Sustainability and Urban Density in Vancouver

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Executive Summary

This study analyses the role urban density plays throughout sustainable planning in the City of Vancouver. The research asks the following questions: Is increased density inherently "Eco" or "Sustainable?" What must be considered to create sustainable urban densification? How does this fit with the City of Vancouver's density model and what gaps exist in current planning to create a sustainable future? Through expert interviews in conjunction with an analysis of peer reviewed literature and government documents, it can be seen that there is significant debate surrounding density as a tool for sustainability. Given this background, it is recommended that urban density be analysed further by the City of Vancouver through the conduction of Life Cycle Assessments (LCAs) to obtain more comprehensive data to eliminate this ambiguity. I recommend the city of Vancouver should conduct LCAs to obtain more complete data surrounding emissions and urban density and should follow the standards as put forth in ISO 14040 and 14044. By looking at past legislation, specifically the EcoDensity Charter of 2006, it is recommended that density is reintegrated in the sustainability conversation. Because of the negative reaction EcoDensity received, density as a topic was not included in the Greenest City 2020 Action Plan and as the city moves forward to create a new sustainability mandate, they should adopt constructive practices to bring the density question back in to the discussion as it is a key piece, without which a sustainable city cannot be achieved.

Introduction

There are many scales, levels, and platforms from which to combat climate change: as an individual, a household, a city, country, or internationally. My research focuses on the role of the city of Vancouver as an active player in the discussion and action surrounding climate change and sustainability. Specifically, I am focusing on the way in which the City of Vancouver uses urban density as a means to achieve a sustainable future and reduce emissions. Buildings account for 55% of total Greenhouse Gas (GHG) emissions in the city of Vancouver, and as such are a key in assessing the long-term goal and target setting as delineated in Vancouver's sustainability plans (City of Vancouver, 2012, p. 23). Vancouver's sustainability blueprint, the "Greenest City 2020 Action Plan" is reaching the end of its relevant period as the year 2020 draws nearer and the plan will necessarily be revised in coming years. As such, now is a critical time to assess the plans effectiveness in achieving sustainability and diagnose gaps or areas of improvement. By exploring different methods of measuring density effectiveness, discourse surrounding density publications and discussions, and various conditions surrounding urban densification, I have determined that density must once again be discussed as an active player in the sustainability discourse in Vancouver. Given the important role density has to plan in the sustainability of a city, Vancouver should invest time and resources into the acquisition of stronger more complete data through the undertaking of Life Cycle Assessments, a holistic "cradle-to-grave" measurement tool. Using this data, in the creation of a new sustainability plan, urban density in Vancouver should receive broad public consultation and discussion to properly develop a successful plan for creating a more sustainable city.

Method

This research was conducted through a literature review of scholarly works and studies on urban density. These scholarly works were then compared to Vancouver's current planning documents and potential gaps between the two were assessed. Further, recommendations were put forth in how to address these gaps in the creation of a new sustainability plan. This background research was underscored by three expert interviews conducted to confirm research findings and discuss possible recommendations and ways forward. By conducting these expert interviews and through my literature review of both scholarly and municipal government documents, I have determined that a reinvigorated focus on urban density will lead Vancouver in a more sustainable direction.

The Urban Density Debate

The effect of urban density on sustainability, particularly environmental sustainability through emission reduction, is a highly discussed and debated subject. What is not debated and generally agreed upon is the extremely high impact the built form holds on global GHG emissions. Buildings account for 30-40% of global GHG emissions and as such "decisions on the structure, including the building types, density, location and public transport, delineate the long-term frames for the GHG emissions of a community" (Heinonen & Junnila ., 2011, p. 1). In Vancouver, it has been found that this number can be even higher at up to 55% of total GHG emissions (City of Vancouver, 2012, p. 23). However, given this strong consensus on the importance of the built form in the release of GHG by a city, the way to use this form to achieve lower emissions is hotly debated. Multiple studies have been conducted in various cities that find often contrasting results

when asking the question if increased density will yield increased sustainability through decreased emissions.

Heinonen and Junilla (2011) conducted a Life Cycle Assessment (LCA) in several Finnish metropolitan districts and found that increasing the density in urban centres, such as Helsinki, did not decrease emissions but in fact increased them (p. 8). This was due to change in behavioural habits such as consumption, income, and standard of living that led to an overall increase in net GHG emissions. Midali et al. (2004) found similar findings when conducting a study of urban density and energy consumption that denser cities were not unequivocally more sustainable and that "density (not including employment density) has no effect on energy consumption" (p. 158.) However, in asserting this, the authors do not suggest that there is no relationship between emissions and certain aspects of urban density (p. 160). Their findings suggest that increased employment density coupled with increased overall density did yield decreased overall emissions. Echenique et al. (2012) projected growth and urban patterns in the UK through computer modeling to determine the most efficient way forward for urban growth. The authors came to the conclusion that current planning policy strategies for land use and transport have virtually no impact on the major long-term increases in resource and energy consumption. They go on to argue that compaction should not be sweepingly implemented based on the modest potential for CO2 reductions as it can have large negative social and economic consequences such as "less housing choice, crowding, and congestion" (p. 136).

Another key criticism limiting the positive effects of denser neighbourhoods on decreased emissions is the argument of pre-determination and self-selection of individuals who choose to live in mores sustainable, denser neighbourhoods. Chatman (2009) studied

this relationship to determine if existing data as presented by many scholars and government documents may be misleading in the net impacts of denser neighbourhoods. His primary point of analysis is the residential self-selection hypothesis in which households choose neighbourhoods based on preconceived ideas of their expected travel patterns. If this is true, increased density and sustainable mixed use building design would not have a strong impact on emission reductions, as those that inhabit these spaces would already be emitting fewer emissions than the average person (p. 1073). Chatman's results did not entirely support this theory and found that residential self-selection was modest and did not render reductions in emissions insignificant (p. 1087).

On the other side of this debate, studies have been conducted that positively correlate increased urban density with decreased energy consumption and emissions. Senbel et al. (2014) analysed four neighbourhoods in the Metro Vancouver area with varying levels of building density. They analysed the dense mixed-use neighbourhoods and their proximity to transit services and determined that higher density, even in the absence of other changes, yielded a decrease in emissions. The study found that a high-density neighbourhood adjacent to a suburban city centre, and one adjacent to a central city centre, produced 50% and 67% fewer emissions than the neighbourhood of large single-family homes (p. 1240). In Canada, numerous studies have been done regarding the creation and effectiveness of sustainable mixed-use New Urbanism neighbourhoods to combat GHG emissions (Grant & Bohdanow, 2008). Results are varied with some showing success in walkability and a decrease in Vehicle Kilometres Traveled (Moos et al., 2006) with others painting a different picture of New Urbanism developments not achieving in reality what they set out to achieve in their initial conception (Grant & Bohdanow, 2008).

In Toronto, Norman and Kennedy (2006) found that low density suburban developments emitted on average 2.5 times the amount of GHG emissions annually per capita than their high-density urban counterparts (p. 18). They conducted an LCA that encompassed the three broad categories of material productions, building operations, and transportation to determine the overall emissions from an area. The largest finding they determined to be extremely significant in their study was the variation that occurred when changing the functional unit of measurement. When this was changed from per capita to per square metre, the energy savings seen from the dense areas were significantly reduced. Chau et al. (2015) confirmed this importance and the variability in functional unit of measurement when comparing different LCA studies (p. 404).

What is highlighted through a thorough reading of all these studies, especially the Toronto study of Norman and Kennedy, is the significant impact the methods of measurement have on the results obtained. The inputs selected by the authors, the interpretation and extrapolation from these inputs can strongly impact and alter the outputs. As showcased through the literature, the topic of sustainable urban density is extremely complex and encompasses aspects from all areas of built form, transportation, consumption, and behaviour to name only a few. The situation is intricate and complex and "this complexity derives from the mutual influence that the different factors have on each other and from their joint effect on the consumption of energy" (Mindali et al., 2004, p. 150). To account for this complexity, extra care must be taken when selecting data to analyse and the limitations of methods and what is omitted must be carefully considered.

Life Cycle Assessment

One method that recurs through multiple density studies is the Life Cycle Assessment (LCA) and this will be explored further in the research as an option that should be undertaken by the City of Vancouver when assessing the density of the city. As defined by the International Standards Organization for LCAs, "LCA addresses the environmental aspects and potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal (i.e. cradle-to-grave)" (International Organization for Standardization [ISO], 2006.) LCAs can take the form of a top down approach that aggregates data from regional economic data, a bottom up approach that builds from each individual material input, or a hybrid of the two (Carnegie Mellon University Green Design Institute, 2008). As determined through an expert interview with Rob Sianchuk, a practitioner and professor in the field of LCAs, the study and use of LCAs is relatively new and limited, although demand is increasing (Sianchuk, 2015). Fava et al. (2009) confirm these statements as they completed an overview study of LCA use and concluded, "demand is increasing for LCA and impact/inventory category-focused LCA-like protocols and analyses that utilize the LCA principles and decision rules applied to a single issue, such as GHG and water availability" (p. 493).

International standards are published and continually updated on the steps and guidelines of conducting a complete LCA including the proper selection of inputs and modeling. ISO 14040 "Life Cycle Assessment – Principles and Framework" and ISO 14044 "Life Cycle Assessment – Requirements and Guidelines" were published in 2006 and

contain comprehensive internationally recognized guidelines on the proper conduction of LCAs (ISO, 2006). These two guides are "now considered the leading and most important international standard for environmental assessment according to the life cycle or cradle-to-grave or holistic method" (Klopfer, 2012, p. 1087). Fava et al. (2009) recommend the use of these standards across bodies in the conduction of LCAs and this was supported by Rob Sianchuk during his interview. As such, I recommend the city of Vancouver should conduct LCAs to obtain more complete data surrounding emissions and urban density and should follow the standards as put forth in ISO 14040 and 14044.

Vancouver Density Policy

The City of Vancouver has addressed the density question head on in the past with the EcoDensity Charter that was introduced by Mayor Sam Sullivan in 2006 (Toderian et al., 2008). At its launch, the EcoDensity initiative was defined as "high quality and strategically located density to make Vancouver more sustainable, affordable, and livable" (Toderian et al., 2008, p. 3). The plan states that the goals of EcoDensity were quite broadly: environmental sustainability, improved affordability, and livability through densification (Toderian et al., 2008, p. 8). However, upon introduction of the plan to the public, the Mayor and Council were immediately met with fierce and vocal backlash and opposition to this plan on numerous fronts. EcoDensity was seen by many groups as a top-down, institutional fix, and was introduced in a "battering ram" approach that did not effectively or meaningfully consult public opinion in its creation and implementation (Rosol, 2014, p. 2242). Only after its introduction was public consultation sought in 2006/07 and 2008 (Rosol, 2014, p. 2242). The Charter underwent four official versions

and was eventually passed by council in 2008 (Toderian et al., 2008). However, despite the fact that it was eventually passed by Council, it appears that EcoDensity was never acted upon as a new municipal government was formed under Mayor Gregor Robertson just months after the Charter was passed. This new government sought to distance itself from the controversy surrounding EcoDensity and create a new sustainability plan, and did just that in its Greenest City 2020 Action Plan.

The current sustainability plan in the City of Vancouver is the Greenest City 2020 Action Plan (GCAP), put forth to ensure "a healthy, prosperous, and resilient future for our city" (City of Vancouver [COV], 2012, p. 5). The plan was introduced after hundreds of hours of community and expert consultation and contributions were made by over 60 City staff, 120 organizations, and thousands of individuals (COV, 2012, p. 6). This high level of citizen engagement was highlighted in an expert interview conducted with City Councilor and Deputy Mayor Andrea Reimer. Councilor Reimer emphasized that the goal of the plan was to be "owned by the city," not just the government and to do this involved internal and external committees, citizen engagement boards, and large scale mobilization efforts that engaged upwards of 40,000 individuals (Reimer, 2015). This stands in stark opposition to the methods undertaken in the creation of the EcoDensity Initiative. In regulating this growth to be sustainable, the key to success is "to strike a balance between citizenly demands (be they progressive or reactionary) and the requirement that complex societies be in some way formally managed according to abstract rules, measurement and regulation" (Scerri & Holden, 2013, p. 276).

The GCAP is divided in to 10 smaller sections covering areas from Green Business, Water and Waste and, most relevant to this research, Green Buildings. The Green Buildings

subsection focuses on the "greening" of existing buildings, and regulating the construction of new buildings to reduce building GHG emissions by 20% over 2007 levels (COV, 2012, p. 23). An expert interview conducted with Green Building Planner Chris Higgins at the City of Vancouver revealed the high level of data that is being obtained surrounding the sustainability of the built form. For example, what materials, heights, and forms provide the greatest reductions in emissions is actively studied by professionals with the city like Higgins (Higgins, 2015). However, it appears that the way in which these green buildings fit within a larger density plan is less clear, and this is reflected in the GCAP. The broader GCAP does not explicitly link the issue of density to GHG emission reduction, nor does it the issue in any larger capacity. This may be due to the current government's desire to distance itself from the arguably disastrous EcoDensity Charter of the previous administration. While this research cannot speak to the success or failure of the GCAP, as it is still an ongoing initiative, there are certain successes (the vast community engagement) and concerns (the as the lack of density discussion) that can be carried in to recommendations for a future city sustainability plan.

Research Recommendations

As stated earlier in this research, the methods undertaken to assess the sustainability of urban density are extremely important and must be carefully chosen. It can be seen that "when cities have begun to adopt targets, their planning efforts have often been impeded by variable data, methodological uncertainty, political obstacles, and a general lack of resources" (Senbel et al., 2013, p. 29). To combat this uncertainty, I recommend the City of Vancouver conduct Life Cycle Assessments to determine the best

way to move forward with density planning and obtain more complete and accurate data on the subject that cuts across sectors and incorporates the multiple interacting aspects of the density debate. The LCAs should be conducted by professionals trained in this field, and follow the guidelines and steps as outlined in the International Standards on conducting LCAs. The City of Vancouver should take the first steps necessary to create a plan to move forward with these LCAs in advance of the development of a new City Sustainability plan, so that the data is compiled, analysed, and readily available to inform public and expert consultation.

The second recommendation is nested within the first. Using the data obtained from the LCA, the discussion of density should be reintegrated in to the development of the plan that will succeed the GCAP. In conjunction with the discussion that is already present surrounding green buildings, this should be integrated in to the larger picture of both environmental and social sustainability through density planning. The discussion should follow the active citizen engagement as employed in the GCAP creation (as opposed to what was used for the EcoDensity Charter) and should allow meaningful community dialogue to shape the plan in conjunction with expert opinion and information.

Possible limitations to these recommendations include the resources, time, and money that are required to conduct a thorough and proper LCA of density in Vancouver. This is a naturally limiting factor in any system of government with a limited time in office and a constant driver of re-election. Further limitations of LCAs are summarized in the following table, all of which must be considered and accounted for by the City of Vancouver in the conduction of density LCAs.

Table 1: Limitations of LCAs

Category	Limitations
Boundary scoping	• Only focuses on environmental impacts • Some environmental qualities such as indoor air quality are not included • Economic and social dimensions of sustainability are not included • Environmental impacts are assumed to be constant over time • Geographic site specific factors are not included
Methodology framework	• Different tools may include different types of impact categories • Different studies may adopt different normalization factor, grouping or weighting methods • Different studies may have different assumptions on building configurations, climate conditions, etc. • Assumptions in studies may lead to uncertainties
Data inventories	• Materials/products from different manufactures cannot be compared • A lack of inventories for new innovative materials • Availability and uncertainty of inventory data can affect results
Practices	• The lack of benchmarks in LCA results • Life cycle evaluations of buildings are more complicated than conventional products • Reluctance to move design timeline • A lack of chain management responsibilities

Source (Chau et al, 2015, p. 407).

Conclusion, Limitations, and Further Research

This research does not suggest what path Vancouver should take forward in regards to sustainable urban density planning, but rather addresses certain gaps that exist for the city to accurately and informatively make these decisions. The research posits that there is a lack of complete data that exists and this should be rectified through the employment and creation of Life Cycle Assessments. Further, the research has found that the way in which the community and broader public are engaged in a plan has a deep impact on the success of policies and, as such, vast community engagement, as was seen in the creation of the Greenest City Action Plan, should be continued in this renewed density discussion. The two recommendations cannot exist without one another as policies without complete data cannot be successful, and data that is not openly shared and debated will not bring about meaningful change.

As has been displayed, the debate surrounding sustainable urban density is extremely vast and encompasses many complex issues. As such, the scope of this research project naturally limited a complete overview of this complexity and chose to focus on certain elements of the debate, mostly in the environmental realm. Social sustainability is an equally important aspect of density and issues such as affordability, heritage preservation, and quality of life (to name a few) must be integrated in to the discussion. The two recommendations put forth do account for social sustainability as this can be included in LCA investigations, and certainly is a large consideration in public consultation.

Further research should be conducted in Vancouver on the relationship between Vancouver's density and the surrounding area in which it is situated. Vancouver density does not exist within a vacuum and is directly impacted by densification in surrounding municipalities and the Greater Vancouver region. Senbel et al. (2013) explored the way in which various municipalities in British Columbia (including Vancouver) have responded to municipal GHG reduction targets and found that "one of the challenges to the regional response is the disparity of target emissions between adjacent municipalities" (p. 39). This disparity, specifically surrounding density targets, should be further analysed to create a more effective policy.

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