (e.g., floor area divided by land area[15]). The latter can be mathematically represented as follows:

$$Df' = \frac{\sum_{i=1}^{n} A_i s_i}{A_{\text{Land}}} \tag{1}$$

with the numerator in Eq. (1) above representing total floor space as a sum of products between the building footprint area, A, and number of floors, s, for the generic i^{th} building. The main limitation of such a metric is that it does not allow to differentiate between the separate effects resulting from horizontal and vertical densifications. This is graphically illustrated in Fig. 6 where three urban configurations (Cases 1, 2 and 3) score the same urban density (16% as per Eq. (1)); however, they are significantly different if we look at them in terms of land occupation and vertical development. Two separate metrics are therefore required in order to estimate the effect of these two parameters independently. Specifically, we developed two distinct factors for density and height, a "density factor" (*Df*) and a "tallness factor" (*Tf*), as defined in equations (2) and (3), where A_i is the building footprint of the generic building i, A_{Land} is the useable land area, H_i is the building height of the generic building i and n is the number of all buildings.

$$Df = \frac{\sum_{i=1}^{n} A_i}{A_{\text{Land}}} \tag{2}$$

$$Tf = \frac{\sum_{i=1}^{n} H_i}{n} \tag{3}$$

Using the two density factors in Eqs. (2) and (3) above allow for an independent evaluation of the effects that horizontal densification (occupying more of the available land) and vertical densification (building taller) have on urban environments. When density and height are combined, for example expressing density as a function of floor area (e.g. Eq. (1)), two scenarios can have identical urban densities but completely different typologies, thus masking the impact of building type.

Additionally, the density factor we developed always ranges between 0 and 1 (or 100%), thus enabling meaningful comparisons within strict and defined boundaries. The existing metric instead allows density values to exceed 100% (Case 4 in Fig. 6) and potentially has no theoretical upper bound thus limiting further its practical use in comparing the density of different urban typologies.

DATA AVAILABILITY

The data generated and analysed during this study are described in the following data record: https://doi.org/10.6084/m9.figshare.14663313[41]. All code and supporting data can be accessed via GitHub at https://github.com/jayarehart/Denser-Taller. Static versions of the two data files included in the GitHub repository have also been included with the figshare data record[41] (downloaded from GitHub on 24/05/2021). Additional supplementary data and notes are available in the files 'supplementary_methods.xlsx' (Excel spreadsheet with multiple tabs) and 'supplementary_notes.pdf', which are publicly available in the Mendeley Data repository at https://doi.org/10.17632/kj3zn5nx6b.1[42], as well as together with this figshare data record[41].

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AUTHOR CONTRIBUTIONS

F.P. and B.D. conceptualised the research. R.S. conducted the primary data collection and N.G. developed the parametric model. R.S., N.G. and J.A. developed the methods and performed the analysis. All authors contributed to the discussion and interpretation of the results. F.P., R.S. and J.A. wrote the manuscript and SI. All authors reviewed and edited the manuscript and approved the final version.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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