The Carbon Footprints of Returning to Work: Office Leasing and Commuting Impacts

Avis Devine
Schulich School of Business
York University
Canada
adevine@schulich.yorku.ca
519-212-0653

Chongyu Wang
College of Business
Florida State University
USA
cwang@business.fsu.edu
850-644-7414

April 2025

Abstract
The transition towards remote and hybrid work (RHW) practices has not only led to a decrease in office leasing activity but also raised questions about the future of urban office spaces. This study investigates how sustainable and urban characteristics of office spaces moderate office leasing decisions in the new RHW era, and the downstream effects. Drawing on a proprietary dataset encompassing the Canadian office market post-2020 (representing one of the most stabilized RHW environments globally) we integrate leasing activity with sustainability and mobility data to examine the intersection of organizational and worker preferences, space utilization, and environmental impact. Findings indicate that sustainable certifications (governing both the assets directly and the landlord) have cemented their role in the definition of high-quality office buildings, and that the strongest demand for office space is situated in dense areas, particularly those with strong public transit access. Mobility analysis indicates that, within the larger context of less commuting in the RHW era, these sustainable and urban office spaces are associated with longer commutes by workers - employees are evidencing that they value these attributes by commuting further to obtain them. Taken together, this indicates that sustainable investment at the asset and firm level leads to not only strong leasing activity in the building, but also enhanced vibrancy for the surrounding community.

Keywords
Remote and hybrid work, work from home, return to work, COVID, green buildings, healthy buildings, Commercial Real Estate, ESG

Written correspondence to: Avis Devine, Schulich School of Business, York University, 4700 Keele St, Toronto, ON M3J 1P3 CANADA.

1. Introduction

Organizations are grappling with decisions regarding remote and hybrid work (RHW) policies, considering ways to best calibrate their operations and maximize performance (Barrero et al., 2020). A key component in these RHW discussions is the physical space it involves, and two space categories are deeply integrated in the RHW conversation. First, there is the office space, provided by organizations for their workers. This space relates to questions about interactions which happen in the office, the innovations that may spur, and the loneliness such interactions may quell (Aksoy et al., 2023). It relates to outcomes regarding how much office space a firm needs, where it should be located, and what types of amenities and characteristics it should have. And, it asks what cities should do with under- and un-utilized office spaces (The Economist, 2024). Second, there is the housing space in which the workers live. These spaces raise timely questions about housing affordability, where – or more accurately "how far away" - people need to live to be able to afford their housing, and the resulting impacts to community infrastructure and the environment. Importantly, what links these two spaces together is the commute – the trip workers make on in-person days between their home and their office. An individual's commute shapes their quality of life, and the net commuting trends of a city impact the quality of life for the community overall as well as the health of the natural environment. These relationships indicate that office leasing decisions carry impacts not just for the organization leasing office space, but also for the individuals utilizing that space, the communities shaped by occupied or vacant office buildings and commuting trends, and the natural environment. This study will tease apart several of these impacts, focusing on the links between RHW's role in office space leasing decisions, the environmental knock-on effects, and how such impacts may be felt by individuals and communities.

The relationship between the built world and the natural world has garnered substantial attention over the last few decades, and with good reason: real estate's environmental footprint is the largest of any industry globally. Buildings consume more than 40% of the global energy supply annually and are the most significant emitter of greenhouse gases (GHGs). Real estate is responsible for 30% of global raw material consumption and more than 25% of solid waste generation (Environmental Sustainability Principles for the Real Estate Industry, 2016). This reality is overlaid by the global trend of people moving away from rural areas and into cities. Such behavior is associated with several benefits including increased economic activity and innovation for businesses, greater access to public services such as healthcare, education, and transportation infrastructure for people, and lower per capita resource consumption and GHG emissions for the natural environment. Yet urbanization is also associated with drawbacks such as strain on inadequate infrastructure (including housing) and environmental degradation if urban areas sprawl outwards in search of affordable housing alternatives (Kantel et al., 2024).

This important and dynamic relationship between buildings and the environment has led to a shift in how the real estate sector approaches sustainability. Leading sustainability frameworks have specified the outsized role of real estate in addressing global climate change. Of the United Nations' 17

Sustainable Development Goals (SDGs), several are applicable to the real estate industry and cities (including #11: Sustainable cities and communities).[1] Academic literature streams speak to sustainable real estate development and building operations, through varying lenses including economics, engineering, and policy. Studies indicate that sustainable buildings (often measured as green certified buildings) can improve energy and water efficiency and reduce consumption of raw materials. Financial impacts of this are tracked through asset valuation and lower risk measures for firms that associate with sustainable buildings (Clayton, Devaney, et al., 2021).

At the intensive margin, office space decisions play a multifaceted role in both organizational and individual (professional) performance. A well-known commercial real estate (CRE) rule of thumb is the 3-30-300 rule, which states that for each square foot of office space, an organization should expect to pay $3 in utilities, $30 in rent, and $300 in associated payroll expenses (Mørch, 2020). While an oversimplification, this rule carries some important insights. First, the costs to lease or own office space (i.e. rent and utilities) comprise approximately 10% of an organization's operating costs (for some industries this can run as high as 25%), rendering office space decisions a significant aspect of organization operations. Second, refined calibration of office space use can allow organizations to extract value. This technique gained much attention during the rise of green building certification activity, as rental rate premiums for green buildings are accompanied by utility expense reductions (Devine & Kok, 2015; Devine & Yönder, 2023; Eichholtz et al., 2010, 2013; Fuerst & McAllister, 2011).[2] Further, as organizations are presently committing to RHW environments, their office space needs change requiring a re-examination of their office space leasing activities. For example, a U.S. study found that work from home days are stabilizing at 30%, up from 5% pre-pandemic, with higher values in knowledge-worker industries (Barrero et al., 2020). Yet this doesn't map directly to leased space needs; consideration needs to be given to when workers will come into the office (at the same time vs. different times), and what type of space they need while in the office (quiet vs. collaborative).

Aside from meeting the structural space needs, in order to attract and retain talent, tenants aim to offer amenities which draw workers to their office space, such as co-locating with great food options and easy accessibility to the office. This aspect relates to the largest 3-30-300 expense bucket: payroll costs. Here, benefits are realized through several channels. Employees that value environmental commitment may consider environmentally certified office space in their employment decision, resulting in a relationship between green building certified office space and stronger employee attraction and retention. A JLL study found that green building certified office space could be associated with a 10% improvement in employee retention.[3] Second, studies have shown that improved indoor environmental quality (IEQ) is associated with improved productivity through the benefits of daylit

[1] For details, please see: https://sdgs.un.org/goals.
[2] For service-providing firms, office occupancy is 2nd largest expense after payroll (Nelson, 2023). For many firms, a large part of Scope 2 will be office space-related. With separately metered space, tenants can reclaim that control, and those wanting to address their Scope 2 emissions can utilize this opportunity.
[3] For details, see: https://www.jll.ca/en/trends-and-insights/workplace/a-surprising-way-to-cut-real-estate-costs.

space, outdoor views and lighting, improved acoustics, greater thermal comfort and ventilation (see Loder et al., 2025 for in-depth review). For example, the Allen, MacNaughton, et al. (2016) study of office workers evidences that higher levels of CO2 and VOCs in the air caused by poor ventilation leads to lower cognitive scores for workers. A follow-up study finds that improved ventilation carries productivity savings of approximately $6,500 per person annually through improved employee productivity, further enhanced by lower absenteeism and fewer instances of respiratory healthy issues (Allen, Bernstein, et al., 2016). Third, workers benefit from the socialization opportunities of in-office environments. Data indicates a higher level of isolation post-pandemic, with the average American spending an additional 30 minutes alone each day, with socializing and volunteering occurring less frequently than in 2019 (The Economist, 2025).

At the extensive margin, employment has always shaped where and how we live in society. This held true when we were predominantly farmers, when we worked in factories, and when we worked in office-based services. In each situation, we selected where we live, where we shop, and how we move around based on where and how we work. For the developed world, this meant that we spent the last few decades developing the built environment around office towers in urban centers. With this came a variety of knock-on sustainability-related effects that shaped our commutes and our communities. Resulting impacts included benefits, such as the notion that cities are more environmentally friendly, per capita, than life in the leafier suburbs (Glaeser, 2012). Yet there are also societal drawbacks, including worsening housing affordability which developed, in part, as people competed for locations that maximize benefits (or minimize costs) to both their personal and professional lives.

Remote work, or telework, has existed for decades, originally pioneered by IBM in the 1970s (Butler, 2021). Yet it was the COVID-19 pandemic which flipped the world of office work on its head by forcing the adoption of remote work by nearly all office workers. Instead of needing to gather at an office space to create value for organizations, the pandemic taught us we can – and often prefer the opportunity to – work from our homes. The severity of this structural change in work is highlighted by a global study of over 36,000 working individuals and their RHW experience and expectations (Aksoy et al., 2022). Respondents in the U.S. and Canada indicated that, if told to return to in-person work 5 or more days a week, fewer than 60% would comply – strengthening to fewer than 1 in every 2 workers in the heaviest office-use industries (Finance, Insurance, and Real Estate, or FIRE; Information; and, Professional & Business Services). Importantly, evidence also shows that workers and employers alike value time in the office. Major firms such as Amazon, Dell, and Meta made news in 2024 announcing strict “return to the office” policies (Business Insider, 2025). Concurrently, a June 2024 survey of U.S. office workers found that only 20% of workers preferred fully remote employment (Berger, 2024).

(Insert Figure 1 about here)

The post-COVID push and pull between employers and employees regarding RHW has left several office buildings and their surrounding streets underutilized, raising questions about future utilization. In financial markets, forward contracts (such as leases) reflect market perception of future pricing and

valuation. Therefore, vacancy rates and leasing activity are effective measures of current and future office market health, respectively. U.S. quarterly gross leasing activity for office space dropped 30% over 2021 and 2022 (Rowden, 2024), and a Q3 2021 study of Canadian office use found that 15% of organizations (and as high as 30% of Information industry organizations) expected to shrink their office use in the future (Statistics Canada, 2021). Despite the "return to the office" push, both vacancy rates and office space utilization remained stagnant in 2024. In January 2025, the U.S., national office occupancy rose to 54.2% - the strongest performance since pre-pandemic. With national vacancy rates sitting just below 20%, this indicates that approximate one-quarter of U.S. office space is leased but unused (Lopez & Peck, 2025). Accordingly, U.S. office subleasing (when an existing leasee rents out a portion of their unused space) has doubled over pre-pandemic levels (Nelson, 2023). Figure 1 presents the vacant space available for direct and sublet leasing in the four major Canadian office markets: Calgary; Montreal; Vancouver; and, Toronto.[4] With the exception of Calgary (a market which has been struggling with office occupancy for many years), vacancy has been increasing, as has subletting activity.

"Flight to quality" is a common response when office markets weaken (vacancy grows and demand for space lessens), and evidence indicates that likely occurred in the post-COVID weakened office market as recovery began. A study of net office absorption found that, utilizing building age as a proxy for quality, only recently built office assets experienced positive net absorption post-COVID (Ryan, 2021). However, what defines an office building as high quality adjusts over time in response to changing market preferences, and newer definitions often include metrics of environmental sustainability, health, and digital connectivity. Hu, Kok, and Palacios (2024) finds that higher tenant satisfaction with office space is associated with stronger rents, rent growth, and occupancy rates, and one of the metrics which shaped tenant satisfaction was green building certification. A JLL study from November 2023 found that in 20 major office markets, only one-third of the upcoming demand for low-carbon workspaces will be met.[5] Set against the backdrop of rising overall office vacancy and continued office space downsizing, this tells a story of substantial divergence in demanded office space, split along the sustainability seam. This raises the question: **In the stabilized RHW era, is sustainability part of the new definition of high-quality office space?**

During the COVID-19 pandemic, many workers moved away from urban cores when they did not need to access their firm's office space; some are now either not able or willing to move back. This issue is worsened by the concurrent affordable housing problems plaguing major cities. A McKinsey (2023) study indicated that as much as 7% of the population that left the core will not return. Teasing apart remote and hybrid preferences, a 2024 industry study found that workers increasingly prefer the latter over the former, indicating a possible move toward hybrid in the long term (He, 2024). Literature

[4] Office stock in all four markets was growing at a slow and stable rate during this time, indicating that this is an issue of demand, not supply.
[5] For details, see https://www.facilitiesdive.com/news/demand-for-sustainable-buildings-outstripping-supply-jll-says/701006/.

on the relationship between remote work and commuting indicates that as the number of days a worker needs to make a commute decreases, the distance they are willing to commute increases, resulting in a net *increase* in travel distance (Larson & Zhao, 2017; Ravalet & Rérat, 2019). If a worker's post-pandemic commute is, on average, a longer distance fewer times a week, the net GHG travel-related emissions and associated congestion will increase.

Understanding the impact of RHW on land use patterns and cities is a topic of recent interest, with several researchers grappling with theoretical models on the subject (Delventhal et al., 2022; Gillette, 2023; Kyriakopoulou & Picard, 2023; Monte et al., 2023). Suggested outcomes range broadly, from the hollowing out of inner cities or the strengthening of city cores, to both improved and worsening worker outcomes regarding commute times and distances for both remote and in-person workers, and the associated congestion and emissions outcomes. Rosenthal et al. (2021) examines the decreasing rent gradient in transit-centric urban areas compared with car-based areas, finding that the rent premium associated with employment density declines sharply following the COVID-19 shock, but more so in transit-centric areas. The authors postulate that effectively cities fall into two categories - car cities and transit cities - and find that, post-pandemic, transit cities will be losers in the CRE office market.

While this post-pandemic RHW literature is deep in theoretical modeling, it falls short in empirical evidence. Anecdotally, in Q1 2025, New York City – the epitome of transit cities in North America - experienced its strongest performance since 2018 (Long, 2025). The reality is that, while some (smaller) cities may be truly car cities (i.e. – with little to no public transit), there is no such thing as a pure transit city. Cities are amalgamations of transit-friendly places and transit deserts, and it is the net of these areas' interactions that shape outcomes – including office leasing, worker commutes, and related CO2 emissions. This raises questions about the role of new market preferences, for sustainable and urban office spaces and the resulting commute-related outcomes to individuals and to the environment. We will extend the forward-looking insights from the leasing activity analysis address the question: **What roles do the urbanity and sustainability of office spaces play in mediating the community and environmental consequences of RHW trends?**

Aksoy et al. (2023) finds that full-time employment has stabilized globally at just shy of one remote day per week on average since 2023 (with notable variation by country), but survey results indicate that workers ideally would prefer two days per week remote, on average. No country hits this stabilized definition of RHW, but one country comes close: Canada, at 1.9 days per week (The Economist, 2025). Yet there are no RHW studies to-date examining Canada. The preponderance of studies examines the United States – a market still very much in the throes of negotiation and adaptation to the new RHW normal (and with an average remote days per week of 1.6).

Through a coordinated partnership with multiple real estate service providers, we have been granted access to a proprietary dataset examining the universe of Canadian office leasing data, providing a unique opportunity to examine not only an infrequently studied leasing environment, but importantly

the most stabilized RHW environment which exists globally. This data, combined with proprietary data on sustainable building certification activity as well as demographic, business activity, and mobility data, allows us to examine the relationships between office leasing and both environmental and social impacts in the post-COVID, RHW era Canadian context. Subsequently, we estimate impacts of office leasing locations on commutes, shaping individuals' quality of life as well as GHG emissions.

The paper begins with an exploration of several applicable theoretical frameworks, indicating where they intersect in our analysis of office space utilization moderated by RHW. After a description of the data sources and methods, we begin by analyzing the first question specified above. We find that, as firms begin to incorporate RHW into their permanent working arrangements, environmentally certified office spaces are associated with higher likelihoods of leasing activity during the weak post-pandemic market conditions; similar yet distinct findings are uncovered relating to relative urbanity. Exploration into tenancy attributes indicates these effects are driven by buildings with diverse and resilient tenant categories. We then move to analysis of mobility data to address the second question above, finding that areas with those sustainable and urban attributes described above are attracting more visits, and are increasing the average commute distance (which has otherwise decreased due to RHW) as workers evidence their willingness to commute further to work in such spaces. A discussion follows, linking the analysis findings to social and environmental outcomes, with a particular focus on estimating environmental impact. This discussion is illustrated with an in-depth examination of how such impacts may present themselves in one of the studied markets: Calgary. We conclude the paper with recommendations for targeted audiences and applications of these findings, both within industry and for policy makers.

2. Theoretical Framework

Leasing decisions are multidimensional, incorporating behavioral aspects of individuals, competitive forces from an organization's industry, and both labor and real estate market dynamics. We employ several prominent theoretical frameworks to better understand how such decisions are made, examining both leasing decisions in the RHW era, as well as the moderating roles of sustainability and urbanity on such decisions.

Office leasing is costly, including expenses such as rent, utilities, maintenance of space, and administrative overhead both in the execution of the lease and ongoing operations. When the COVID-19 pandemic occurred, most organizations suddenly had to move their office employees to fully remote work. While remote work had existed prior to this time, it had not generally been considered a permanent option for most organizations, yet the pandemic indicated that might be possible. Importantly, this discovery provided an opportunity for organizations to optimize leasing-related costs. This manifested by decreasing their existing office space (through non-renewals or subleasing) thereby lowering their total leasing expense, or by deploying their same office space budget on a smaller footprint of higher quality space. At the extreme, some firms attempted to eliminate office space

expenses, closing offices and announcing all employees were allowed (or required) to work fully remote from that point onward. Yet there has been a return-to-work movement in recent years, and Transaction Costs Economics (Williamson, 1981) addresses why organizations are seeking to once again incur leases expenses. Specific to office leasing, this theory considers the costs associated with coordinating and monitoring employees. These are sunk costs that affect the location and organization of economic activities. While remote work may reduce office leasing expenses, it may concurrently increase monitoring costs, and firms are evaluating this trade-off in their leasing and RHW decisions.

The impact of RHW on leasing is also observed through other channels. Labor Market Economics (Ehrenberg et al., 2021), which examines labor supply, demand, and wage-setting, considers the impact of remote work on labor mobility and availability. RHW can widen the labor pool for organizations, allowing them to hire talent from a broader distribution of locations. Fully remote workers can be hired at relatively lower yet competitive wages depending on local costs of living, and hybrid workers may still be able to live further away from the office if they only need to commute a few days of the week. If RHW expands the labor pool by allowing organizations to hire from diverse geographies, those hiring outcomes may reduce their need for office space. Labor market dynamics influence how much office space an organization needs, as well as space location and cost relative to employee distribution.

The role of individuals in leasing decisions can be understood through Behavioral Economics and Social Exchange Theory. Behavioral Economics (Thaler, 2016) considers biases and perceptions which influence decision making, such as those held by managers as they determine their organization's RHW policies. Other related factors impact both workers and management such as trust, job satisfaction, and perceived autonomy, all of which are key to productivity and job retention. A 2023 study indicates that successful RHW adoption is well predicted by the country's individualistic versus collectivist mindset, with more individualistic societies thriving under the RHW model which requires a greater degree of trust between managers and workers (Aksoy et al., 2023). Relatedly, Social Exchange Theory (Cropanzano & Mitchell, 2005) posits that employees reciprocate favorable working conditions – such as RHW – with loyalty and productivity. Therefore, organizations may adopt RHW policies to enhance employee satisfaction and retention.

Finally, at the industry level, the organization's leasing decisions are shaped by competitive forces defined through two frameworks. First, Institutional Theory (Jepperson & Meyer, 2021) captures the effect that leasing decisions are influenced by industry standards, norms, and pressures regarding their physical presence. This theory focuses on how firms conform to industry standards and expectations, such as RHW, to maintain their reputation and align with industry expectations. For example, service-based firms may feel compelled to retain physical office space, even if remote work is feasible (or superior). On the contrary, Resource-Based View (Kraaijenbrink et al., 2009) suggests that firms gain competitive advantage by leveraging resources unique to them, such as a locationally-flexible workforce. Offers of RHW may attract and retain high-quality workers; conversely, if an organization's

competitive advantage is contingent upon in-person collaboration, innovation, or client interactions, maintaining office space may be strategic.

Several of the above-described frameworks also shed light on how the sustainability and urbanity of office space may moderate the leasing decision, particularly in the RHW era. If the sustainable or urban nature of the space is perceived as a non-pecuniary benefit of working for the organization, it can be a differentiating factor that helps attract and retain talent. There has been much attention given to "the 15-minute city" over the recent few decades, identifying benefits to individuals, society, and the environment (Moreno et al., 2024). This idea formalizes a community in which individuals can complete their daily activities (including commuting to work) within a 15-minute active- (walk or bike) or public-transit trip. Such dense environments would, by definition, drastically decrease time spent commuting as well as the carbon footprint, as well as enhance social benefits through channels such as greater socialization amongst the communities that interact more frequently (Jacobs, 1961).

Employees increasingly value sustainable, healthy work environments, so under competative Labor Market Economics conditions, firms may decide to lease such spaces to enhance their appeal. By factoring in the preferences of the workforce for sustainable spaces, firms may find it advantageous to lease green-certified buildings, especially when competing for top talent. Behavioral Economics considers the psychological effects of the workplace on employee motivation and well-being. Healthy office spaces that offer natural light, better air quality, and ergonomic designs can positively influence employees' mental and physical health, leading to improved performance and job satisfaction. Understanding these behavioral factors can encourage firms to invest in greener and healthier office spaces, believing that the improved employee experience will translate into higher productivity. Finally, Social Exchange Theory indicates that positive workplace conditions, such as green or healthy environments, foster employee loyalty and productivity. By providing healthier workspaces, companies offer employees a tangible benefit, which employees may reciprocate with greater engagement and commitment. This can make the investment in sustainable office space leasing attractive, as the improved employee satisfaction may reduce turnover and enhance overall productivity.

These three theoretical lenses describe how green and healthy certified office space can shape employee attraction, productivity, and retention. Summarily, Resource-Based View indicates that green or healthy office spaces can serve as a valuable resource that enhances employee well-being, satisfaction, and productivity, making it a strategic asset. Companies may decide to lease spaces that align with green standards or health certifications as a way to attract and retain talent, giving them a competitive edge.

There are other industry-level channels through which these certifications shape leasing decisions. Since Institutional Theory emphasizes the impact of industry standards, regulations, and societal expectations on corporate decisions, as green and healthy building practices become more standard and customers increasingly value sustainability, organizations may feel pressure to lease certified office space to align with these norms. Leasing healthy spaces can also enhance a company's reputation,

demonstrating corporate social responsibility, which is increasingly important to stakeholders and clients. Therefore, there may be industry-specific norms amplifying (or dampening) the sustainable office space adption.

The impact of the relative urbanity of office space is best described in terms of commutes. Transaction Cost Economics indicates that changes in commute patterns influence the transaction costs for both organizations and employees. If RHW reduces the need for commuting, employees save time and money, potentially enhancing their productivity and job satisfaction. This can shift organizations' decisions on leasing, as reduced commuting costs may justify a remote or hybrid model, reducing the need for office space. Also, commute patterns are directly tied to labor market dynamics, as the accessibility of an office affects which employees can realistically work there. Labor Market Economics considers how reducing commutes can make a job more attractive, and how organizations may respond by relocating to suburban areas to better align with where employees live, which directly impacts leasing decisions. Finally, Social Exchange Theory considers the commute as part of the "cost" to employees, where a long commute might be seen as a burden that reduces overall job satisfaction. When companies reduce commuting demands (through RHW), employees may reciprocate with loyalty and productivity, creating a beneficial exchange. This reinforces the firm's choice to reduce office space if they can still retain (and sufficiently monitor) engaged, productive employees remotely.

These theories reveal a multidimensional approach, indicating that companies weigh both economic incentives and behavioral factors when determining their leasing decisions, particularly in the new era of RHW. Together, these theories create a comprehensive view of why and how organizations make decisions about office leasing, factoring in costs, flexibility, competitive positioning, and adherence to industry standards. We will test these theories by measuring: the impact of sustainably-certified and sustainably-situated office space on office leasing outcomes; the moderating effect of tenant industries; and, the resulting impacts to commute patterns.

3. Data and Descriptive Analyses

This study leverages proprietary commercial real estate office market conditions and leasing activity data provided by Altus Group. These data are augmented with proprietary and publicly available sustainability data from third party commercial real estate certification and benchmarking organizations, as well as with supporting market and mobility data sourced from other providers.

Altus is a commercial real estate consulting firm originating in 2005 in Toronto, Canada from the merger of three Canadian real estate consulting firms. They now provide real estate valuation and consulting services across North American, European, and the Asian Pacific regions and are considered a leading provider of real estate data, analytics, and advisory services globally. Decades of data collection and CRE intelligence work – particularly in Canada – allowed Altus to amass tremendous depth of data in commercial real estate markets, particularly in the areas of CRE leasing, occupancy, and transactions. Given this combination of expertise and their history in Canada, Altus Group is widely

considered the strongest and deepest source of Canadian CRE data.[6] This study utilizes their data on existing assets in Canadian office markets, historical asking rents and listing details, and lease transaction details, as well as metrics of overall market conditions such as space vacancy and availability.

We compare all Altus tracked office assets, representing the overwhelming majority of commercial office space available for lease (770M+ square feet across more than 8,000 buildings). For these buildings we observe location, year of construction and any major renovations, quality (Class A, B, C), size, height, and on-site parking availability; in many cases we can also observe asking rent details and building vacancy. The sample is thinned for missing data, and assets situated in markets without leasing activity. We additionally exclude assets in pre-leasing or construction phases of development. The resulting sample includes 7,942 assets situated in 14 markets across Canada.

The inability to observe dynamic building-level vacancy could be problematic when explaining leasing trends, as only buildings with available space would be capable of experiencing leasing. However, this study focuses on leasing outcomes during a time of market weakness, in which the availability of space for lease is not a constraint (please see the Introduction and Figure 1 for more detail). When we examine the subsample of the buildings for which any space availability data are available during the post-COVID period (5,859 buildings), we find that only 251 buildings (4.3%) have no available space during our sample period. An additional 10.2% of the subsample are buildings which only have space available for subleasing, with the balance of the buildings (85.5%) having a portion of the space vacant. While this does not preclude dynamic conditions where a building may, for a time, be fully leased, this indicates that availability of space is unlikely to be a constraint on leasing activity during this period of weakened market conditions through early market recovery.

We focus on leasing activity between Q1 2021 and Q3 2023, which occurred in approximately 1,500 of the Altus-tracked buildings. Lease transaction data includes the execution date, location, size, term, and type (new, renewal, expansion, or sublet). The executed lease sample includes 2,356 unique leases governing approximately 40M square feet of office space across 14 Canadian markets. The average lease size was approximately 20,000 square feet and scales from 1,000 to 400,000 square feet.

(Insert Figure 2 about here)

Figure 2 provides insights into the characteristics of the Canadian office space leased in the post-pandemic period. Panel A highlights the distribution of leased space, indicating that while leasing occurred in 14 CMAs, 92% of the activity (by square footage) occurs in five major markets, with 44% occurring in the Greater Toronto Area. Panel B identifies the average lease size (in square feet) by lease type over time. This highlights the relatively similar size of the average lease across the three categories of new space acquisition (new tenancy, lease expansions, and sublettings). It also highlights the substantially larger, and increasing, size of lease renewals. Panel C highlights the total space leased

[6] For more details, please visit www.altusgroup.com.

quarterly from 2021 through Q2 2023, by type of lease executed. This graph highlights that, despite the weak market, new leasing remained the most common type of lease activity. Interestingly, there are very similar amounts of space both sublet and renewed during this timeframe. Taken loosely, this reflects the similar prevalence of firms deciding that either they need the same amount of space (renewal), or that they require less space (sublet). On the contrary, expansion activity was quite limited during this horizon, as is expected given the weaker economic conditions and RHW environment.

3.1 Tenancy Data

Tenancy data provides insights both into the types of firms and organizations that are leasing Canadian office spaces of varying attributes, as well as into the business dynamics of the areas surrounding office buildings. We utilize tenancy data from the executed lease sample where it is available, and supplement that data with additional sources to create a more complete picture of local business activity.

Tenant firm is unambiguously identified in half of the executed leases, governing 2/3rds of the leased space. Comparative analysis indicates that there are unlikely to be any notable unobservable differences between the leases for which identifying tenant information is (or is not) available – both categories represent a similar cross-section of lease types and tenant industries. Examination of the disclosed tenancies indicates representation by large multinational firms as well as individuals and small firms, non-profit and for-profit organizations, and public administration offices. Figure 3 presents a summary of the industries represented in the executed lease sample. In terms of leased area square footage, half of the leasing was completed by firms in Information Services industries, including such dominant subindustries as Professional & Business Services and FIRE firms. When the executed leased space sample is broken into the four lease type subgroups (new, expansions, sublettings, and renewals), Professional & Business Services also dominates each subgroup, followed by FIRE in each case. Interestingly, Information Services industries were some of the best-known adopters of RHW, and are now also the industries in the news as they attempt to bring employees back to their offices (Business Insider, 2025).

(Insert Figure 3 about here)

As the existing tenants in the Altus universe are not observable, we supplement our office building dataset with business listings from the S&P Global Marketing List: Businesses Database. This dataset provides granular information on business establishments, including company name, number of employees, estimated annual sales, latitude and longitude coordinates, and the 6-digit NAICS code. We match business listings to Altus properties and agglomerate at the Dissemination Areas (DAs); DAs are the smallest standard Canadian statistical areas composed of adjacent dissemination blocks with populations ranging from 400 to 700 people. This matching process yields our final sample of 1,074,200 tenants distributed across 7,861 Altus properties within 2,403 DAs as of 2021. We utilize this matched

sample to construct several variables capturing heterogeneity in tenant composition and the related worker density, by industry.

3.2 Sustainability Data

We utilize several third-party measures of sustainability in our analysis, certifying both the buildings directly and the owner/operators (i.e. landlords) of the buildings. At a building level, we employ both green and healthy building certifications from the leading certifying bodies in Canada. At an organization level, we employ the globally dominant assessment and benchmarking tool for real estate and infrastructure industries. Sustainability data are collected directly from each certifying body and geospatially matched to the buildings in the sample.

Green building certification data is collected directly from the certifiers of the two leading green building programs in Canada: LEED Canada and BOMA BEST. LEED (Leadership in Energy and Environmental Design) Canada is the Canadian adaptation of the U.S.-based LEED green building certification system; it is executed by the Canadian Green Building Council. This green building certification scheme is designed to promote sustainable building practices across Canada and provide standards for environmentally responsible and resource-efficient buildings. The LEED Canada framework evaluates buildings based on performance metrics such as sustainable site development, energy use, materials selection, and indoor air quality. BOMA BEST is a green building certification program developed by the Building Owners and Managers Association of Canada (BOMA Canada) for CRE assets. Its criteria cover topics including energy, water, air quality, comfort, health and wellness, and waste reduction. Both programs have been widely adopted across Canada for approximately 20 years, are well suited to measure sustainability in CRE assets, and have dedicated certification schemes measuring the sustainability of ongoing building operations; LEED and BOMA BEST operations-focused certifications must be renewed every five and three years, respectively. In both cases, the primary goal of the program is with respect to impact on the natural environment, yet both also include criteria which speak to impact on building users as well. Both programs include third-party verification of data and certify assets at varying level of sustainability. Literature has evidenced that building owners, investors, financiers, and tenants in Canada capitalize these green building certifications into asset valuations (Clayton, Devine, et al., 2021a; Devine & Kok, 2015; Eichholtz et al., 2019).[7]

Healthy building certification data is collected directly from the certifiers of the two leading healthy building programs in Canada: WELL and Fitwel. The WELL Building Certification was developed by the International WELL Building Institute in 2014 as a performance-based system for measuring and certifying buildings. The program's goal is to enhance building occupants' physical and mental well-being through healthier spaces, and it promotes improved productivity, satisfaction, and overall quality of life for building occupants. WELL focuses on design, policies, and operational strategies across ten

[7] For more details, see: https://www.cagbc.org/our-work/certification/leed/ and www.bomabest.org.

core concepts: air, water, nourishment, light, movement, thermal comfort, sound, materials, mind, and community. Fitwel is a global healthy building certification system developed in 2016 by the U.S. Centers for Disease Control and Prevention and the General Services Administration; the program's goal is the promotion of health and well-being within buildings and communities. Fitwel assesses buildings on their design, operations, and policies that impact human health, and covers criteria including promoting physical activity, reducing health risks, enhancing mental health, and supporting social equity. Both WELL and Fitwel are third-party verified, with certifications expiring every three years. Both programs certify at a variety of levels and are widely used by developers, tenants, and owner/operators to identify spaces that prioritize occupant health and align with broader wellness goals in the built environment. [8]

GRESB (formerly The Global Real Estate Sustainability Benchmark) is a voluntary ESG performance reporting framework that originated in The Netherlands in 2009. This assessing and benchmarking organization provides a standardized and transparent framework to measure and compare the ESG performance of property portfolios on an annual basis. GRESB assessments are used by institutional investors to understand the sustainability performance of their assets and support responsible investment decisions. The GRESB program takes the form of an annual survey and is broken into three components: management; performance; and, development. Management components describe an organization's ESG strategy and leadership policies along with information about risk management and investor engagement. Performance data capture organization-level performance across an array of ESG elements, including building-specific reporting on water and energy consumption, waste generation, and carbon emissions. Both quantitative and qualitative data are collected, with scoring weighted more toward the former (70% vs. 30%). Topics range from resource consumption and emissions performance data to diversity, equity, and inclusion policies and metrics; green building certification accounts for approximately 10% of GRESB scoring. GRESB ratings are on a scale of zero to 5 stars, and scoring takes asset allocation and property type distribution into account for both scoring and benchmarking purposes. GRESB is similar to green and healthy building certification programs in that it is a third-party verified sustainability scheme well-suited to measuring the social and environmental impact of CRE assets and firms dynamically over time and at varying levels of accomplishment. It differs from the other certifications in that it is ESG focused, rather than specifically green or healthy, and most importantly in its unit of measurement (organization level rather than building level).[9] A high-level inspection of the intersection of the GRESB and Altus datasets revealed that, of 1,764 executed office leases in Canada, 28% were owned by CRE firms that complete voluntary sustainability reporting to GRESB.

[8] For more details, see: www.wellcertified.com and www.fitwel.org.
[9] For more details, see: www.gresb.com.

3.3 Urbanity Data

We quantify the level of urbanity, or density, of an area through two dominant techniques. First, we include a dummy variable identifying if a building is situated within a city's downtown area. Second, employ qualitative measures of each location's density by utilizing Walk Score, Bike Score, and Transit Score. These scores are metrics developed in 2007 by Walk Score, a company focused on promoting walkable neighborhoods and sustainable living. Walk Score evaluates the walkability of an address by measuring the distance to nearby amenities such as grocery stores, schools, and parks. Bike Score assesses the bike-friendliness of a location based on factors like bike lanes, hills, and the presence of bike shops. Transit Score measures the availability and quality of public transportation networks within a given area, considering factors such as nearby transit routes and the frequency of service. In each case, scores scale from 0 to 100 with higher scores indicating areas more accessible by active (walk and bike) and public transit.

3.4 Movement Data

Movement data is collected from two sources and is utilized to understand the impacts to workers and the natural environment (through the associated carbon footprint) of changes in commute behavior associated with office leasing activity in post-pandemic period. Baseline commuting patterns data is collected from the 2016 Statistics Canada census. These data provide insights into individuals' distance, duration, and mode of commute, which is agglomerated at the DA level. This data is augmented with the Advan Research Neighborhood Patterns dataset which tracks devices to identify home and work locations, as well as commute distances from each of those bases. These data are collected at a DA level presenting monthly averages of daily commuting patterns for the period of 2018 through June 30, 2024. Data are averaged to the quarter to minimize seasonality impacts in daily commuting.

(Insert Figure 4 about here)

Figure 4 presents that average daily commute distance, in kilometers, for individuals working in or living in DAs associated with the office building sample. An examination of average commute distances over the 2018 through 2024 period highlights the similar trend in commute distance when measured from the work location vs. home location base. However, the commute distance from the work base is generally a bit less, reflecting the impact of some trips originating only from home (e.g. weekend errands, etc.). Similar commute trends were broken out by CMA indicating that, at the market level, the average commute behavior was largely consistent across the studied markets.

Also visible in the time trends are the COVID-19 pandemic "stay at home" orders; these were enacted country-wide in March 2020 and ended in June 2021. The exact execution of the end to the "stay at home" orders varied by jurisdiction, yet both Ontario and Quebec lifted the orders province-wide in June 2021. Given the overwhelming dominance of these provinces in our analysis (representing 2/3rds of both office market space and executed lease space), the significance of these dates allows for unique insights around commuting behavior changes.

3.5 Descriptive Statistics

In Table 1 Panel A, we compare descriptive statistics for the full sample of building observed (representing the existing office market), and subsamples of the building-year-quarters in which a lease is (is not) executed. Our sample period spans from the first quarter of 2021 to the third quarter of 2023; over this horizon, the All Buildings market estimation is generally stable, with between approximately 7,000 and 7,700 building observations each quarter. In the full sample, approximately 8% of the building-year-quarters participated in GRESB; this share increases to 31% among buildings with any leasing transaction. The table also examines two variables representing sustainable building certification standards: Green and Healthy. In the full sample, about 18% are green building certified through labels such as BOMA BEST, LEED DB+C, or LEED EBOM, while only 3% are certified as healthy buildings visa Fitwel and WELL. These proportions increase substantially amongst buildings with leasing activity to 50% and 14% respectively. Similar relationships are visible regarding GRESB Ratings and the higher propensity for leasing in downtown areas. Walk and Bike Scores are slightly higher in the leasing subsample, yet a comparison of Transit Scores indicates that leases are being executed in areas that are substantially better supported by public transit. An examination of building attributes indicates that buildings with leasing activity tend to be larger and of higher quality, but only a few years younger, on average. The last column of Table 1, Panel A provides t-test results comparing the the two subsamples, indicating that the differences described above are statistically quite strong.

(Insert Table 1 about here)

Table 1, Panel B proves summary statistics for the DA-level variables utilized in movement-related analyses. There are approximately 33,000 DA-year-quarters in the study capturing the immediate neighborhoods of every building in the sample, covering the period of 2019Q1 to 2024Q2, excluding the pandemic (2020Q1-2021Q2). Approximately one-quarter of all DA-year-quarters is associated with a green certified building, while only 5% and 11% are associated with a healthy certified building and a GRESB building, respectively; 18% of the studied DAs are situated in a downtown area. Commute variables indicate that the average daily commute is approximately 4 to 5 kilometers, with the 75th percentile commute not exceeding 7 kilometers. Importantly, these daily averages are based on total monthly distance, so RHW should dampen the distances travelled. The census indicates that 7% of the population in those DAs worked from home in 2016, and the Dingel Neiman calculation indicates that, on average, 52% of the positions held by firms in those DAs are eligible to be worked remotely. The average amount of office space per DA is approximately 327,000 square feet.

4. Methodology

We examine the Canadian office leasing activity to identify sustainability impacts to a variety of stakeholders, from individuals and organizations to communities and the natural environment. Through comparison of the overall office space market to the buildings experiencing leasing activity in the weakened post-pandemic market, we speak to the nature of spaces that are (or are not) attracting tenants in the RHW market landscape, as well as which asset, market, and stakeholder characteristics are shaping office lease execution. Specifically, we examine the impacts of two metrics: sustainably certified office spaces and relative urbanity.

First, we conjecture that buildings with pre-existing sustainable attributes and/or management practices are associated with higher levels of leasing activity following the onset of the COVID-19 pandemic. To empirically test this hypothesis, we estimate the following linear probability model:

$$Leased_{i,t} = a_i + \beta_1 Sustainability_{i,t-1} + \beta_2 X_i + \beta_3 Y_i + \theta_{l,t} + \epsilon_{i,t} \qquad (1)$$

where the dependent variable (*Leased*) captures various dimensions of leasing activity, and the independent variable (*Sustainability*) measures lagged sustainability attributes, while controlling for building hedonics (*X*), market attributes (*Y*), and submarket (*l*)-temporal (*t*) fixed effects. The primary measure, *Leased*, is a dummy variable equal to 1 if any leasing transaction occurs at the building level within a given year-quarter, and 0 otherwise. The sustainability proxies include property-level and organization-level metrics. At the property level, we include established green building certifications (*Green Certification*), LEED and BOMA BEST, and health-focused certifications (*Healthy Certification*), Fitwel and WELL. At the portfolio level, we incorporate variables related to the global ESG benchmark for real assets (*GRESB*), including metrics of both participation and performance. The model controls for potential confounding factors related to building-specific characteristics, market attributes, and submarket dynamics. *X* is a vector of the hedonic building characteristics (e.g., building class, space size, building age), and θ captures Submarket-Year-Quarter fixed effects. We cluster standard errors by submarkets to account for potential spatial correlation in the error terms.

For each set of specifications, a book of market attributes, specified in Eq. 1 as *Y*, is tested using Lasso methods (Tibshirani, 1996). As the outcome variables and unit of observation changes throughout the analyses, this process is repeated on an extensive list of market attributes each time, to best fit each set of models. The list of market attributes is compiled from related studies in the academic literature, encompassing demographic (population metrics including growth, density, and age distribution, as well as income, education, and employment metrics), housing (capturing the differences between owners as well as relative housing affordability), and tenant industry metrics (proportion of employees in the area sorted by NAICS 2-digit industry codes). Whenever NAICS tenant metrics are included in the model, the full set of observed industry codes is included, not a subset of industries.

These market attributes are observed at the Dissemination Area (DA) level. DAs, which are analogous to Census Block Groups in the U.S. context, serve as our primary geographic unit of analysis.

DAs are the most granular geographic jurisdictions in Canada and throughout our sample period, there is an average of three office buildings within a DA, indicating an extremely high degree of granularity. DAs are considered relatively static in footprint, and have on average between 400 and 700 residents each.

We extend the baseline analysis described in Eq. 1 by incorporating variables that capture urban amenities, while controlling for our primary green certification measures. This extension is motivated by the emerging literature on the flattening of the bid-rent curve in the post-pandemic era as people became less reliant on cities' central business districts (Rosenthal et al., 2021). Specifically, we tackle the question of which urbanity features may attract people to return to the office. To capture this, we introduce new variables: *Downtown*, a dummy variable for buildings situated in central business districts (CBDs), and three measures of accessibility: *Walk Score*, *Bike Score*, and *Transit Score*. These metrics represent different aspects of commuting means and proximity to essential amenities. Given that commuting metrics are predominantly determined at the Census Metropolitan Area (CMA) level (e.g. the Greater Vancouver area, etc.), we replace Submarket-Year-Quarter fixed effects with broader CMA-Year-Quarter fixed effects, which account for broader market dynamics while maintaining model flexibility.

4.1 Tenancy Impacts

To explore potential tenant-driven heterogeneity in the impact of sustainability on leasing activity, we conduct a series of tests, interacting the Sustainability variables with factors capturing cross-sectional tenancy heterogeneity. These factors include: measurement of diversified tenant base industries; industry exposure to business disruptions during the pandemic; and, resilience to RHW adoption post-pandemic. We categorize tenants utilizing NAICS industry codes; these tenancy metrics are time-invariant over the sample horizon.

First, we develop a tenant diversification measure based on a negative Herfindahl index, calculated as:

$$DivHHI_l = -\sum_i (\%\ employment_{i,l})^2 \quad (2)$$

where $\%\ employment_{i,l}$ represents the share of employment within a DA (l) in the 4-digit NAICS industry i. We aggregate employment from the 6-digit NAICS level to the 4-digit level. By grouping establishments into 4-digit sectors, we can smooth out idiosyncratic fluctuations and focus on meaningful variation in industry concentration. This measure captures the diversity of tenant industries, with larger values indicating a more diverse tenant mix and smaller values suggesting concentration in fewer sectors.

Next, we identify tenants operating in critical industries following the classification by Papanikolaou and Schmidt (2020). This refined classification, which offers greater precision than the Cybersecurity and Infrastructure Security Agency (CISA) designation, encompasses industries engaged in food and

beverage production and distribution, utilities, pharmaceutical services, transportation, waste management, and select healthcare and financial service segments. For each DA, we calculate $\%\ Critical_l$ as the proportion of business listings operating within these designated critical industries.

Finally, we construct a DA-level remote work index (RHW_l) based on Dingel and Neiman (2020)'s remote work index. Dingel and Neiman assess the share of jobs that can be performed remotely for each occupation by analyzing responses to 17 survey questions from the O*NET database. By integrating their remote work suitability information with occupational employment and wage data from the U.S. 2018 Bureau of Labor Statistics, they calculate the proportion of jobs within a 3-digit NAICS industry that can be performed remotely. For our analysis, we compute the DA-level remote work index as:

$$RHW_l = \sum_i (\%\ employment_{i,l} \times RHW_i) \quad (3)$$

where the summation is over all industries within a given DA. RHW_i represents the remote work index for industry i. This variable serves as a proxy for the average exposure of tenants to remote work, reflecting the adaptability of the tenant mix to disruptions that limit face-to-face interactions. Together, these proxies derived from detailed business listing data provide a comprehensive view of demand-side adjustments that may affect the desirability of building sustainability.

4.2 Dynamic Shifts in Space Use

Building on the previous analyses which focus on leasing activities, we investigate a broader paradigm shift in demand for commercial space, providing insights into potential future trends in space use patterns - not just by tenants, but by individuals. We hypothesize that properties with sustainable attributes are associated with increased visit frequency post-pandemic. To test this hypothesis, we estimate the following specification:

$$SpaceUse_{l,t} = a_l + \beta_1 Sustainability_{l,t-1} + \beta_2 Ln(SF)_{l,t-1} + \beta_3 Y_i + \theta_{l,t} + \epsilon_{l,t} \quad (4)$$

where the dependent variables (*Space Use*) capture various dimensions of space use, and the independent variables (*Sustainability*) are lagged sustainability characteristics, while controlling for the logarithm of the total office space square footage (*Ln(Office SF)*) as well as a vector of market attributes (*Y*) within each DA. We employ Submarket-Year-Quarter fixed effects to account for time-invariant area-specific characteristics, and we cluster standard errors by submarkets to account for potential spatial correlation in the error terms.

Two measures of space use are used, each scaled by the total square footage of office space in the DA to compare relative intensity of space use. *Ln(#Stops)*, equals the log-transformed count of personal electronic device stops within a given DA during each month, while *Ln(#Devices)* captures the log-transformed count of unique devices that made stops in the area. Analysis is restricted to stops with a dwell time of at least one minute, ensuring that we capture more meaningful visits. These proxies reflect different dimensions of space usage patterns, offering insight into the evolving demand for space with respect to different metrics of sustainability.

The sustainability proxies include measures of green and healthy building certifications as well as GRESB participation. We construct dummy variables if such a building is observed within a DA (recalling that there are, on average, three office buildings in a DA). These measures provide complementary insights into environmental sustainability and health-conscious design features.

4.3 Commute Impacts

Commute data are sourced from Advan's Neighborhood Patterns dataset, which provides high-frequency, DA-level mobility data. We measure commuting intensity using the variable *WorkDistance*, defined as the quarterly average of the median daytime travel distances to a given destination DA. Specifically, *WorkDistance* is calculated as:

$$WorkDistance_{l,q} = \frac{\sum_q Dist\ from\ Primary\ Daytime\ Location_{l,t,q} \times Device\ Daytime\ Areas_{l,t,q}}{\sum_q Device\ Daytime\ Areas_{l,t,q}} \quad (5)$$

where $Dist\ from\ Primary\ Daytime\ Location_{l,t,q}$ represents the median distance travelled during a day by devices from daytime destination DA l in day t of year-quarter q, and $Device\ Daytime\ Areas_{l,t,q}$ is the number of observed devices in that DA and day. This measure is interpreted as the distance travelled during a day by an average device that spends the majority of its visiting daytime hours in a destination DA (i.e. it's work location) during a given quarter. We winsorize this *WorkDistance* at the 99.95th percentile to remove implausibly high commuting distances.

As discussed in Section 3.1, we construct a DA-level *RHW* index by calculating for each DA the average of industry-level remote work indices across all businesses within the DA, weighted by the employment share. We define *HighRHW* as a binary variable equal to 1 for DAs in the top quartile of the *RHW* distribution.

We perform an event study to assess whether high-RHW neighborhoods experienced larger declines in commuting distances after the lifting of the Stay-at-Home orders. Our baseline model is:

$$= \beta_1 HighRHW_l + RHW \times Post\ 2021Q2_q + Controls_l + \delta_m + \delta_q + \epsilon_{l,q} \quad (6)$$

where Post-2021Q2 is a dichotomous variable for post-2021 periods. Our sample period is from 2019Q1 to 2024Q2, excluding the pandemic (2020Q1-2021Q2). The coefficient of interest, β_2, captures the impact of local businesses' RHW exposure on the commuting distance post-reopening. We conjecture that RHW is negatively associated with the commuting distance to work DAs post-reopening due to the prevalence of RHW. The dummy is absorbed by year-quarter FE (δ_q). We control for demographic variables included in Equation (4), CMA FE (δ_m), and year-quarter FE. Standard errors are clustered by DA.

To further examine potential mechanisms that could moderate the RHW effect, we extend Equation (5) to a triple-differences (DDD) model incorporating interaction terms for green building and urbanity:

$$\log(WorkDistance_{l,q}) = \beta_1 HighRHW_l + \beta_2 HighRHW_l \times Post\ 2021Q2_q + \beta_3 DDD_l + \beta_4 DDD_l \times Post\ 2021Q2_q + \beta_5 DDD_l \times HighRHW_l + \beta_6 DDD_l \times HighRHW_l \times Post\ 2021Q2_q + Controls_l + \delta_m + \delta_q + \epsilon_{l,q} \quad (7)$$

where DDD_l captures distinct sustainability- and urbanity-related features of DA *l*. Specifically, we define the following indicators:

- Green Office: Equal to 1 if a DA hosts any Green-, Healthy-, or GRESB-certified properties
- Downtown: Equal to 1 for DAs located within downtown areas
- WS90/BS90/TS90: Equal to 1 if the DA has a Walk Score, Bike Score, or Transit Score above 90, respectively

The coefficient, β_6, captures the extent to which green buildings or urban amenity features moderate the post-pandemic decline in commuting associated with high RHW exposure. We conjecture that such features partially hedge against the "office apocalypse" effect by preserving the attractiveness of the workplace despite the rising prevalence of remote work (Gupta et al., 2025).

5. Results: Sustainability and Urbanity Impacts on Leasing

Table 2 reports the results from estimating Equation (1), which examines the impact of sustainability measures on leasing activity. Model (1) provides the baseline specification in which all sustainability measures are excluded, and only control variables (building hedonics, market attributes, and fixed effects) are included. Lasso testing of this analysis set indicated the necessary inclusion of controls for the portion of the DA population that holds at least a Bachelor's degree, as well as NAICS industry controls. Results indicate that higher building quality (e.g., *Class A*) and larger buildings are positively associated with leasing activity. These traditional metrics of building quality (age, size, and class) are performing as expected in a weak office market.

The coefficient associated with a higher proportion of university degree holders in a DA consistently carries a significant, negative loading. This must be evaluated within the context of the Submarket fixed effects, indicating that within a given submarket, the leasing is less likely to occur in neighborhoods housing the more educated residents. (Glaeser et al., 2004) posits that locations with more educated residents (human capital) tend to grow faster (or survive longer) by adapting their economies to new technologies. These highly educated enclaves are likely dominated by residential uses that adopted the new technology of RHW at an above average rate. Further, the bachelor's degree metric captures the portion of the population over 25 years old. Residential uses immediately surrounding office buildings are often populated by young professionals such as recent graduates, including many individuals that are not yet 25 years old. Additionally, while the NAICS industry control results are suppressed to conserve space, four industries consistently return significant results for all analyses in Table 2. The

proportions of DA-level employment in the FIRE and Agriculture sectors are associated with an enhanced probability of a leasing outcome, and those employment proportions in the Healthcare and Social Assistance as well as Arts and Entertainment sectors are associated with a lower likelihood of lease execution. Throughout the balance of the leasing analyses in this paper, results associated with employment in the FIRE industry are persistently associated with a bounce-back in leasing activities.

(Insert Table 2 about here)

Models (2) through (4) incrementally introduce sustainability measures into the analysis. In Model (2), we include *Green Certification* and *Healthy Certification*, both dummy variables equal to 1 for third-party certified buildings and 0 otherwise. The coefficients on both variables are positive and statistically significant. Specifically, green and healthy buildings are, on average, associated with a 1.7% and 3.0% higher likelihood of leasing activity in the post-COVID period, respectively. Importantly, these results co-exist and report statistical and economic significance, indicating that neither certification type (environmental nor social) swamps the effect of the other. Models (3) and (4) focus on GRESB-related measures: Participation and Rating, respectively. *GRESB Participation* is associated with a 1.8% higher likelihood of leasing activity. For *GRESB Rating*, the estimated coefficient of 0.006 (with a t-statistic of 4.14) confirms that higher ESG performance by the building owner translates into higher leasing activity.

(Insert Table 3 about here)

Table 3 examines the impact of urbanity, or density, on leasing activity. Three sustainability measures from Table 2 are also included in this analysis: *Green Certification*; *Healthy Certification*; and, *GRESB Participation*. The baseline controls remain the same as those included in the prior analysis. As this model looks to compare activity across submarkets within a CMA, the fixed effects are modified to be CMA-Year-Quarter. The loadings and significance of the control variables remain largely unchanged from Table 2.

In Model (1) we introduce *Downtown*, a dummy variable equal to 1 for buildings located in a metro area's CBD and 0 otherwise. The findings reveal that downtown offices are associated with a 1.0% higher likelihood of leasing activity. In Models (2) through (4), we include each of the three urbanity amenity scores. The results indicate that higher *Walk Score* and *Transit Score* are associated with increased leasing activity, yet only the *Transit Score* results prove statistically significant. A one-unit increase in the *Transit Score* corresponds to a 1.5% higher likelihood of having leasing activity.

Sustainability measures continue to play a notable role – particularly *Healthy Certification*, which is associated with roughly a 3% increase in leasing activity. This is consistent with the post-pandemic surge in demand for health-centric spaces. Importantly, even when combined into the same model, building level social and environmental certifications matter concurrently alongside ESG commitments from the landlord and the urbanity metrics. Statistically, these varied measures of sustainability offer non-duplicating sources of significant impact on leasing, and when taken together, they can explain a sizable portion of the probability of leasing activity.

5.1 Incorporating Tenancy Impacts

Thus far our analyses have been agnostic to tenant-specific demand drivers, generally treating all tenants as a similar entity. However, the variation in significance and directionality of effect for the NAICS industry control variables indicates that different types of tenants may be uniquely motivated to pursue different office space sustainability attributes. McWilliams & Siegel (2001) posits that organizational pursuit of sustainability may be for operational or corporate image benefits. For example, health-related industries may be more likely to pursue *Heathy Certification*. Eichholtz et al. (2009) finds that firms in the oil and banking industries are the most prominent green building tenants. The authors indicate that, particularly for oil firms, this move may be driven by corporate image benefits rather than the organization's commitment to environmental responsibility.

(Insert Table 4 about here)

Our first test focuses on the diversity of the tenant mix. Specifically, we hypothesize that the effect of sustainability on leasing activity will be more pronounced for buildings with a heterogeneous tenant base, where tenants operate in diverse industries. The motivation is that sustainable buildings are more likely to accommodate the varying space needs of tenants operating in different industries. This is due to the thoughtful structure and systems of sustainable buildings which allow new tenants to easily reorganize spaces to fit their needs, allowing tenants to right size their leased space. In addition, increased disclosure related to building certification may mitigate moral hazard concerns arising from the complexity of managing a mixed tenant portfolio (e.g., uncertain space uses and needs), leading to more active leasing. To test this hypothesis, we employ *DivHHI* which measures the diversity of tenant industries in the vicinity of each building. *DivHHI* scales from 0 to 1, and higher values indicate greater diversity of the tenant mix. We regress the proxies for leasing activity against sustainability measures, interacted with *DivHHI*, while controlling for building hedonics, market attributes, NAICS industry controls, and Submarket-Year-Quarter fixed effects.

In Table 4, Model (1) we present the baseline results with three sustainability measures – *Green Certification, Healthy Certification*, and *GRESB Participation* – without interaction terms; the coefficient estimates are largely consistent with those reported in Table 2. In Model (2), we introduce interaction terms between sustainability measures and *DivHHI*. Our results show that buildings owned by landlords which voluntarily participate in GRESB, and which are populated with a more diverse tenant base, are associated with higher levels of leasing activity. Specifically, *GRESB Participation* alone is associated with a 1.2% higher likelihood of leasing activity. After interacting with *DivHHI*, the coefficient is 0.054, indicating that a one unit increase in tenant diversity for buildings owned by GRESB-certified landlords results in a 5.4% additional increase in the likelihood of leasing activity. Similarly, the effect of *Green Certification* on leasing activity is 5.7% more pronounced in buildings with a higher tenant diversity. Interestingly, we do not find evidence that this magnifying effect exists with healthy certified buildings, despite the persistence of the significance of healthy building certification.

Our second tenancy-related test explores the impact of tenants situated in critical industries. Critical industries are defined as those sectors that were less economically affected by the COVID-19 lockdowns due to the nature of their work and are thus more resilient to business disruption risks. These critical industries often address infrastructure needs to keep society operating (e.g. telecommunication providers). Importantly, critical industries are not necessarily all in-person workers; critical industries span the RHW adoption continuum, even during a pandemic lockdown. In this analysis, the share of tenants operating in critical industries, denoted as *% Critical*, is used to differentiate between DAs that are more or less exposed to business disruption.

In Table 4 Model (3), interaction terms between the sustainability measures and *% Critical* are introduced. The results indicate that the positive effect of *GRESB Participation* on leasing activity is largely explained by the higher proportion of resilient tenants. In particular, the interaction term for *GRESB Participation* and *% Critical* has a coefficient of 0.104 (t-statistic: 3.11), suggesting that a one-standard-deviation increase in the share of tenants operating in critical industries within a DA is associated with an increase in the likelihood of leasing activity by approximately 2.09% (0.104 x 0.201). In contrast, the interaction terms for green and healthy building certifications with *% Critical* do not produce a statistically significant effect on the likelihood of leasing activity.

GRESB-certified buildings may be more successful at attracting tenants operating in critical industries for several reasons. First, these buildings are assessed on a continuous basis, which captures the operational performance and risk management practices that are essential during periods of uncertainty, such as the COVID-19 pandemic. This regular monitoring and focus on day-to-day performance may reassure tenants that the building management is capable of addressing disruptions quickly and effectively. Second, the proactive approach to managing energy, water, and other resources in GRESB-certified buildings can lead to more stable and efficient operations. Tenants in critical industries may prefer to locate in environments where operational reliability is a priority. Annual GRESB reporting provides an arm's length measurement of such operational focus. This may result in a more resilient tenant mix that in turn enhances overall leasing activity. Third, the transparency provided by the GRESB framework may help tenants assess the risk profile of a building, making it easier for them to identify spaces that are less vulnerable to business interruptions.

Table 4 Model (4) further examines the stability and resiliency of tenant mix in the post-pandemic period. We replace the tenant heterogeneity variable with a remote and hybrid work index (*RHW*) constructed at the DA level. Higher *RHW* values suggest that the tenants operating within the area, are more adaptive to remote work and are likely to be less susceptible to business disruption risks. In Model (4), interaction terms between the sustainability measures and the *RHW* index are introduced. The results indicate that the positive effect of *GRESB Participation* on leasing activity is largely driven by buildings in areas with a higher capacity for remote work. In particular, the interaction term between *GRESB Participation* and *RHW* has a coefficient of 0.071 (t-statistic: 2.16). This result suggests that a one-unit increase in the *RHW* index is associated with an increase in the likelihood of leasing activity

by approximately 7.1%. In contrast, the interaction terms between the *RHW* index and the green and healthy building certifications do not show a significant effect on leasing activity.

5.2 Robustness Tests

This section explores alternative explanations which might confound the observed relationship between sustainability and urbanity measures and leasing activity. We perform several robustness checks that account for potential confounding factors such as utility pricing structure of the lease, landlord characteristics, parking availability, and the effect of recently renovated space. We also explore the informativeness of asking rental rates on subsamples for which such data are available. We find that the results are consistently driven by tenants' demand for sustainability and urbanity, rather than by these alternative explanations.[10]

First, we consider the role of varied lease terms governing in-suite energy provision. Our sample is divided into buildings where utilities are included in the rental rate or charged on a per square foot basis, versus those that are separately metered. The rationale behind this is that differences in how electricity costs are allocated may influence the uptake of sustainability measures. Our findings indicate that buildings for which there is a fixed expense to tenants for energy consumption are associated with a negative and significant standalone effect on leasing activity. However, the interaction of this variable with the sustainability measures does not account for the observed effects, so the sustainability effect is unlikely to be driven by in-suite power types.

Second, we explore the potential impact of landlord characteristics. Using data from S&P Global (formerly SNL), which tracks historical property holdings by publicly listed companies, we identify whether a property is owned by a landlord that is publicly listed (i.e. elects REIT status). Publicly listed companies typically face higher disclosure requirements, which may affect their decisions regarding the adoption of sustainability measures, independent of space market demand. Similarly, REITs are structured as flow-through entities and tend to be more transparent than non-REIT property companies. Results indicate that neither listing status nor REIT status confounds the primary findings. This suggests that the observed relationship between sustainability measures and leasing activity is not driven by landlord organizational type heterogeneity. This is supported by the literature identifying growing market pressures on privately-held real estate firms for sustainability commitment and disclosures, often through the GRESB vehicle (Devine et al., 2021; Devine et al., 2023).

Third, we examined the impact of parking availability and building renovations on lease activity. Parking was measured both as parking spaces per square foot of office space, and as a proportion of active leasing. Tests completed on both the sustainability and urbanity results indicated that parking availability proved uninformative in describing leasing activity. Similarly, we examined the impact of recently-completed building renovations on leasing activity, which also proved uninformative. It is

[10] Results suppressed to conserve space yet are available upon request.

likely that the quality-enhancing effects of building renovations are captured in building quality control variables.

Finally, we examined the role of asking rents in shaping leasing activity. Asking rent is the rental rate publicly listed for buildings when they have space available for lease. Contract rent is the result of negotiations between the tenant and the landlord, and often differs substantially from the listed asking rents as well as from tenant to tenant within the same building; we do not observe contract rents. Asking rents are not always provided, and are often considered to be uninformative at a building-specific level, offering greater insight when amassed to compare different markets or submarkets. Therefore, asking rents may be viewed more as a comparison tool when considering various leaseable spaces than a measure of the actual cost of renting space. Testing of this variable supported this interpretation, as inclusion of asking rents in sub-sample analyses proved uninformative.

6. Results: Dynamic Shifts in Demand and Mobility

Beginning with this set of analyses, we move beyond the tenant-centric explanations to capture broader metrics of space utilization by individuals, and the relationships between office space use and mobility.

Similar to the analyses presented in Table 3, we first link commitments to sustainability at the building or organization level to urbanity (or density) impacts. While the earlier analysis spoke to leasing activity specifically, here we look to how CRE organizational sustainability commitments shape space usage not just within the building but within the surrounding community. To achieve this, we link properties within each DA to footfall data from the Neighborhood Patterns dataset. We utilize two metrics of the detailed, high-frequency data to approximate population movement: the number of stops and the count of unique device visits.

(Insert Table 5 about here)

Focusing on *Ln(# Stops/Office SF)* as the dependent variable, Table 5 indicates that green building certification and GRESB participation variables are significant predictors of footfalls. For example, Models (2) and (3) reveal that DAs with green certified and GRESB-certified properties are associated with a 11.4% and 15.2% increase in the number of stops (or 308 and 410 stops, respectively, given the average number of stops of 2,698), respectively. Similar to the results tenancy interaction results, healthy building certfication activity in an area is not significantly associated with more footfall activity. When the analysis is repeated using *Ln(# Devices/Office SF)* as the dependent variable, the results persist and slightly strengthen around GRESB-certification. This indiates that areas with third-party sustainable certification of the office assets attract more visitors.

These findings are important because they extend the implications of sustainability and urbanity measures beyond tenant occupancy. GRESB-certified buildings, through their focus on continuous operational performance and risk management, appear to enhance overall space utilization by attracting a broader spectrum of space utilization by visitors and other stakeholders. Green and healthy certified

buildings many attract certain tenant types and users through the provision of specific amenities (i.e. bike racks and changing rooms to support active transit), or the active consideration of tenant mix in the building to meet users' daily needs (i.e. daycare, coffee shops, pharmacist). As a consequence, the future of commercial space utilization may shift from static occupancy metrics toward more dynamic measures of engagement, with sustainability—particularly performance-based certification—emerging as a key driver of commercial activities and urban vibrancy in the post-pandemic landscape.

Since sustainably-certified buildings are associated with more visits, this indicates that such areas may be able to draw users to the area. When this is set within the context of RHW, it begs the question of how such sustainability commitments will draw people out of their home to these buildings. If workers are, on average, living further away from the center of cities (where the preponderace of office buildings are situated), and the sustainable and urban features more frequently sought during the post-pandemic "flight to quality" convince those workers to commute further, what will be the net impact to commuting behaviors?

6.1 Commute Trends

Finally, we examine how remote work adoption has reshaped neighborhood-level commuting patterns in the post-pandemic period. Table 6 reports the results from estimating Equation (6) and the extended triple-differences (DDD) model (Equation (7)).

In Model (1) of Table 6, we find a significant negative coefficient on the interaction term HighRHW X Post-2021Q2, indicating that businesses in neighborhoods with higher remote work exposure experienced a pronounced reduction in daytime commuting distance following the lifting of Stay-at-Home orders in June 2021. Specifically, relative to their counterparts, HighRHW DAs experienced an additional 12% decline in commuting distance after 2021Q2. This finding supports the "office apocalypse" narrative: businesses in HighRHW neighborhoods were more likely to institutionalize hybrid or fully remote work arrangements even after reopening, resulting in fewer workplace visits and lessened total travel distances among their employees.

Models (2) through (6) examine whether urban amenities and green building attributes help moderate this paradigm shift. Overall, we find evidence that such features act as a buffer. For instance, in Model (2), the coefficient on the triple interaction term HighRHW X Post-2021Q2 X Green Office is 0.243 and marginally statistically significant. Relative to their counterparts, HighRHW DAs with green properties experienced an additional 24 percent increase in commuting distance after 2021Q2. This magnitude is sufficient to fully offset the 12 percent decline observed in HighRHW DAs, implying that the presence of environmentally certified buildings may help attract or sustain in-person office use by signaling higher-quality workplaces or greater employer investment in post-pandemic office appeal. Downtown and walkable/bikeable neighborhoods (Models (3)-(5)) also exhibit attenuated negative effects of remote work. These findings corroborate a flight-to-quality explanation, where workers appear more willing to return to higher-quality or more convenient workplaces.

(Insert Table 6 about here)

In contrast, Model (6) indicates that high transit accessibility (Transit Score above 90) does not seem to mitigate the RHW impact. This may reflect broader structural shifts in urban travel behavior, especially in transit-oriented cities where the pandemic induced a more pronounced flattening of the commercial rent gradient (Rosenthal et al., 2021). Amidst such environments, public health concerns, changes in commuting preferences, and weaker agglomeration forces may have disproportionately eroded the traditional value of transit access. Additionally, in the context of (Larson & Zhao, 2017), if workers are travelling further, fewer days a week, transit commuting may not be as accessible an option as for someone commuting the same net distance but spread over five days. Taken together, these results suggest that while the rise of RHW has substantially reduced commuting distances in high-exposure neighborhoods, investments in building quality and neighborhood amenities may be offsetting these impacts.

7. Discussion: Social and Environmental Impacts

There has been a rise in the importance of sustainability considerations in CRE assets over the last two decades. From voluntary disclosures by CRE firms to their investors, to the provision of healthy and responsible space to attract and retain talent, sustainability has become a material matter for real estate markets. This study has evidenced increased office leasing activity associated with environmentally sustainable buildings within the context of the new RHW era. We have discussed the drivers of these trends in Sections 1 through 6, and now we turn to the possible effects.

Moves from fully in-office work environments to hybrid environments allow tenants to provide less space per employee. The average worker generally requires 150 to 200 square feet of office space for a fully in-office presence. However, with a move to hoteling or hot-desking along with meeting spaces and other office utilization refinements, the leased space footprint can be decreased to 100-125 square feet per worker (Studio Forma, 2024). The most conservative reduction in space needs would offer the tenant a chance to reduce their leased space by 25 square feet per worker. At 150 square feet per worker (the most common estimate), the average lease size in the sample (20,000 square feet) would serve approximately 130 workers fully in-house. A move to RHW would allow that firm to provide for the same workforce in approximately 16,500 square feet, decreasing their lease expenses by 17.5%.

However, in the weak post-pandemic market, firms could optimize that possible savings through a blend of cost cutting on total space leased and increased investment in the quality of office space, aiding worker attraction and retention efforts. Any reduction in office footprint would carry not only a lower operating cost per square foot, but would also decrease the related carbon footprint. In a study of Canadian office space, Clayton, Devine, et al. (2021b) found that electricity consumption decreased 19% and avoided up to 2.5Kg of CO2 per square foot per year, on average, for buildings with dual BOMA BEST and LEED EB:OM green building certification. Additionally, the collaborative working spaces which are in-demand in hybrid work environments require 25-50% less energy than traditional

office space (Lovins, 2018). Taken together, when tenants increasingly lease environmentally-certified space in the new RHW era, the environmental benefits of using less space and higher quality space (in environmental terms) are notable.

The impacts of these leasing decisions also carry social benefits for the workers (see Section 1), such as superior indoor environmental quality (i.e. access to daylight, higher fresh air turnover), supporting employee physical and mental health. Studies find related evidence of improvement in absenteeism and employee productivity (Loder et al., 2025). These benefits shape both organizational performance and individual quality of life.

Consideration must also be given to the social and environmental impacts of these leasing changes outside the footprint of the office building. Most topical in evaluating the balance of office use and RHW is the question of commuting. The footprint of a commute is a function of both the distance travelled and the mode of transit. Downtown offices are often reached through public or active transit, with notably lower emissions footprints for commuters as compared to car commuters (as well as health benefits for those undertaking active transit). Offices situated in lower density areas such as suburbs) are much more likely to be reachable only by car. The substitution from an urban location to a suburban will therefore bring with it an increased emissions footprint, as well as less opportunity for physical activity from active transit. However, that is holding distance constant. Since many people moved further from the city during the pandemic, downtown locations may, on average, require a further commute.

Aside from impacts on individuals and the environment, changes in office use may also have knock-on effects to surrounding land uses and society. First, a move away from dense locations could decrease public transit ridership (particularly full-fare ridership), and with lower demand from the working majority, the public transit system may not be able to support and subsidize disabled, low-income, and special needs passengers.

Second, the density of employees in walkable office areas creates demand for nearby services such as drycleaners, dentists, restaurants, etc., as well as housing. This mixing of land uses – or mixed-use development - contrasts the common separation of land uses pursued in suburban models. In suburban land use models (particularly in North America), there are separate nodes in a community for each use (retail areas, office areas, and residential areas), and individuals are required to commute from node to node to meet their daily needs. As these nodes are less likely to be accessible by public or active transit, it requires a high degree of car ownership, which carries a financial cost for individuals as well as larger time burden to complete daily activities.

Importantly, urban mixed-use developments are often considered highly desirable and can be associated with a high cost of living, matching or even exceeding that of the suburban home and car ownership. However, what is often overlooked in the financial comparison is the time burden that comes from the car-based suburban model (both commuting and daily errands), as well as the health impacts such as loss of active transit physical activity and the mental health benefits of greater time outdoors

and, specifically, outside the car. Finally, it is important to consider those for whom public transit is the only option, and what impact less accessible office space will have on their quality of life.

7.1 Calgary Example

To explore the net effects of these impacts, we take a deeper look at one of the CMAs in the study. We select Calgary for this analysis for three reasons. First, it is one of the largest office markets in Canada, with 45M square feet of office space and 3.23M square feet of leasing activity during the sample period. Second, it is a straightforward city to study, as it is a monocentric city (having only one major urban area, roughly in the middle of the market's center of gravity) and has a public transit system of acceptable caliber operating consistently since well before the pandemic (with no major additions or closures). Third, the city is representative of market trends, experiencing deep vacancy, an active subleasing market, and a full recovery of transit ridership (Calgary Transit, 2023).

(Insert Table 7 about here)

Summary statistics of Calgary commute distance and emissions by mode of transportation are provided in Table 7. Census data indicates that approximately 515,000 Calgary commuters experienced just over 10M kilometers of commuting distance daily in 2016, averaging approximately 20 kilometers per commuter. These commutes are spread across three major transportation modes, each with their own average carbon footprint: active transit (biking and walking, estimated at 0-21 gCO2e/kilometer); public transit (estimated at 60-90 gCO2e/kilometer); and, car, truck or van (estimated at 120-180 gCO2e/kilometer).[11] Only 7.5% of the population commutes by active transit, with an average total daily distance of 7 kilometers. Both car and public transit commuters each commute approximately 20 kilometers daily, on average, yet their associated carbon footprint differs tremendously, with the car footprint estimated at double that of public transit. This is particularly impactful since over three-quarters of commuters travel by car. Taken together, this results in the 75% of commuters travelling by car representing between 88% and 94% of total commute-related emissions in Calgary (using low and high estimates).

Applying the results from Table 6 Column 3, we see that after the lifting of the Stay-At-Home orders there was a decrease in commute distances, but that this was offset in urban areas with High RHW scores and green-certified office space. The result is a net increase of 21.3% (utilizing only the statistically significant coefficients). Applying this to the Calgary commute data, it would mean an increase of 2.1M kilometers travelled, and between an additional 234,000 and 340,000 kilograms of carbon dioxide emitted per day. For the representative Calgarian commuter, it would mean an additional 4.26 kilometers travelled and between 445 and 670 grams of carbon dioxide emitted per day.

[11] The high and low estimates for each travel format represent a range of likely values, scaling from a low estimate which includes only operating costs to a high estimate which includes lifecycle costs). Data are taken from: https://ourworldindata.org/travel-carbon-footprint.

Given the magnitude of the car commute footprint, and the similar commute distance for public transit, there are great opportunities to decrease the carbon footprint associated with worker commute through substation of transportation mode. If 20% of those baseline (10.1M) kilometers travelled were completed through public transit instead of by car, the substitution impact to total commuting footprint would be a decrease of 121,000 to 126,000 kilograms of carbon dioxide per day. When the magnifying pull of the urban offices is applied in this scenario, the net benefit would be approximate 26,000 fewer kilograms of emissions daily, or 40 to 60 gCO2e per daily commuter. This substitution from car to transit may be relatively accessible to execute in Calgary, as the average commute distance per person is roughly the same for car and transit commutes.

A substitution of 10% of total commute kilometers from car to active transit would be a much larger change in transportation structure, and would have much larger impacts at the margin, both socially and environmentally. In terms of carbon footprint, the changes associated with this 10% substitution in car-based commuting kilometers to active transit are quite similar to those outlined for a 20% substitution toward public transit, rendering the substitution effectively twice as potent. Socially, the impact to individuals would be much greater given the substantial difference in average commute length for active transit versus car or public transit (7 vs. 20 kilometers). This would mean many more individuals would need to commute on foot or by bike, or individuals utilizing active transit would commute greater distances, and one kilometer on foot is much more time and energy intense than one more kilometer in a vehicle (public or private). In order for such a substitution to happen, and happen safely, the city would need to ensure appropriate road sharing, particularly closer to the downtown areas which are attracting more workers. This would mean bike lanes, signaled crosswalks, and sufficient sidewalks. Additionally, office spaces can encourage and support active transit implicitly through the inclusion of on-site bike storage and showers/locker rooms. Such features are eligible for consideration in the green and healthy building certification programs described in this study, so there is a natural fit between the sustainable buildings drawing people to work, and the advancement of more environmentally-friendly commute methods to access those in-demand buildings.

8. Conclusion

Accepting that RHW is now a permanent component in the work equation, organizations are re-evaluating their office space needs. The focus is on optimizing un- or under-utilized office space and ensuring that leased office space is of an appropriate quality. The efficacy of office space can be measured in terms of how it encourages productivity amongst workers, and how it assists the organization in minimizing risk. Worker productivity benefits can arise from space that allows workers to complete tasks effectively (e.g. quiet space for high-focus work, meeting space for collaborative work), and space that supports human health so that employees can thrive (i.e. daylit, outside views, good indoor air quality, etc.). Junior employees benefit from the mentorship and training that arises from being “at the elbow” of management. When these benefits are understood by the employee, the

office space can also serve as a risk management tool, positively impacting employee attraction and retention. Conversations regarding these associated impacts are deepening across business-related academia and the industry, often framed in the context of financial outcomes including occupancy rates, valuation, and space use (Fiorentino et al., 2022; Gupta et al., 2025; Hu et al., 2024). Yet this shift also carries important environmental and social implications.

The impacts of (environmentally and socially) sustainable investment in office space come through two major channels: operational improvements and corporate image benefits (McWilliams & Siegel, 2001). Operational benefits, including rental rate premiums and energy efficiency, have been well studied and documented, and largely agglomerate to owners. This study adds evidence to this list of benefits to owners of sustainable buildings by identifying the higher probability of executing leases during weak market conditions (see Table 2). There has been less analysis to-date on which tenants are paying for such premium space (EKQ 2009), and why (Chang Devine 2019; Hu, Kok, Palacios, 2023WP). This study works to address this through tenancy analyses (see Table 4), identifying that, in weak market conditions, GRESB participating buildings are more likely to experience leasing activity from a diverse book of tenants, and by tenants from two resilient groups: critical industries, and those investing in leased space despite being well-fit industries for RHW.

Corporate image benefits are captured both by owners and tenants, as ESG considerations have become table stakes for many firms in their efforts to attract capital, tenants, and employees. This last point is of particular importance as firms work to attract employees to return to the office in-person. In the new RHW era, workers demand high-quality space if they are going to be lured away from their home office, and the definition of high-quality space now includes features such as a green and healthy building. Table 5 indicates sustainably certified buildings are attracting more visits, and Table 3 indicates that buildings in dense or urban areas are more likely to attract tenants. Importantly, urban and sustainable building attributes are determined to offer non-duplicating impacts on leasing, and when taken together, can explain a sizable portion of the probability of leasing activity.

If the active leasing of sustainable and urban office spaces signals these features are the ones demand by workers to return to their office in the RHW era, then we should be able to follow the leasing activity to observe changes in commute patterns. Following the lifting of the Stay-At-Home orders, there was a decrease in total commute distance as compared to pre-pandemic levels. However, the efficacy of sustainable and urban office space mutes that effect, showing a correlation with higher commute distances (Table 6). With this comes benefits to the workers (socialization, mentorship), firms (innovation, productivity), and surrounding communities (demand for services, vibrancy). However, it also brings drawbacks (loss of time to commuting, congestion, emissions).

Throughout this paper we have teased apart social and environmental impacts to organizations (including both landlords and tenants) and individuals as well as the communities surrounding the office buildings and the natural environment. Given the breadth of stakeholders impacted by the ongoing

office space utilization changes, there are takeaways for several audiences. For organizations involved in either side of leasing decisions, careful consideration should be given to the role of sustainability and urbanity attributes of office spaces. This attention should be focused not only on the direct impacts to operating cost management, but more importantly to the role such attributes play in attracting and retaining talent.

The attraction of workers to more sustainable and urban office areas will also create knock-on effects of importance to policy makers. Communities are currently trying to correctly identify which office buildings will survive in their current use and which will not; understanding what building and local market attributes are correlated with successful office uses in the new RHW era can allow for timely planning actions on two fronts. First, areas that are more likely to continue as successful office nodes will both create and demand a vibrancy supported by both walkability and access to effective public transit. Second, existing office nodes that are not associated with the new definition of high-quality office attributes can proactively be considered for redeployment for other uses. Such efforts may help cities advance their efforts on affordable housing in a timely manner.

The evolving use of office space carries significant implications not only for organizational operations but also for broader societal and environmental outcomes. As patterns of occupancy and space utilization shift, they generate externalities that can influence urban form, infrastructure demands, and environmental sustainability. It is therefore essential that not only organizations but also governments, investors, and even employees critically consider the carbon footprint and wider societal consequences of these changes when making decisions about which projects to support. These choices will ultimately play a pivotal role in shaping the future of our cities and their environmental impact.

9. Works Referenced

Aksoy, C. G., Barrero, J. M., Bloom, N., Davis, S. J., Dolls, M., & Zarate, P. (2022). Working from Home Around the World. *Brookings Papers on Economic Activity*, *2022-Fall*. https://doi.org/10.1353/eca.2022.a901274

Aksoy, C. G., Barrero, J. M., Bloom, N., Davis, S. J., Dolls, M., & Zarate, P. (2023). *Working from Home Around the Globe: 2023 Report*. https://bit.ly/Figures-GSWA-2023

Allen, J. G., Bernstein, A., Sita, E., Flanigan, S., Gokhale, M., Goodman, J. M., Klager, S., Klingensmith, L., Guillermo, J., Laurent, C., Macnaughton, P., Pakpour, S., Spengler, J. D., Vallarino, J., Williams, A., Young, A., Yin, J., & Chan, H. T. H. (2016). *Building Evidence for Health: The 9 Foundations of a Healthy Building*. www.ForHealth.org.

Allen, J. G., MacNaughton, P., Satish, U., Santanam, S., Vallarino, J., & Spengler, J. D. (2016). Associations of cognitive function scores with carbon dioxide, ventilation, and volatile organic compound exposures in office workers: A controlled exposure study of green and conventional office environments. *Environmental Health Perspectives*, *124*(6), 805–812. https://doi.org/10.1289/EHP.1510037/ASSET/63A57572-458B-4ECE-A77D-AC4864D7408E/ASSETS/GRAPHIC/EHP.1510037.G002.JPG

Barrero, J. M., Bloom, N., & Davis, S. J. (2020). Why Working From Home Will Stick. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3741644

Berger, R. (2024, August 19). Here's a Surprising Shift in Remote Work's Appeal. *Commercial Property Executive*. https://www.commercialsearch.com/news/heres-a-surprising-shift-in-remote-works-appeal/

Business Insider. (2025). The List of Companies Ordering Employees Back to the Office. *Business Insider*. https://www.businessinsider.com/companies-requiring-return-to-office-rto-mandate?international=true&r=US&IR=T

Butler, H. (2021). *The History of Remote Work: How It Became What We Know Today*. Crossover.

Calgary Transit. (2023). *RouteAhead: 2023 annual status update*. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.calgarytransit.com/content/dam/transit/plans---projects/2023%2520RouteAhead%2520Annual%2520Status%2520Update.pdf&ved=2ahUKEwiLoJ7XtIiNAxUVEFkFHXEYHaEQFnoECBgQAQ&usg=AOvVaw2IlRupE2-muqqJlVrshsGp

Clayton, J., Devaney, S., Sayce, S., & van de Wetering, J. (2021). *Climate Risk and Commercial Property Values: a review and analysis of the literature.* https://www.unepfi.org/industries/investment/climate-risk-and-commercial-property-values/

Clayton, J., Devine, A., & Holtermans, R. (2021a). Beyond building certification: The impact of environmental interventions on commercial real estate operations. *Energy Economics*, *93*, 105039.

Clayton, J., Devine, A., & Holtermans, R. (2021b). Beyond building certification: The impact of environmental interventions on commercial real estate operations. *Energy Economics*, *93*, 105039. https://doi.org/https://doi.org/10.1016/j.eneco.2020.105039

Cropanzano, R., & Mitchell, M. S. (2005). Social Exchange Theory: An Interdisciplinary Review. *Https://Doi.Org/10.1177/0149206305279602*, *31*(6), 874–900. https://doi.org/10.1177/0149206305279602

Delventhal, M. J., Kwon, E., & Parkhomenko, A. (2022). JUE Insight: How do cities change when we work from home? *Journal of Urban Economics*, *127*, 103331. https://doi.org/10.1016/J.JUE.2021.103331

Devine, A., & Kok, N. (2015). Green Certification and Building Performance: Implications for Tangibles and Intangibles. *Journal of Portfolio Management*, *41*(6), 151–163. https://doi.org/10.3905/jpm.2015.41.6.151

Devine, A., Kok, N., & Wang, C. (2023). Sustainability Disclosure and Financial Performance: The Case of Private and Public Real Estate. *Journal of Portfolio Management*, *49*(10), 119–133. https://doi.org/10.3905/JPM.2023.1.534

Devine, A., Sanderford, A. R., & Wang, C. (2021). *ESG Investment and Private Equity Real Estate Returns*.

Devine, A., & Yönder, E. (2023). Impact of Environmental Investments on Corporate Financial Performance: Decomposing Valuation and Cash Flow Effects. *Journal of Real Estate Finance and Economics*, *66*(4), 778–805. https://doi.org/10.1007/S11146-021-09872-Y/TABLES/6

Ehrenberg, R. G., Smith, R. S., & Hallock, K. F. (2021). Modern labor economics: Theory and public policy. *Modern Labor Economics: Theory and Public Policy*, 1–758. https://doi.org/10.4324/9780429327209/MODERN-LABOR-ECONOMICS-RONALD-EHRENBERG-ROBERT-SMITH-KEVIN-HALLOCK/ACCESSIBILITY-INFORMATION

Eichholtz, P., Holtermans, R., Kok, N., & Yönder, E. (2019). Environmental performance and the cost of debt: Evidence from commercial mortgages and REIT bonds. *Journal of Banking and Finance*, *102*, 19–32. https://doi.org/10.1016/j.jbankfin.2019.02.015

Eichholtz, P., Kok, N., & Quigley, J. M. (2009). Why companies rent green: CSR and the role of real estate. *Academy of Management 2009 Annual Meeting: Green Management Matters, AOM 2009*. https://doi.org/10.5465/AMBPP.2009.44248224

Eichholtz, P., Kok, N., & Quigley, J. M. (2010). Doing well by doing good? Green office buildings. *The American Economic Review*, *100*(December), 2494–2511. https://doi.org/10.1257/aer.100.5.2492

Eichholtz, P., Kok, N., & Quigley, J. M. (2013). The Economics of Green Building. *Review of Economics and Statistics*, *95*(1), 50–63. https://doi.org/10.1162/REST_a_00291

Fiorentino, S., Livingstone, N., Mcallister, P., & Cooke, H. (2022). The future of the corporate office? Emerging trends in the post-Covid city. *Cambridge Journal of Regions, Economy and Society*, *15*(3). https://doi.org/10.1093/cjres/rsac027

Fuerst, F., & McAllister, P. (2011). Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values. *Real Estate Economics*, *39*(1), 45–69. https://doi.org/10.1111/j.1540-6229.2010.00286.x

Gillette, C. P. (2023). Remote Work and City Decline: Lessons From the Garment District. *Journal of Legal Analysis*, *15*(1), 201–234. https://doi.org/10.1093/JLA/LAAD004

Glaeser, E. L. . (2012). *Triumph of the city : how our greatest invention makes us richer, smarter, greener, healthier, and happier*. Penguin Books.

Glaeser, E. L., Saiz, A., Burtless, G., & Strange, W. C. (2004). The Rise of the Skilled City [with Comments]. *Brookings-Wharton Papers on Urban Affairs*, *2004*(1), 47–105. https://doi.org/10.1353/URB.2004.0005

Gupta, A., Mittal, V., & Van Nieuwerburgh, S. (2025). Work From Home and the Office Real Estate Apocalypse. *American Economic Review*, *forthcoming*. https://doi.org/10.2139/ssrn.4124698

He, A. (2024). *State of Workers: 2024 Report*. https://pro.morningconsult.com/analyst-reports/state-of-workers-2024

Hu, M., Kok, N., & Palacios, J. (2024). Tenant Satisfaction and Commercial Building Performance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4721577

Jacobs, Jane. (1961). *The death and life of great American cities*. Bodley Head.

Jepperson, R. L., & Meyer, J. W. (2021). *Institutional Theory: The Cultural Construction of Organizations, States, and Identities*. https://doi.org/10.1017/9781139939744

Kantel, A., Preuss, S., Janssen, H., Brunzema, I., Perobelli, E., Saportio, R., Miraglia, E., Massari, M., Sabatini, F., Huebner, G., Peretto, M., & Panica, D. (2024). *Defining housing inequality- a state-of-the-art literature review*. https://ieecp.org/2025/01/24/defining-housing-inequality-a-state-of-the-art-literature-review-reveals-a-multifaceted-concept/

Kraaijenbrink, J., Spender, J. C., & Groen, A. J. (2009). The Resource-Based View: A Review and Assessment of Its Critiques. *Https://Doi.Org/10.1177/0149206309350775*, *36*(1), 349–372. https://doi.org/10.1177/0149206309350775

Kyriakopoulou, E., & Picard, P. M. (2023). The Zoom city: working from home, urban productivity and land use. *Journal of Economic Geography*, *23*(6), 1397–1437. https://doi.org/10.1093/JEG/LBAD025

Larson, W., & Zhao, W. (2017). TELEWORK: URBAN FORM, ENERGY CONSUMPTION, AND GREENHOUSE GAS IMPLICATIONS. *Economic Inquiry*, *55*(2). https://doi.org/10.1111/ecin.12399

Loder, A., Candido, C., Altomonte, S., Rothmann, I., Kawai, Y., Lindberg, C., Chung, S., Devine, A., Austin Gray, W., Satish, U., & Augustin, S. (2025). *Developing a transdisciplinary and adaptive framework to measure health and well-being for the workplace: the 12 Competencies*.

Long, C. (2025, April 24). Investors Circling NYC CRE At Levels “Unlike We’ve Seen Since 2018.” *BixNow*. https://www.bisnow.com/new-york/news/office/investor-demand-is-back-for-nyc-offices-execs-say-129075

Lopez, N., & Peck, E. (2025, February 12). San Francisco office occupancy rises but still lags behind national average. *Axios San Francisco*. https://www.axios.com/local/san-francisco/2025/02/12/sf-office-occupancy-rate-grows

Lovins, A. B. (2018). How big is the energy efficiency resource? *Environmental Research Letters*, *13*(9), 090401. https://doi.org/10.1088/1748-9326/AAD965

McKinsey Global Institute. (2023). *Empty spaces and hybrid places | McKinsey*. https://www.mckinsey.com/mgi/our-research/empty-spaces-and-hybrid-places

McWilliams, A., & Siegel, D. (2001). Corporate social responsibility: A theory of the firm perspective. *Academy of Management Review*, *26*(1), 117–127. https://doi.org/10.5465/AMR.2001.4011987

Monte, F., Porcher, C., & Rossi-Hansberg, E. (2023). *Remote Work and City Structure* (Working Paper 31494; National Bureau of Economic Research). https://doi.org/10.3386/W31494

Mørch, A. (2020, February 6). *Understanding Office Space Utilization & Efficiency*. https://www.askcody.com/blog/office-space-utilization-efficiency

Moreno, Carlos., Gehl, Jan., & Thorne, Martha. (2024). *The 15-minute city : a solution to saving our time & our planet*. 276.

Nelson, A. (2023). The Office Market Reckoning is Nigh. *CRE Real Estate Issues*, *47*(12), 1–8. https://cre.org/real-estate-issues/the-office-market-reckoning-is-nigh/

Ravalet, E., & Rérat, P. (2019). Teleworking: Decreasing mobility or increasing tolerance of commuting distances? *Built Environment*, *45*(4). https://doi.org/10.2148/benv.45.4.582

Rosenthal, S. S., Strange, W. C., & Urrego, J. A. (2021). JUE Insight: Are City Centers Losing Their Appeal? Commercial Real Estate, Urban Spatial Structure, and COVID-19. *Journal of Urban Economics*, *127*. https://doi.org/10.1016/J.JUE.2021.103381

Rowden, J. (2024). *U.S. Office Market Dynamics: Q3 2024*. https://www.us.jll.com/en/trends-and-insights/research/office-market-statistics-trends

Ryan, P. (2021). *United States Office Outlook – Q1 2021*. https://www.us.jll.com/en/trends-and-insights/research/office-market-statistics-trends

Statistics Canada. (2021). *Businesses or organizations anticipated to shrink office locations due to the workforce teleworking*. https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3310039201

Studio Forma. (2024, October 7). *Typical Office Size: How Much Office Space Do You Need*. https://www.studioforma.ca/typical-office-size/

Thaler, R. H. (2016). Behavioral Economics: Past, Present, and Future. *American Economic Review*, *106*(7), 1577–1600. https://doi.org/10.1257/AER.106.7.1577

The Economist. (2024, February 22). How working from home is reshaping Canary Wharf. *The Economist*. https://www.economist.com/britain/2024/02/22/how-working-from-home-is-reshaping-canary-wharf

The Economist. (2025, April 21). Unlike everyone else, Americans and Britons still shun the office. *The Economist*. https://www.economist.com/finance-and-economics/2025/04/21/unlike-everyone-else-americans-and-britons-still-shun-the-office

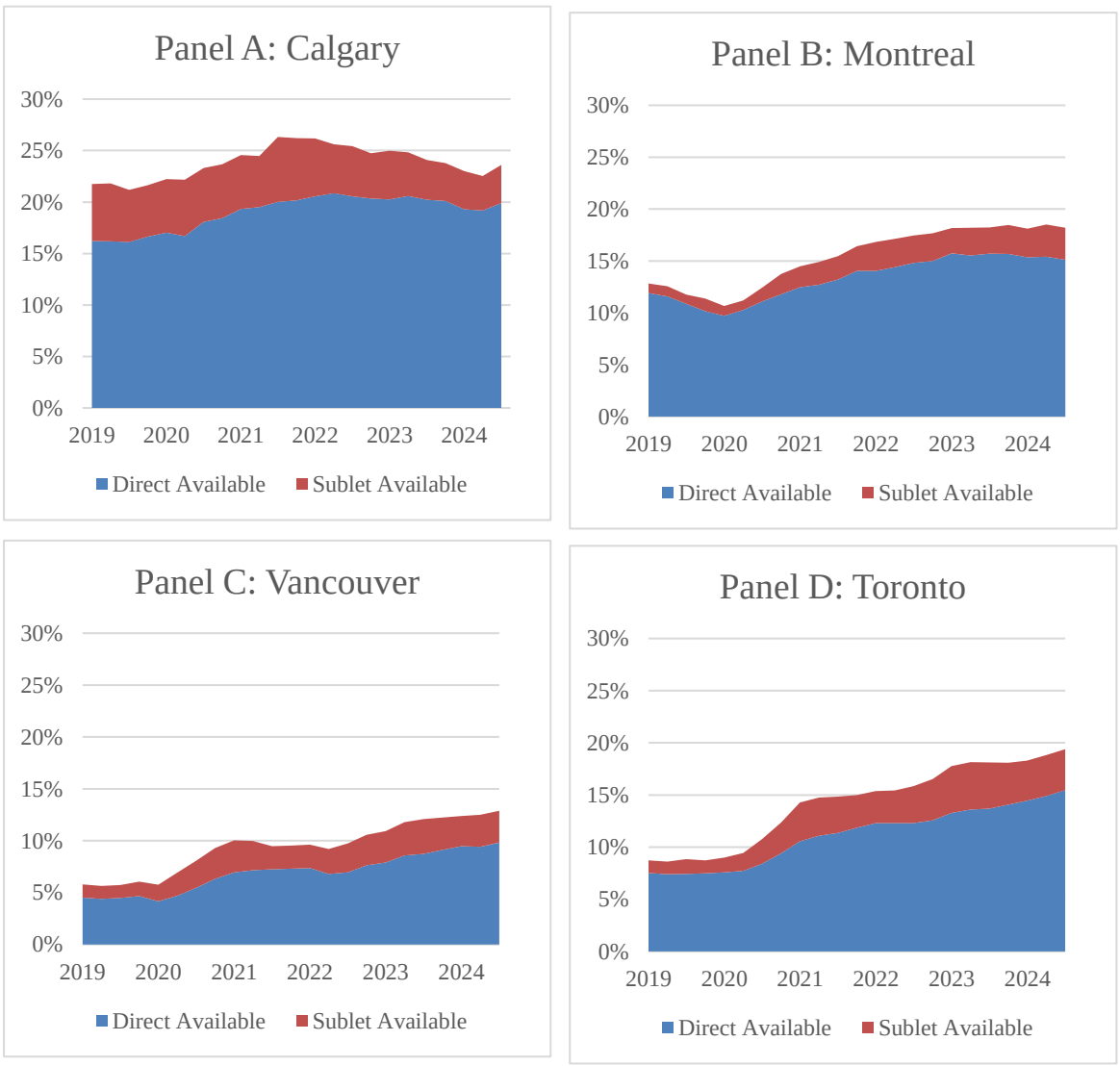
Tibshirani, R. (1996). Regression Shrinkage and Selection Via the Lasso. *Journal of the Royal Statistical Society. Series B: Methodological*, *58*(1), 267–288. https://doi.org/10.1111/J.2517-6161.1996.TB02080.X

Williamson, O. E. (1981). Williamson - 1981 - The Economics of Organization The Transaction cost Approach.pdf. In *American Journal of Sociology* (Vol. 87).

World Economic Forum. (2016). *Environmental Sustainability Principles for the Real Estate Industry*. www.weforum.org

10.Tables and Figures

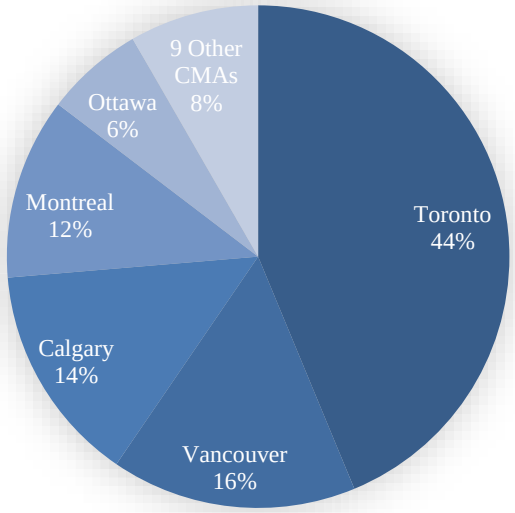
Figure 1: Direct and Sublet Vacancy Trends, by Market



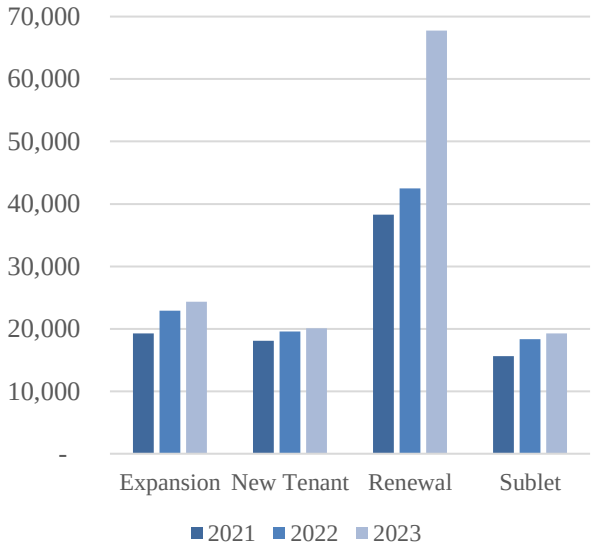
Notes: Direct and sublet vacancy status for four metro area markets over time (2019-Q3 2024). The left axis presents the percent of vacant space, broken down into space available rent: direct (blue) and sublet (red).

Figure 2: Characteristics of Leased Space

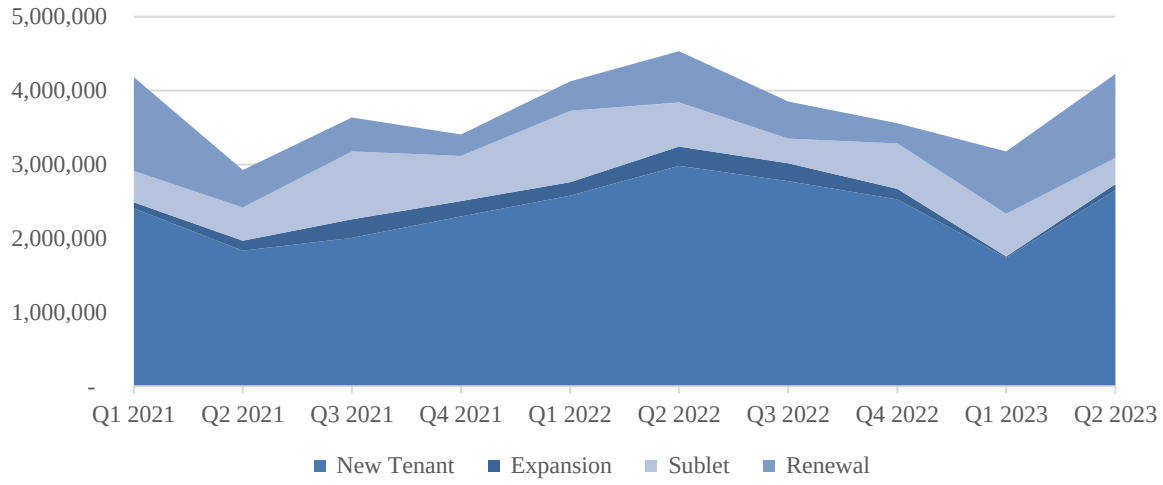
Panel A: Executed Lease Space, by CMA



Panel B: Average Lease Size, by Lease Type

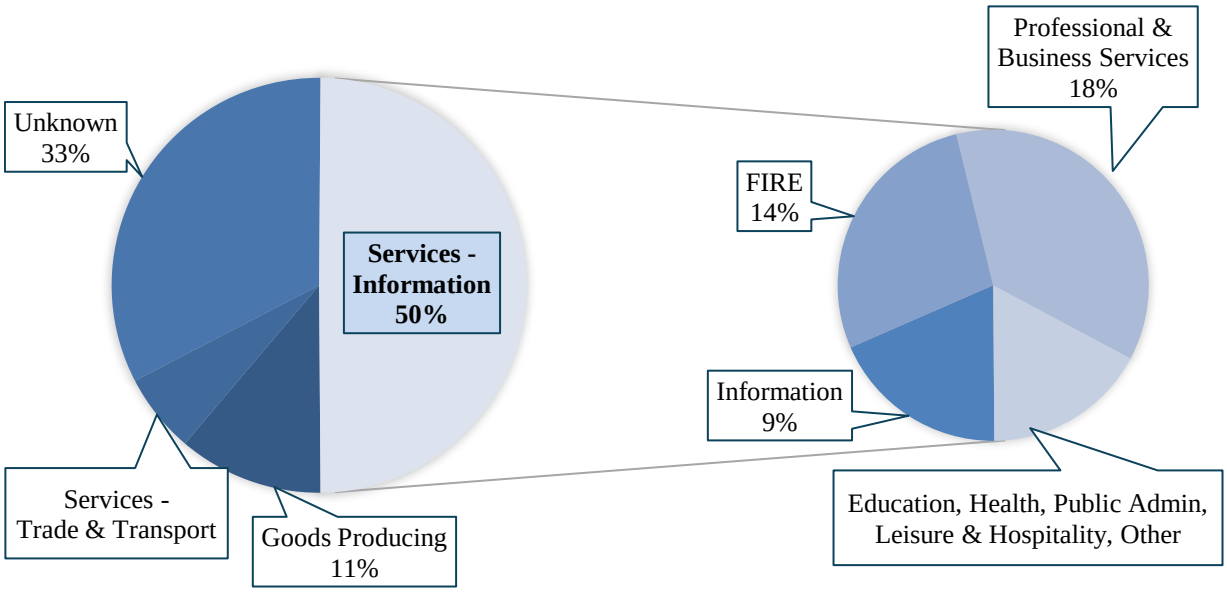


Panel C: Executed Lease Space Over Time, by Lease Type



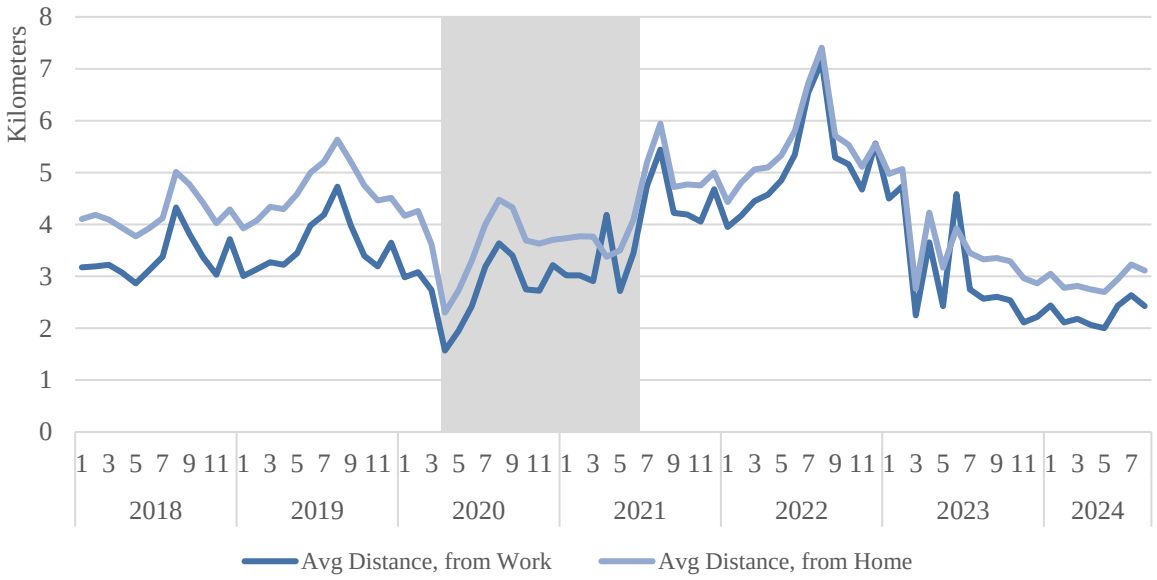
Notes: The above figures present characteristics of the executed lease sample. Panel A presents the breakdown of total executed lease space (in terms of square footage) by CMA. Panel B presents the average lease size in square feet over time, broken down by lease type. Panel C presents the quarterly total executed lease space (in terms of square footage) over time for the period of Q1 2021 through Q2 2023, broken down by lease type.

Figure 3: Tenancy of Executed Lease Space



Notes: The above figure presents the 2-digit NAICS business categories for the tenants associated with the total square footage of executed office space leases in the sample. Leases are tracked by Altus and represent office leasing activity in all major Canadian markets from Q1 2021 through Q3 2023. One-half of all leases are governing firms in the service-information category; within this group, the largest subcategories of tenancy represent Professional and Business Services and firms in the FIRE sectors. One-third of leases involve tenants that did not disclose their industry.

Figure 4: Canada-wide Monthly Average of Daily Commute Distances, from Work and Home Bases



Notes: The above figure presents the monthly average of individuals' daily commute distances (in kilometers), for the period of January 2018 through July 2024. Data is averaged for all studied DAs. Results are present for both the average daily commute distance for an individual from both their work location and from their home location. Data is collected based on tracking of personal electronic devices. The greyed portion indicates the COVID-19 pandemic, proxied by active stay-at-home orders dates.

Table 1: Summary Statistics

Panel A: Leasing Sample Comparison

Average *(Std Dev)*	**All Buildings**	**Buildings without Leases**	**Buildings with Leases**	**No Leases minus Leases**
Sustainability:				
GRESB Participation (D)	0.10	0.08	0.31	-0.23***
	(0.31)	(0.27)	(0.46)	(-32.87)
GRESB Rating (0-5)	0.40	0.28	1.34	-1.05***
	(1.25)	(1.05)	(2.08)	(-38.15)
Green Certification (D)	0.18	0.13	0.50	-0.37***
	(0.38)	(0.34)	(0.50)	(-41.66)
Healthy Certification (D)	0.03	0.02	0.14	-0.12***
	(0.18)	(0.13)	(0.35)	(-33.34)
Urbanity:				
Downtown (D)	0.29	0.27	0.46	-0.19***
	(0.45)	(0.44)	(0.50)	(-17.01)
Walk Score (0-100)	80.21	80.11	83.20	-3.09***
	(21.90)	(21.73)	(21.75)	(-5.56)
Bike Score (0-100)	73.39	73.38	75.11	-1.73***
	(19.41)	(19.38)	(19.16)	(-3.48)
Transit Score (0-100)	69.10	68.13	77.27	-9.14***
	(20.72)	(20.39)	(21.13)	(-17.36)
Building Attributes:				
Building Size (000s SF)	91.00	71.72	266.52	-194.80***
	(139.71)	(101.35)	(329.38)	(-68.16)
Class-A (D)	0.28	0.23	0.60	-0.37***
	(0.45)	(0.42)	(0.49)	(-33.99)
Class-B (D)	0.38	0.38	0.29	0.09***
	(0.48)	(0.49)	(0.46)	(7.25)
Class-C (D)	0.24	0.27	0.10	0.17***
	(0.43)	(0.44)	(0.29)	(15.19)
Year Built	1978	1977	1983	-6.21***
	(31.69)	(32.23)	(27.41)	(-7.44)
Obs (Building-Year-Quarter)	81,511	68,078	1,562	

Table 1: Summary Statistics (cont.)

Panel B: Dissemination Area Sample Descriptives

	Observations	Mean	Std Dev	p25	p50	p75
Sustainability & Urbanity:						
Green Certified Bldgs (D)	32,906	0.24	0.43	0.00	0.00	0.00
Healthy Certified Bldgs (D)	32,906	0.05	0.22	0.00	0.00	0.00
GRESB Participating Bldgs (D)	32,906	0.11	0.32	0.00	0.00	0.00
Downtown (D)	32,906	0.18	0.38	0.00	0.00	0.00
Walk Score	32,906	0.82	0.19	0.74	0.89	0.97
Bike Score	32,906	0.74	0.18	0.61	0.76	0.90
Transit Score	30,810	0.67	0.18	0.53	0.66	0.82
Commuting:						
Work Distance (km)	32,906	3.71	5.98	1.28	3.04	4.98
Home Distance (km)	32,904	4.45	5.96	1.16	3.57	6.45
Commute, Car (%)	30,874	0.57	0.22	0.39	0.59	0.75
Commute, Active (%)	30,874	0.17	0.16	0.05	0.11	0.25
Commute, Transit (%)	30,874	0.26	0.15	0.15	0.24	0.35
Office Use:						
RHW (%)	32,698	0.52	0.12	0.44	0.52	0.60
2016 WfH (%)	30,890	0.07	0.05	0.04	0.07	0.10
Office Space (SF)	32,906	326,714	1,231,677	32,290	76,038	236,827
Demographics:						
Population	32,906	1,031	1,055	536	708	1,117
Population Density	32,906	7,989	11,912	1,643	4,194	9,557
Population Working Age (%)	32,906	0.10	0.08	0.06	0.09	0.13
Population Over 65 (%)	32,906	0.03	0.03	0.01	0.02	0.04
Unemployment (%)	32,906	0.11	0.05	0.08	0.11	0.14
Average Cost to Rent	29,324	1,368	490	970	1,300	1,700
Bachelor's Degree (%)	32,906	0.49	0.18	0.36	0.50	0.63

Notes: The above table presents select summary statistics on the data for the 14 major Canadian markets tracked by Altus which experience leasing activity during the sample period. Panel A presents building-level characteristics for the sample during the period of Q1 2021 through Q3 2023. Average and standard deviation values are presented for the full sample (All Buildings) as well as for the subsamples of building-year-quarters in which a lease is (or is not) executed. The last column presents t-test results of the statistical difference between the buildings without leasing activity and those buildings with leasing activity. *, **, and *** indicate significance at the 10%, 5%, and 1% level of significance, respectively. Panel B presents DA-quarter values for all DA's in which at least one Altus-tracked office building is situated. (D) indicates a dummy variable. Higher values for GRESB Rating, Walk Score, Bike Score, and Transit Score indicate stronger performance. Green Building Certification represents LEED or BOMA BEST certification; Healthy Building Certification represents WELL or Fitwel certification. Downtown tracks if an asset is situated within the CMA's downtown area. Work Distance presents the average distance travelled daily by a personal electronic device from the devices' primary daytime location (i.e work location). Home Distance presents the average distance travelled daily by a personal electronic device from the devices' primary overnight location (i.e home location). Measures of Commute by Car, Active, and Transit indicate the proportion of the population that resides in a DA that predominantly travel by each mode of transportation. RHW presents the Dingel and Neiman calculation of the proportion of workers whose firm is housed in each DA that could work from home. 2016 WfH presents the Statistics Canada proportion of individuals that live in each DA that work from home.

Table 2: Sustainability Attributes and Leasing Outcomes

	(1)	(2)	(3)	(4)
Green Certification		0.017***		
		(6.26)		
Healthy Certification		0.030***		
		(3.79)		
GRESB Participation			0.018***	
			(3.42)	
GRESB Rating				0.006***
				(4.14)
Class-A	0.017***	0.013***	0.016***	0.015***
	(7.73)	(7.58)	(7.90)	(7.67)
Class-B	0.002	0.002	0.002	0.002
	(1.49)	(0.99)	(1.06)	(0.99)
Ln(Building Size)	0.012***	0.010***	0.011***	0.011***
	(5.46)	(5.11)	(5.44)	(5.47)
Building Age	-0.000*	-0.000	-0.000*	-0.000*
	(-1.96)	(-1.65)	(-1.92)	(-1.87)
Bachelor's Degree (%)	-0.017**	-0.017**	-0.017**	-0.017**
	(-2.48)	(-2.66)	(-2.40)	(-2.43)
Constant	-0.021**	-0.014	-0.018*	-0.017*
	(-2.09)	(-1.41)	(-1.87)	(-1.76)
NAICS 2-Digit Industry Controls	Yes	Yes	Yes	Yes
Submarket-Yr-Qtr FE	Yes	Yes	Yes	Yes
R-squared	0.044	0.045	0.047	0.046
# Obs	58,166	58,166	58,166	58,166

Notes: The above table presents linear probability model results estimating the probability of lease activity in Canadian office buildings over the Q1 2021 through Q3 2023 time period. Class C buildings serve as the baseline category against which Class A and Class B buildings are compared. Building Age is measured in years. Bachelor's Degree presents the portion of the population over 25 years old holding a bachelor's degree. NAICS 2-digit industry control variables are suppressed from the table to conserve space, but are included in the model. Observations are at the building-year-quarter level. There are fixed effects for Submarket-Year-Quarter, capturing both time-varying and submarket-specific unobservable characteristics. *, **, and *** indicate significance at the 10%, 5%, and 1% level of significance, respectively.

Table 3: Urbanity and Leasing Outcomes

	(1)	(2)	(3)	(4)
Downtown (D)	0.010***			
	(3.51)			
Walk Score (/100)		0.007		
		(1.68)		
Bike Score (/100)			-0.003	
			(-0.54)	
Transit Score (/100)				0.015***
				(3.45)
Green Certification	0.015***	0.015***	0.016***	0.015***
	(5.93)	(6.08)	(6.32)	(5.68)
Healthy Certification	0.029***	0.029***	0.029***	0.028***
	(4.25)	(4.56)	(4.65)	(4.34)
GRESB Participation	0.012**	0.012**	0.012**	0.012**
	(2.47)	(2.50)	(2.52)	(2.50)
Class-A	0.011***	0.011***	0.010***	0.011***
	(4.24)	(4.21)	(4.02)	(4.46)
Class-B	0.001	0.000	0.000	0.001
	(0.29)	(0.12)	(0.05)	(0.32)
Ln(Building Size)	0.010***	0.010***	0.010***	0.010***
	(4.49)	(4.46)	(4.41)	(4.45)
Building Age	-0.000	-0.000	-0.000	-0.000
	(-1.65)	(-1.04)	(-0.85)	(-1.15)
Bachelor's Degree (%)	-0.014**	-0.012*	-0.011	-0.016*
	(-2.18)	(-1.84)	(-1.48)	(-2.14)
Constant	-0.016**	-0.019**	-0.013	-0.024**
	(-2.60)	(-2.39)	(-1.44)	(-2.77)
NAICS 2-Digit Industry Controls	Yes	Yes	Yes	Yes
CMA-Yr-Qtr FE	Yes	Yes	Yes	Yes
R-squared	0.04	0.04	0.04	0.04
# Obs	58,163	58,163	58,155	55,385

Notes: The above table presents linear probability model results estimating the probability of lease activity in Canadian office buildings over the Q1 2021 through Q3 2023 time period. Class C buildings serve as the baseline category against which Class A and Class B buildings are compared. Building Age is measured in years. Bachelor's Degree presents the portion of the population over 25 years old holding a bachelor's degree. NAICS 2-digit industry control variables are suppressed from the table to conserve space, but are included in the model. Observations are at the building-year-quarter level. There are fixed effects for CMA-Year-Quarter, capturing both time-varying and market-specific unobservable characteristics. *, **, and *** indicate significance at the 10%, 5%, and 1% level of significance, respectively.

Table 4: Tenancy Impacts

	(1)	(2)	(3)	(4)
TENANCY Definition	**N/A**	**DivHHI**	**% Critical**	**RHW**
Green Certification	0.014***	0.018***	0.006	0.018*
	(5.18)	(5.71)	(0.90)	(1.73)
Green Certification X TENANCY		0.057***	0.025	0.011
		(2.90)	(1.30)	(0.47)
Healthy Certification	0.025***	0.021**	0.043***	0.048**
	(2.77)	(2.49)	(3.41)	(2.53)
Healthy Certification X TENANCY		-0.063	-0.063	0.056
		(-0.70)	(-1.61)	(1.15)
GRESB Participation	0.009*	0.012*	-0.022**	0.039**
	(1.76)	(1.97)	(-2.66)	(2.48)
GRESB Participation X TENANCY		0.054**	0.104***	0.071**
		(2.53)	(3.11)	(2.16)
TENANCY		0.007	-0.009**	-0.006
		(1.61)	(-2.20)	(-0.92)
Class-A	0.013***	0.012***	0.013***	0.013***
	(7.44)	(7.16)	(7.43)	(7.29)
Class-B	0.001	0.001	0.001	0.001
	(0.53)	(0.52)	(0.57)	(0.52)
Ln(Building Size)	0.010***	0.010***	0.010***	0.010***
	(5.33)	(5.36)	(5.66)	(5.26)
Building Age	-0.000*	-0.000*	-0.000*	-0.000*
	(-1.84)	(-1.87)	(-1.82)	(-1.77)
Bachelor's degree (%)	-0.009*	-0.009*	-0.011*	-0.010*
	(-1.75)	(-1.68)	(-1.97)	(-1.99)
Constant	-0.017**	-0.017**	-0.014*	-0.019*
	(-2.04)	(-2.03)	(-1.84)	(-1.88)
NAICS 2-Digit Industry Controls	Yes	Yes	Yes	Yes
Submarket-Yr-Qtr FE	Yes	Yes	Yes	Yes
R-squared	0.043	0.043	0.044	0.044
# Obs	77,547	77,547	77,547	77,547

Notes: The above table presents linear probability model results estimating the probability of lease activity in Canadian office buildings over the Q1 2021 through Q3 2023 time period. Class C buildings serve as the baseline category against which Class A and Class B buildings are compared. Building Age is measured in years. Bachelor's Degree presents the portion of the population over 25 years old holding a bachelor's degree. NAICS 2-digit industry control variables are suppressed from the table to conserve space, but are included in the model. Observations are at the building-year-quarter level. There are fixed effects for Submarket-Year-Quarter, capturing both time-varying and submarket-specific unobservable characteristics. *, **, and *** indicate significance at the 10%, 5%, and 1% level of significance, respectively.

Table 5: Mobility Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
LHS (Movement Metric)	**Ln(# Stops/Office SF)**			**Ln(# Devices/Office SF)**		
Green Certified Bldgs >1		0.152***			0.152***	
		(2.94)			(2.93)	
Healthy Certified Bldgs >1		0.022			0.003	
		(0.28)			(0.04)	
GRESB Participating Bldgs >1			0.114**			0.123**
			(2.17)			(2.34)
Ln(Office SF)	-0.735***	-0.757***	-0.744***	-0.755***	-0.776***	-0.765***
	(-59.67)	(-51.61)	(-56.77)	(-61.61)	(-52.93)	(-58.17)
Population (/1000)	0.226***	0.222***	0.223***	0.166***	0.163***	0.164***
	(6.66)	(6.51)	(6.70)	(5.47)	(5.31)	(5.50)
Population Growth Rate	0.052***	0.053***	0.053***	0.044**	0.045**	0.046**
	(2.78)	(2.95)	(2.85)	(2.22)	(2.37)	(2.30)
Population Density (/1000)	-0.023***	-0.024***	-0.023***	-0.021***	-0.021***	-0.021***
	(-7.23)	(-7.26)	(-7.24)	(-6.78)	(-6.81)	(-6.79)
Population Working Age (%)	-3.319***	-3.401***	-3.363***	-2.383***	-2.460***	-2.429***
	(-5.83)	(-5.95)	(-5.93)	(-4.52)	(-4.64)	(-4.63)
Population Over 65 (%)	-4.756***	-4.765***	-4.733***	-3.199***	-3.204***	-3.175***
	(-4.62)	(-4.63)	(-4.60)	(-3.13)	(-3.14)	(-3.11)
Bachelor's Degree (%)	-0.364*	-0.350*	-0.372**	-0.235	-0.220	-0.244
	(-1.94)	(-1.87)	(-1.99)	(-1.23)	(-1.16)	(-1.28)
Unemployment (%)	-0.662	-0.635	-0.631	-0.470	-0.444	-0.437
	(-1.54)	(-1.48)	(-1.47)	(-1.07)	(-1.01)	(-0.99)
Average Cost to Rent (/1000)	0.205***	0.194***	0.202***	0.171***	0.161***	0.168***
	(3.86)	(3.64)	(3.81)	(3.17)	(2.97)	(3.12)
Constant	5.440***	5.677***	5.547***	4.139***	4.365***	4.254***
	(11.91)	(12.21)	(12.15)	(8.80)	(9.09)	(9.06)
NAICS 2-Digit Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes
Submarket-Yr-Mon FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.765	0.767	0.766	0.770	0.771	0.770
# Obs	84,670	84,670	84,670	84,670	84,670	84,670

Notes: The above table presents panel regression results estimating the mobility patterns in Canadian Dissemination Areas (DA) with any office buildings over the Q1 2021 through Q3 2023 time period; observations are at the DA-year-month level. Ln(Office SF) is the logarithm of the total office space within a DA. Population is measured as the total population within each DA, expressed in thousands, Population Growth is the percentage change in total population from 2016 to 2021, and Population Density is the ratio of total population to land area, expressed in thousands. Average Cost to Rent is the average monthly shelter costs for rented dwellings in Canadian dollars. NAICS 2-digit industry control variables are suppressed from the table to conserve space, but are included in the model. There are fixed effects for Submarket-Year-Quarter, capturing both time varying and submarket-specific unobservable characteristics. *, **, and *** indicate significance at the 10%, 5%, and 1% level of significance, respectively.

Table 6: Commute Distance from Work Location Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
DDD Definition		**Green Office**	**Downtown**	**WS >90**	**BS >90**	**TS >90**
HighRHW	-0.233***	-0.252***	-0.205***	-0.260***	-0.200***	-0.217***
	(-4.67)	(-4.08)	(-3.62)	(-3.28)	(-3.28)	(-3.78)
HighRHW X Post-2021Q2	-0.117*	-0.273***	-0.257***	-0.402***	-0.275***	-0.146*
	(-1.81)	(-3.36)	(-3.45)	(-3.94)	(-3.54)	(-1.93)
DDD		0.164***	0.015	0.054	0.033	0.090
		(3.11)	(0.21)	(0.95)	(0.56)	(1.47)
DDD X Post-2021Q2		0.478***	0.186**	0.116**	0.139**	0.131*
		(7.68)	(2.20)	(2.01)	(2.13)	(1.80)
DDD X HighRHW		0.025	-0.066	0.067	-0.076	-0.058
		(0.25)	(-0.57)	(0.68)	(-0.77)	(-0.54)
DDD X Post-2021Q2 X HighRHW		0.243*	0.489***	0.478***	0.459***	0.070
		(1.90)	(3.30)	(3.67)	(3.36)	(0.48)
Constant	9.198***	9.031***	9.106***	9.072***	9.164***	9.138***
	(38.99)	(36.81)	(39.40)	(38.76)	(39.37)	(39.10)
NAICS 2-Digit Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	DA	DA	DA	DA	DA	DA
CMA FEs	Yes	Yes	Yes	Yes	Yes	Yes
YQ FEs	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.146	0.171	0.151	0.154	0.151	0.148
# Obs	32,906	32,906	32,906	32,906	32,906	32,906

Notes: The above table presents event study results estimating commute trends in the DAs with any office buildings before and after the lifting of the Stay-at-Home mandates. Our sample period is from 2019Q1 to 2024Q2, excluding the pandemic (2020Q1-2021Q2). Post-2021Q2 is a dichotomous variable indicating periods after 2021Q2. HighRHW is a dichotomous variable equal to 1 for DAs in the top quartile of the remote work index (RHW) distribution. DDD is one of the variables capturing green building and urbanity: Green Office indicates DAs with any Green-, Healthy-, or GRESB-certified properties. Downtown indicates DAs located within downtown areas. WS90, BS90, and TS90 equal to 1 if a DA has a Walk Score, Bike Score, or Transit Score is above 90, respectively. NAICS 2-digit industry control variables are suppressed from the table to conserve space, but are included in the model. Observations are at the DA-year-quarter level. There are fixed effects for Submarket-Year-Quarter, capturing both time varying and submarket-specific unobservable characteristics. *, **, and *** indicate significance at the 10%, 5%, and 1% level of significance, respectively.

Table 7: Calgary Commute Distances and Emissions, by Transportation Mode

Commute Mode:	Active Transit	Car, Truck or Van	Public Transit	Total
Total Commuters	38,330	388,315	88,520	515,165
Average Distance Per Commuter (km)	7	21	19	20
Total Commute Distance (km)	259,920	8.1M	1.7M	10.1M
Commute CO2e, Low Estimate (kg)	0	972,000	103,000	1.1M
Commute CO2e, High Estimate (kg)	5,500	1.5M	155,000	1.6M
Per Capita Commute gCO2e, Low Estimate	0	2,504	1,166	2,088
Per Capita Commute gCO2e, High Estimate	142	3,757	1,749	3,143

Notes: The above table presents nonparametric estimates of the total and per commuter daily commute distance and CO2e emissions by mode of transportation for Calgary. Commuter counts, distances, and modes data are taken from the 2016 Canadian census. Carbon emissions by mode of transportation are taken from Our World In Data, and are based on the average carbon dioxide equivalent emissions per kilometer under two scenarios: operating costs only, and lifecycle costs. These ranges are: active transit (biking and walking, estimated at 0-21 gCO2e/kilometer); public transit (estimated at 60-90 gCO2e/kilometer); and, car, truck or van (estimated at 120-180 gCO2e/kilometer).