

**THE BELLY OF THE BEAST:
POST-OCCUPANCY ASSESSMENT OF SUSTAINABLE CONSUMPTION IN
MULTI-UNIT RESIDENTIAL BUILDINGS**

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

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ABSTRACT

A post-occupancy assessment (POA) tool was developed and applied to assess drivers of household consumption in three types of multi-residential housing in Metro Vancouver, Canada: typical condominiums, co-housing, and high-performance green buildings. A mixed methods approach used performance and actor-centred indicators to analyze building performance, household consumption patterns and user feedback on building livability. The POA survey instrument quantified household relationships and compared results with qualitative interviews and site observations. A public policy focus group framed policy implications and assisted in dissemination.

Findings suggest that the type of housing development, governance structure and levels of social cohesion significantly influence household consumption levels with respect to physical design, waste reduction strategies, mobility modes, food preferences and procurement, social connectivity and household behaviour. The consumption levels of occupants of co-housing developments that feature innovative management practices and resource sharing were the lowest among the building types examined. The environmental impact of using green construction material and energy-saving devices proved to be less significant in reducing consumption levels than did the social cohesion of occupants within the building types examined. Findings regarding the relationship of household organization to consumption patterns advance

understanding of the behavioural dimensions of sustainability, of interest to policy makers, academics, planners, architects and designers.

Keywords: sustainable consumption, households, post-occupancy assessment, co-housing, community well-being.

To Mom and Dad

*"Almost all good writing begins with terrible first efforts.
You need to start somewhere."
— Anne Lamott*

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I have almost died twice, well actually three times. In 1992, I trekked across Tibet with a yak. At that time, foreigners were not allowed overland entry due to the ongoing Chinese occupation of Tibet. A Taiwanese friend and I had bribed a ride with a four-star Chinese Army general who had agreed to drive us to Lhasa, the Tibetan capital. Upon stopping for the night after passing over a 5300m plateau, we got a knock on our hotel room door and were promptly arrested. The Chinese police repossessed the general's jeep and after a brief stint in jail, sent the two of us back over the pass. We never did find out what happened to the general, but our ride out of Tibet was with a truck driver who was instructed to return us to the edge of the Gobi Desert. The real drama started when I came down with acute altitude sickness and started drifting in and out of consciousness. I am sure the truck driver saved my life as he realized the serious state that I was in. He knew that my only saving grace was to descend to a lower altitude, which meant driving non-stop for almost two days until we were down to the low-lying foothills of Central China. After recovering for a couple of weeks we successfully re-entered Tibet. This time we sat at the back of a public bus for three days and went through seven check-points to Lhasa, but that story is for another day.

My next near death experience was a few years later when I was scuba diving off of Utila, Bay Islands, Honduras. It was my first "deep dive," yet upon

descending 40 meters, I promptly bit off my respirator mouthpiece. Not knowing what to do, I realized I had only half a breath to decide and I had better think quickly. I swam over to my instructor and gave her the cut-throat gesture for “I’m out of air.” I’m sure my eyes were bulging out of their eye sockets if she had any doubt what was happening. We started buddy breathing until she whipped me around and found my spare respirator tucked in my belt. The dive went down as my best ever, even though I don’t quite remember the coral or marine life that day.

The writing of this dissertation was my third near death experience. While it doesn’t have the sense of adventure my other near misses have had, academic writing is a process where I learned to, at least figuratively, die daily. Each draft died a death before it was resurrected into semi-cohesive prose. Just as they say raising a child takes a village, I am indebted to a host of family, friends, colleagues and mentors for helping sustain me and this dissertation along the way.

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PART 1: RESEARCH SCOPE AND OBJECTIVES

CHAPTER 1: TOWARD SUSTAINABLE CONSUMPTION FOR HOUSEHOLDS

1.1 The Belly of the Beast

Imagine sustainability's three central tenets--ecology, society, and economy--as a human body. The torso is the ecological environment, visible and all encompassing, connecting the physical with the psyche. The heart symbolizes society and is concerned with fairness, ethics and relationships. And the head comprises the economy—its intellectual acumen, and markets—and is used to calculate, to rationalize, to remain objective.

If a human being can act as a metaphor for sustainability, then the biceps represent production— dominant and muscular pistons that rely on industrial brawn. The belly symbolizes consumption, connected as it is to intestines that metabolize and digest nutrients for energy output. Intestines perform a critical but overlooked body function, an afterthought suffering from occasional stomach aches, hunger and flatulence. Although the belly symbolizes consumption, it is not often directly associated with sustainability's central challenge of living within nature's means. It is overlooked and outclassed in humanity's desire to perform faster, higher, stronger and more efficiently than previous generations.

The biceps enjoy the limelight and receive recognition and high profile, while guiding sustainability toward lean production-oriented efficiencies and doing more with less. However, in doing so, sustainability discourse conveniently ignores humanity's insatiable desire and ability to consume

increasingly more “stuff” (Ryan & Durning, 1997, p. 19). Even while doing “more with less,” most modern consumers (that is, citizens) also want more (Princen, 2005). In essence, this research attempts to change the focus of attention from a preoccupation with biceps (production) to examine the belly of the beast, which is consumption.

1.2 Defining the Problem

The focus on energy efficiencies and use of sustainable materials exceeds that given to absolute consumption levels and energy demand (Princen, 2005; Schneider, 2010). Energy-efficient policies that focus on downsizing could reverse present trends towards more energy-consuming appliances and electronics, yet politicians on all sides of the political spectrum are reluctant, in the name of consumer choice, to limit wasteful practices. Housing size in Canada increased from 983 square feet in 1948 to 2,340 square feet in 2002.¹ In 1975, 20% of new single-family dwellings in the country had 2.5 or more bathrooms and 46% had central air conditioning; by 2002, 55% of houses had 2.5 or more bathrooms and 87% had air conditioning features (Wilson & Boehland, 2005). A television set in 1938 consumed 200 watts of energy, for example, while a 41-inch flat plasma screen monitor in 2008 consumed 250 watts (Consumers Reports, 2008).²

¹ See the CMHC. (1993). Canadian Housing Statistics, Ottawa, ON. See Table 46: Estimated Costs of Single-Family Dwellings Financed Under the National Housing Acts (Quarters 1-2, 1955). No historical trend data for multi-unit residential building units is available for Canada (W. Guiang, Personal correspondence, Statistics Canada, January, 19, 2011). One study indicates the average owner-occupied MURB unit floor area in Vancouver, BC was 894 sq ft² in 2001 and 899 sq ft² 2009. See CitySpaces Consulting. (2009, December). Vancouver Condominium Rental Study, Prepared for City of Vancouver. Retrieved February 1, 2011, from http://vancouver.ca/commsvcs/housing/pdf/RentalHousing/Final_Report/STUDY3.pdf, p. 1-16.

² The Dumont Model 180 television in 1938 had a 8 x 10 inch black-and-white picture and the

Approximately 30% of residents in the US live in multifamily buildings, while in Canada, multi-unit residential buildings (MURBs) constitute 31% of housing stock and consume 24% of energy in the residential housing sector (CMHC, 2001). Households as a spatial and social unit are intimately involved in consumption processes (OECD, 2002b; 2002d; 2008a; EEA, 2005; 2008; Gram-Hanssen, 2008; Tukker, Charter et al., 2008; Tukker, Cohen et al., 2010). For the purpose of this study, a household is an individual or group of people occupying one dwelling in a MURB in a Northern industrialized affluent community. Changing household lifestyles is fundamental to addressing the environmental challenges by preserving, restoring, and enhancing local communities and ecosystem services, combined with redefining notions of progress and development (OECD, 2006; Stiglitz, Sen et al., 2009; Tukker, Cohen et al., 2010).

Households remain a “sleeping giant” (Lorek & Spangenberg, 2001, p. 102) because of their important role in purchasing and consuming commodities that influence lifestyle choices, supply and demand, and global consumption levels. More research is needed on the social and behavioural patterns that change consumption levels rather than relying primarily on efficiency-related measures (Rees, 2002).

The construction industry has a long way to go towards green and sustainable manufacturing and decommissioning practices for buildings. Globally, the building sector is the largest contributor to greenhouse gas emissions comprising approximately 33% of global energy end use. The construction sector is responsible for more than one third of global resource consumption, including 12% of all fresh water use and an estimated 40% (by

Samsung FP-T5084 in 2008 at medium brightness used 250 watts of electricity.

volume) of total solid waste (UNEP, 2011). Construction and demolition projects accounted for 160 million tons of building-related materials in the US, but 60% of the materials were sent to landfills (US EPA, 2008). Recovering construction and demolition debris can reach 90% recovery rates and save money by reducing project disposal and transportation costs, conserving energy and landfill space, reducing the cost of new construction materials and creating new job opportunities (Roberts, 2004). In Metro Vancouver, waste from the construction, demolition and renovation sectors constitutes about one third of the region's total waste. Wood waste alone, for example, accounts for 22% of the waste disposed from residents and businesses (Metro Vancouver, 2008).

Solid waste decay in landfills generates methane gas, a potent and harmful by-product, but also a potential heating source. There are more than 520 landfill gas-capture projects in the United States; the remaining 600 landfills have the potential to provide electric power to 900,000 homes (US EPA, 2009). In British Columbia, the methane that produces 7% of the province's greenhouse gas emissions could provide energy for 2,400 houses (Hackney & Dauncey, 2005, p. 25).

Although the construction industry has recently attempted to become more "green," expertise within the building trades is ill equipped to deal with the interdisciplinary approaches needed to address consumption issues. Construction is concerned with engineering, building science and gaining an adequate return on investment, yet it has devoted little attention to behaviours, lifestyles and user satisfaction (Stevenson & Leaman, 2010). Within building design, urban planning and construction processes, the evaluation of building performance provides a useful lens to examine consumption by planners,

architects and engineers, but has been neglected due to cost, liability and jurisdictional issues (Bordass, Leaman et al., 2001; Bordass & Leaman, 2005a; 2005b; Way & Bordass, 2005; Stevenson & Leaman, 2010). Designing infrastructure for housing has traditionally focused on building materials rather than people's lifestyles. When buildings are evaluated, their performance is assessed on efficiency levels of equipment and materials used rather than how occupants react and behave in buildings (Guy & Shove, 2007; Stevenson & Leaman, 2010; Leaman, Stevenson et al., 2010). Building evaluations do not fit neatly into traditional building-trade domains such as architecture, engineering or facilities management due to the multidisciplinary and overlapping nature of assessment that should involve urban design, psychology, economics, planning and sociology (Leaman, Stevenson et al., 2010). Instead, evaluations are conducted by engineers, planners and architects as project managers or consultants, yet few evaluations are verified or standardized. While the evaluation of building performance often relies on computer modeling and physical measurement of energy, water, building materials, etc., its primary focus also needs to involve the occupants of the built site using evidence-based field work (Macintosh & Steemers, 2005; Leaman, Stevenson et al., 2010).

Post Occupancy Evaluation (POE) is an important method of evaluating building performance. POE originated during the 1960s by academic researchers who investigated small scale behavioural issues in institutional settings (Sommer, 1981; Wheeler, 1985). Results from such evaluations often provided information for the subsequent design of similar facilities during the 1970s (Cooper, Ahrentzen et al., 1991). In the 1980s, POE used occupant feedback to help evaluate building performance, but its use has been confined largely to

commercial rather than residential settings (Zimmerman & Martin, 2001; Cooper, 2001; Leaman & Bordass, 2007). The evaluation of user perceptions and behaviour in relation to building performance is an emerging field of research, particularly when applied to residential settings. Nevertheless, the field presents real and daunting barriers as Leaman and Stevenson (2010) attest: “Although the goal is often improved efficiency and productivity, the effect can easily be the opposite.” This is because POEs have shown inconsistent building performance (Birt & Newshaw, 2009) because architects and designers do not necessarily learn from past results and facility managers often have little training to improve the living conditions of occupants.

Post Occupancy Assessment (POA) has been used interchangeably with POE over the years without any clear differentiation. I intentionally use POA rather than POE as an attempt to extend the POE concept into new territory that incorporates quantitative and qualitative evidence into residential multi-family housing (Hendrickson & Wittman, 2010). POA examines ways to mitigate household consumption from demand-side perspectives rather than an over-reliance on a performance-metrics approach. POA builds on work within sustainable household consumption and understanding consumption as an inseparable part of daily practice (Christen, Godskesen et al., 2007; Jensen & Gram-Hanssen, 2008; Seyfang, 2010, Tukker, Cohen et al., 2010).

Within high-performance “green” housing developments, energy efficiency is of primary concern (Kats, 2003; UK Government of Trade and Industry, 2005; Ehrhardt-Martinez, & Laitner, 2010; Gram-Hanssen, 2010), but little is known about how the external drivers of consumption affect resource impacts within households (Cooper, 2005). Another area requiring investigation

is how households might be organized differently in buildings and in communities (Choi, 2004; Gold, 2005; Lakeman, 2008; Seyfang, 2010). This issue is of central importance to the challenge of living within biophysical constraints and ensuring that sufficient resources are available to future generations.

In this study, I conducted a comparative POA on three Metro Vancouver housing types referred to as “green,” “co-housing” and “typical.” Green buildings are those that meet Leadership in Energy and Environmental Design (LEED) or similar standards. LEED is a voluntary, market-based rating system for defining environmental elements and quantifies how “green” a building is when compared to other certification programs. Co-housing is a form of housing that originated in Denmark in which the occupants have intentionally designed their accommodation to foster a sense of community. Typical housing is represented by conventional condominiums in which occupant owners live in a “typical” multi-unit residential building (MURB).

1.3 Research Objectives and Questions

Research objectives for this study are to (1) develop and use POA indicators to evaluate building performance, building design, and urban form; (2) measure household consumption through the lens of four environmentally relevant indicators: housing type, mobility, food and solid waste, which together constitute 70-80% of environmental household impact;³ and (3) consider

³ Lorek and Spangenberg use 70% of material extraction and energy consumption from household impact and Holden uses 80% (Holden, 2004; Lorek & Spangenberg, 2001). While housing, mobility, and food represent more than 15% of total household energy and material consumption, the remaining four indicators (hygiene, clothing, cleaning, and recreation without transport) each comprise less than 5% of aggregate resource consumption influenced by households. Although representing a relatively small percentage of resource consumption, a 10% reduction in total resource consumption is an estimated maximum for these four areas. See

relationships between social capital, sustainable behaviour and livability among households.

Several related research questions inform the study:

- How do households in different housing types consume differently?
- How satisfied are multi-unit residential households with their living environment?
- How can performance and actor-centred indicators measure, influence, and educate occupants and local governments about household consumption and production?
- How does living space and social capital influence sustainable behaviour household consumption patterns?
- What factors and public-policy responses drive household resource consumption within the areas of housing, mobility, food and solid waste?

1.4 Conceptual Research Framework

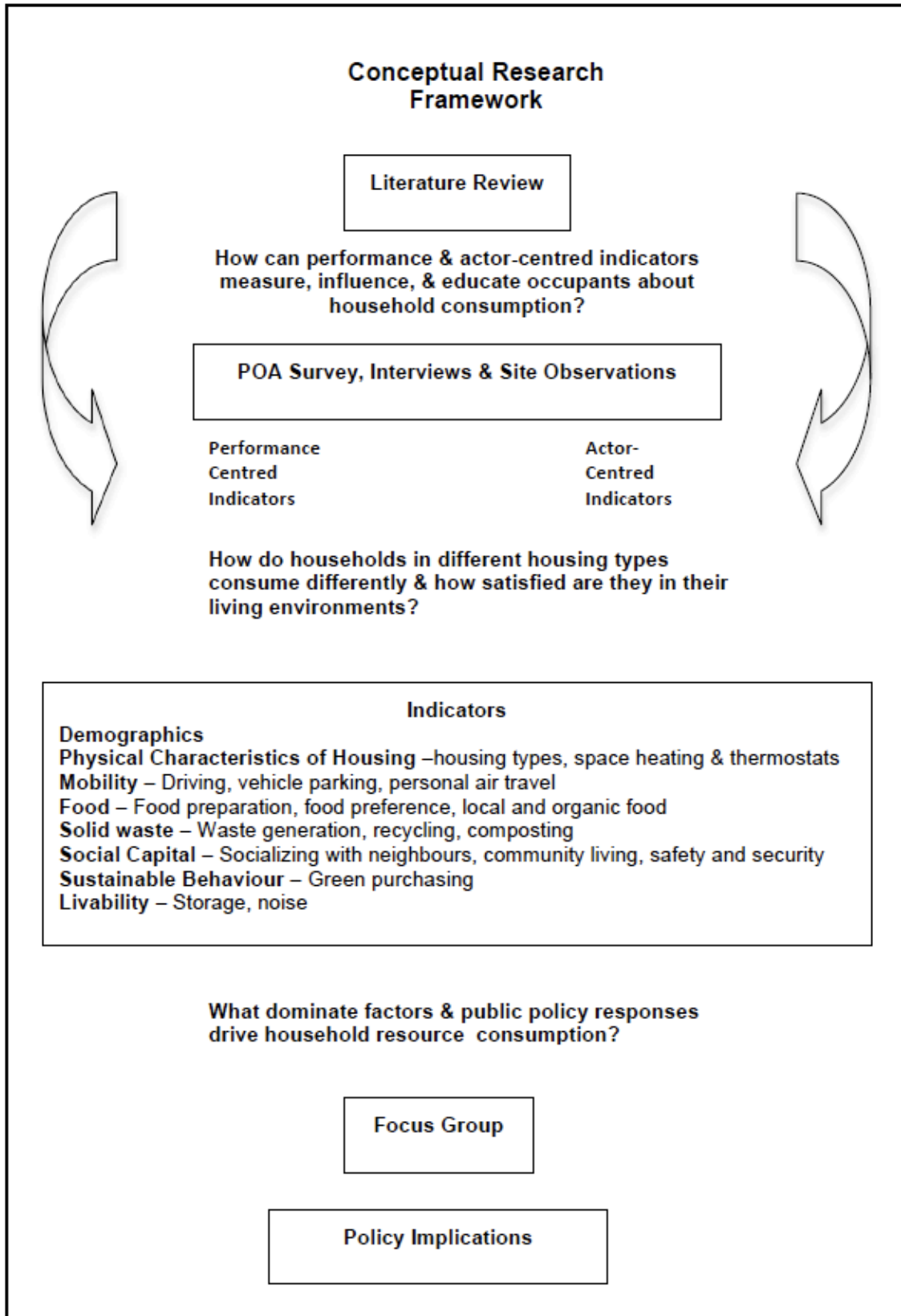
The World Commission on Environment and Development (1987, p. 42) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The conceptual research framework aims to address why sustainable development must first and foremost address consumption impacts.

Lorek, S., & Spangenberg, J. H. (2001). *Environmentally Sustainable Household Consumption: From Aggregate Environmental Pressures to Indicators for Priority Fields of Action* (No. 117). Wuppertal, Germany: Wuppertal Institute for Climate, Environment and Energy, Working Group on New Models of Wealth, 135 and Holden, E. (2004). Ecological Footprints and Sustainable Urban Form. *Journal of Housing and the Built Environment*, 19(1), 91-109.

After reviewing literature that examines the social practices of consumption and rise of a consumer society, I discuss events and policy initiatives that formulate the field of sustainable consumption, including the history and role of green buildings designed to reduce resources and materials and the development of post occupancy evaluation and assessment. I then examine housing as a social practice. Co-housing is one example of an “intentional community” that combines housing design with sustainable living practices.

The conceptual research framework (Figure 1) addresses how households in the three housing types consume differently and how satisfied the occupants are with their living environments. It uses POA techniques to merge performance-centred indicators and what I call actor-centred indicators to better understand, monitor and implement policies to alter household consumption and behaviour. The goal is to redefine and disconnect quality-of-life issues and practices from high-impact lifestyles in order to preserve and enhance security, social connections, environmental quality, health, community values and other communitarian ideals (Tukker, Cohen et al., 2006, pp. 12-13).

Figure 1 Conceptual Research Framework



Performance-centred indicators are quantitative standards of a measurement or rating to assess housing types, mobility, food and solid waste. A performance-centred indicator can be used as a metric to quantitatively assess, control or select a person, process, event or institution to carry out measurements and procedures to interpret an assessment (Theodoridis & Koutroumbas, 2009). Performance indicators help identify household impacts through the use of quantifiable and comparable measurements within key household areas (Korkmaz, Riley et al., 2010). One disadvantage of using performance indicators, however, is using a predefined approach for measuring results rather than adopting participatory approaches to build capacity and expose root causes.

Actor-centred indicators, on the other hand, are qualitative descriptions used for tracking an existing environmental, economic or social condition and may reveal deeper understanding about satisfaction levels, cohesion, action and cause-and-effect relationships. Actor-centred indicators assess the degree of awareness about living situations, routines, behaviour and preferences, enabling new decisions within time, space and contextual boundaries (Hobson, 2003, pp. 103-104). Another reason that actor-centred indicators are important within the analysis of sustainable consumption is that the degree of trust (or lack thereof) and resource-sharing amongst neighbours can influence consumption patterns, increase quality of life and provide clues about how to mobilize households differently (McIntosh Gray et al., 2010; Seyfang, 2010; Gray, Gleeson et al., 2010; Hendrickson & Roseland, 2010).

Relying solely on performance indicators fails to identify root causes of unsustainable states and behaviour, while relying primarily on actor-centred indicators may project an overly subjective approach. Using both indicator types

is preferable in order to monitor household consumption and social practices. I developed these two indicator types as part of my POA survey instrument and qualitative interviews, that are compared and contrasted to arrive at the research findings.

The final stage of the research framework involves a focus group of practitioners to address dominant factors and public-policy responses that drive household resource consumption. Policy implications are organized into roles and responsibilities for sustainable consumption, and four principles of practice guide policy makers toward sustainable consumption. While the findings are preliminary, the use of an interdisciplinary and multi-method approach in this research aims to insert new knowledge about sustainable consumption into a policy agenda for greater awareness, legislation and action.

1.5 Methods and Assumptions

If we are serious about building sustainable communities, it is essential to examine not only how to build buildings and infrastructure that have less impact on the environment but, even more importantly, what other factors can make contributions to reducing levels of material consumption. Thus this study employs a mixed method approach of combining distinct but complementary qualitative and quantitative methodology to assess how occupants of residential buildings collect data on household consumption. Household mail surveys assess how the design of residential multi-unit buildings influences occupant consumption with respect to living space, daily routines and lifestyles. In qualitative interviews with occupants, I explored and audited household consumption levels, attitudes and behaviour.

My own worldview and assumptions appear to be at odds with those of society at large in three major ways. The first is the generally held assumption that “more is better,” which holds that a healthy society is dependent on a growing economy (Durning, 1992; Princen, 2005; Jackson, 2009). We are brought up thinking that we live and behave in a rational economic order by focusing on jobs, the gross domestic product (GDP) and continued growth. My view is that humankind is on a pathway to destruction if we continue to ignore pressing issues such as climate change, biodiversity loss, income disparity and the actions of multinational companies that are accountable only to their shareholders. A major consequence of the “more is better” assumption is that everybody is encouraged to consume more because consumption is what generates economic growth. This is pertinent to households in order to better understand what factors and techniques influence behaviour concerning equipment, appliances and proximity to services to shift consumption patterns (Lovingood, Stamminger et al., 2011).

A second assumption is that nature is a resource to be used primarily for exploitation, what is commonly known as the “domination of nature” thesis (Merchant, 1980; Liess, 1994; Geisinger, 1999). People’s attempts to control the environment have alienated us from being part of the natural world. This mindset creates a dysfunctional and destructive mentality in which planet Earth is viewed as a cornucopia of resources to be used. It is what has made strip mining for coal and clear-cutting of forests standard industrial practice and reinforces the mentality that we are the Earth’s masters. This assumption fails to respect indigenous cultures and beliefs and the essential teachings of most world religions. Within households, occupants may adopt preferential environmental

behaviours in attempts to reconnect with nature, such as to plant a garden or reduce, reuse and recycle, yet evidence suggests that people are more affected by their peers to shift consumption practices than external influences such as government or advertising campaigns (Cialdini & Goldstein, 2004; Noland, Schultz et al., 2008; Goldsmith & Goldsmith, 2011).

The third assumption is that the actual cost of a product is reflected in its established price. When we do not assess the full cost of a commodity, the commodity gets subsidized in ways that often go unnoticed (Daly & Cobb 1989; Daly, 1991; Ekins & Max-Neef, 1992; Myers & Kent, 2001; Fullbrook, 2004). We do not pay the full price for fossil fuel, for example, in terms of the total cost of direct and indirect environmental, economic and social impacts. These actions affect people (particularly poor people) through lost habitat, the exploitation of natural resources, polluted air and water, displacement and ill health (UNDP, 2003; UN, 2010). Households, particularly low-income renters and subsidized housing residents, face disproportionate burdens due to high utility costs, uncomfortable living conditions and a lack of mechanisms to make substantial home upgrades (Pitt, 2007; Brown & Southwell, 2008; Hendricks & Kaufman, 2010).

1.6 Structure of the Dissertation

The dissertation is divided into three parts. Part I introduces an interdisciplinary approach to the field of sustainable consumption and building performance. Chapter 2 defines the social practice of consumption and describes the rise of the consumer society in the twenty-first century. It examines the field of sustainable housing from high performance and green certification systems to

housing as a social practice. In doing so I attempt analytically to unify the current divide between performance-centred studies and actor/ social practice centred studies.

Part II describes methods of inquiry for the research project. Chapter 3 provides a more complete explanation of the methods of inquiry, defines the indicator areas and reviews the procedures for the empirical analysis, including a discussion of its limitations, validity and biases. A residential POA survey mailed to respondents assessed their satisfaction with living space and household consumption behaviour. A multi-regression analysis of the POA survey correlated relationships between residential building classifications, socio-demographic data, living space satisfaction and household consumption levels and behaviours. Interviews and site observations augmented and compared and contrasted the survey data, which were then transcribed, coded and integrated with field note observations to correlate factors comparing household consumption indicators and behaviour.

Part III presents the key findings, analyses and conclusions of the study. Chapter 4 highlights the empirical findings from seven indicator cluster categories. Case sites feature the three categories of residential multi-unit buildings in Metro Vancouver. Members of a public policy focus group commented on a discussion paper to enhance validity, offered practical policy applications and assisted in the dissemination of findings. The concluding chapter presents tentative policy implications derived from the empirical findings and proposes an agenda for future research.

CHAPTER 2: SUSTAINABLE CONSUMPTION

2.1 The Rise of the Consumer Society

Popular thinking and events have influenced building design, urban form and social practices that provide a rationale for humanity's quest for continued economic expansion. At the beginning of the Industrial Revolution in eighteenth century Europe, British manufacturing challenged mercantilist austerity (Leiss, 1976; Mason, 1998; Sagoff, 2001). Free trade evolved as industrialized agriculture depended on divisions of labour moving toward ever-greater specialization (Leiss, 1976; Polanyi, [1944] 2001).

Adam Smith, influenced by Mandeville's *Grumbling Hive* (1705), recognized the importance of prospering economically through consuming. He argued in *The Wealth of Nations* ([1776] 2001) that it was indecent for people of the lowest order to go without (Mason, 1998, p. 9). Smith entrenched consumption's social and economic spheres of influence that promoted sophisticated marketing systems of the day (Mason, 1998). Newspapers and merchant ships advertised common staples that created insatiable desires for more. Any attempt to subdue "keeping up with the Joneses" was abandoned as newly prosperous merchants flexed their spending might. Aristocrats passed laws forbidding *nouveaux riches* from imitating clothing styles, and Italian nobles built lavish palaces inscribing the words "Pro Invidia" (To Be Envied) on their walls (Schor, 1998, p. 8).

An American economist and sociologist, Veblen (1899), introduced the concept of conspicuous consumption and attempted to bring the relationship

between social status and consumption to mainstream attention a century ago. Veblen argued that as choices increase and behaviour intensifies in prosperous societies, attempts to classify solutions were not relevant (Sackrey & Schneider, 2002). Veblen argued consumer behaviour links social status, income and wealth, which are driven by conspicuous consumption and pecuniary emulation (the imitation of peer spending habits for higher social status). Modern culture revolves around social power, though conspicuous leisure and social power is insufficient in itself because material wealth is not necessarily visible (Veblen, 1899).

Veblen's concept of conspicuous consumption was perceived as too trivial in macroeconomics to merit serious analysis since status and prestige incited demand rather than utility. Veblen rubbed against any attempts by neoclassical economists to redefine economics as a "pure" science whose intent was to calculate cardinal utility measurements to explain social phenomena.⁴ Neoclassical economists disregarded Veblen, who did not receive substantial attention until after his death, yet his works inspire research on status effects and private consumption's social positional goods that remain relevant today.⁵

Mass consumerism emerged conspicuously in North America during the 1920s, when productivity grew rapidly, brand names became commonplace, processed and packaged foods gained in popularity, the automobile assumed

⁴ Social phenomena include behaviour that influences or is influenced by organisms sufficiently alive to respond to one another. See Markey, J. (1925-1926). A Redefinition of Social Phenomena: Giving a Basis for Comparative Sociology. *American Journal of Sociology*, 31, 733-743.

⁵ I defer to F. Hirsch and his definition of social positional goods as those products, services, occupations, or other social relationships that are either scarce in an absolute or socially imposed sense, or subject to crowding through more excessive use. For example, executive jobs and desirable neighbourhoods possess high degrees of satisfaction due, in part, to the scarcity and social exclusiveness they hold. See Hirsch, F. (1976). *Social Limits to Growth*. Cambridge, MA: Harvard University Press.

iconic qualities and the middle class burgeoned. Neoclassical economics embraced consumerism, which was entrenched by calls for a labour market and free trade (Polanyi, [1944] 2001 Ch. 12).

The Great Depression may have deferred the rise of mass consumerism, but it re-emerged with a vengeance after the Second World War. Consumption influenced popular culture as market goods grew in quantity and complexity, invoking new emotions with rising consumption levels (Leiss, 1976). Duesenberry revived Veblen's "keeping up with the Joneses" debate, but middle class suburbia now self-identified with the Joneses (Schor, 1999). Consumption became a revolving treadmill, accelerating materially, yet failing to correlate with higher satisfaction and happiness levels (Bell, 2009).

By the 1950s, consumers were spending patriotically in order to expand the economy and keep pace with production although it appeared to serve no other useful purpose (Schor, 1998). Increased consumption accompanied perceived levels of happiness until 1957 when rising prosperity correlated with declining levels of satisfaction (Schor, 1998). The work week declined slightly from 1950 to 1970 in the United States, but increased to 38 hours per week, thus adding a full month of work per year since 1970 (Durning, 1992, p. 113). A significant trend because social levels of consumption were replaced by conspicuous consumption due to lack of time rather than more convenience oriented consumption.

During the 1960's business schools established courses in consumer behaviour as a central area of inquiry, while economic policy promoted a "democratization of consumption," positioning consumption as the key indicator for measuring progress and success (Durning, 1992, pp. 29-30). US President

Eisenhower's chief economic adviser admitted the economy's "ultimate purpose is to produce more consumer goods" (Durning, 1992, p. 30)—a sentiment later echoed by President George W. Bush and New York Mayor Rudolph Giuliani, urging people to go out and shop after the 9/11 World Trade Centre bombings (Carlson, 2001).

Problems associated with expanding choices in the marketplace include inadequate knowledge about commodities, psychological damage from product usage (e.g. children watching excessive hours of television), time pressure from a rushed lifestyle and a blurred distinction between needs and wants. Basic human needs are categorized into biological and cultural components, but are seldom practical in everyday middle-class lifestyles where we are encouraged to align needs with product availability. A hierarchy of relative priorities (e.g., Maslow's hierarchy of needs and Max-Neef's categorization of needs, wants, and satisfiers) ranks commodities with conflicting images of self-esteem, social pressures, and advertising (Maslow, 1968; Ekins & Max-Neef, 1992).

The rise of consumption reveals a consumer- oriented society where material commodities play important symbolic roles with vital social functions. Consumer motivations are embedded in a variety of daily routines and constrained by institutional contexts. People consume to satisfy desires, express themselves or simply because of an insatiable urge to consume (Jackson, 2004; O'Riordan, 2006). Nevertheless, we are prone to view consumption as a normal function of modern society, particularly within the modern array of conveniences found in the home.

With consumption processes entrenched in unsustainable patterns, fortified by social norms and institutional constraints, consumers face isolation

(Jackson, 2004, p. 10). Marketers urge us to travel further, drive faster, build bigger and buy more, yet their messages are rarely found offensive. The media, driven by advertising, are biased towards pitting the consumer economy against nature (Monbiot, 2000).

2.2 The Social Practice of Consumption

Sustainable consumption can be separated into two theoretical dimensions that differentiate the “social practice” of sustainable consumption from the “science of sustainable consumption.” Social practice is used more in a behavioural sense than a technical one (Georg, 1999; Hobson, 2004; Seyfang, 2004; Fuchs & Lorek, 2005; Jackson, 2006; Nye & Hargreaves, 2010; Brand, 2010), emphasizing the notion of equity, health and environmental impacts resulting from the amount of resources Northern affluent communities consume and the pattern in which these resources are consumed. For example, technical solutions exist to replace fossil fuel with renewable energy, but are not readily used due to economic signals that subsidize petroleum and organizational barriers to change institutional culture and behaviour.

The “science of sustainable consumption,” on the other hand, pertains to the technical analysis of material provisioning that draws on ecosystem services, and examines elements of consumption and production (Myers, 2000; Arrow, Dasgupta et al., 2004; Daly, Czech et al., 2007; Ehrlich & Goulder, 2007). The industrial ecology of consumption falls within a sub-section that examines “how specific consumption patterns give rise to specific impacts” (Hertwich, 2005, p. 3).

Within the social practices of sustainable consumption, ordinary household practices are often governed by external forces beyond the control of individual choice (Gronow & Warde, 2001; Warde, 2002). Routine and repetitive behaviours within the household have been emphasized rather than how conscious decision-making about purchases are made (Gronow & Warde, 2001). This has resulted in the most environmentally problematic aspects of consumption extending beyond the scope of sociological interventions to mitigate resource consumption within lifestyles (Shove & Warde, 2001).

Shove (2003) has pioneered research within household social practice, household comfort levels in low-carbon societies (Shove, Chappelles et al., 2008), and how modern conveniences and appliances are designed in everyday life (Shove & Watson 2007). Her research emphasis is concerned with moral and cultural implications of household consumption, noting how notions of comfort, cleanliness and convenience are translated into actual behaviours developed from the use of ordinary appliances such as air conditioners, bathtubs and showers and cook stoves (Shove, 2003). Within Shove's theoretical framework, technology-related dynamics of changes in social practices are phenomena that work both in top-down (vertical) dimensions and bottom-up (horizontal) dimensions (Shove, 2003; Spaargaren, 2006). The installation of air conditioning in residential units by developers, for example, is a top-down operation, while daily showering habits from household members constitute bottom-up initiatives. Comfort, cleanliness and convenience form leverage points within the context of the built environment that connect ecological impacts on individuals to social practice.

Another stream of the social practice of consumption is Spaargaren's

social practice framework (2003) that focuses on actual behavioural practices rather than individual attitudes or norms. He uses social practice innovations, such as solar panels or greening food purchases as units of analysis to connect lifestyles to everyday consumption practices. His social practices model attempts to establish sets of environmental heuristics for policy making. He goes on to identify actual and potential “routines for innovation” within social practices, to differentiate lifestyle groups that emerge from the symbolized use of environmental innovations and to identify roles for governmental and non-governmental actors in policy making.

Social practices of consumption have also focused on energy consumption and conservation within the housing sector. Guy and Shove (2007), for example, present case studies pertaining to insulation, energy efficiency standards and office buildings to develop a social practice lens for analyzing science and technology that challenge common assumptions about energy policy.

Cohen et al. (2010), have fortified inquiries into social practices of consumption through discussing interactions between technology and daily behaviours as a response to technological innovations (also see Evans & Abrahamse, 2009; Røpke, 2009). Cohen et al. (2010) challenge the emerging field of social practices to form more complex system perspectives that identify economic and political drivers of consumption to deepen knowledge about how consumption patterns evolve in modern, technological societies. They challenge scholars to expose the role that policy interventions, social movements, market actors and small-scale cases can influence intensive resource consumption (Cohen, Brown et al., 2010).

I cast the social practice of consumption in a broader frame than Shove (2003) and others (Spaargaren, 2003; Guy & Shove, 2007; Shove & Watson, 2007; Shove, Chappells et al., 2008). My approach is more closely aligned with Cohen et al., (2010) that highlights necessary behavioural responses that interact with planning applications and technological innovations in the built environment. I use the social practice of consumption in a general sense of behavioural and planning research that is applied to households and the urban form coupled with assessment methods and public policies. Lower consumptive behaviour of occupants is often ignored within current studies of household dynamics. For example, occupants may diligently dispose of containers in recycling bins exemplifying sustainable behaviour, but then board an airline for a weekend getaway. These routine decisions are not surprising given the mixed signals our political leaders promote and our own ambivalence. On one hand they profess concern about climate change, but at the same time laud acolytes of consumerism and exponential economic growth (Jackson, 2009; Brand, 2010). Households currently lack the information, infrastructure, convenience, norms and laws to reduce resource-intensive impacts. Hidden forms of consumption, such as housing, mobility and food purchasing choices formulate household routines that have significant resource-intensive impacts, yet lack broader leverage points (Sanne, 2002; Southerton, Chappells et al., 2004, Cohen, Brown et al., 2010). The development of social practices for consumption requires embarking on a planning process to link the physical and technological characteristics of the home to the social and cultural aspects of everyday living.

2.3 The Problematics of Consumption

Consumption's definitional semantics also complicate notions of sustainable development. The term "sustainability" is often used interchangeably with "sustainable development," particularly within a North American context. Nevertheless, some writers clearly distinguish between the two: Scott and Gough (2003, p. xii), for example, explain sustainability as a goal, while sustainable development is a process through which humanity needs to live more in tune with the environment. Porritt (2005, p. 27), describes sustainability as a destination, or the point at which we can claim to live within finite biophysical parameters, while sustainable development is the process or journey taken to reach the destination. Sustainable development as a term gained prominence from the report of the World Commission on Environment and Development in 1987, commonly known as the Brundtland Report, and has been widely contested ever since. Nevertheless, as Robinson (2004) and Roseland (2005) point out, justice, democracy and beauty are also contested terms but are nevertheless legitimate and useful descriptions of common ideals .

A plethora of meanings and images surrounding consumption also leads to confusion and perturbation (Woollard & Ostry, 2000). The Oxford English Dictionary describes consumption as: "the action or fact of consuming or destroying [1], decay, wasting away or wearing out [3]; wasting of the body by disease [4a]; the using up of material, the use of anything as food, or for the support of any process [6a]; the destructive employment or utilization of the products of industry [7]; and the amount of industrial products consumed [7b]" (Oxford University Press, 1989). Synonyms for consumption are burning, consuming, damage, decay, decrease, depletion, desolation, devastation,

diminution, dispersion, dissipation, drinking, eating, exhaustion, expenditure, loss, misuse, ruin, swallowing, utilization and waste (Thesaurus.com, 2010).

Distinguishing “consumption” from “use” is equally perplexing. Wilk (2004, p. 19), queries whether a car is consumed when driven or only when left abandoned, whether investing in mutual funds constitutes consumption, whether something is consumed when borrowed or lent, and if recycling is a form of consumption when waste is reconstituted into a useful product or only when utilized in a closed-loop process. Others, such as Sagoff (2001), point out that current policy priorities should first target wastefulness rather than excess.

The concept of *sustainable consumption* has evolved over the years in various academic disciplines focusing primarily on research around production and more recently on consumption. For example, biologist Norman Myers (1997) related consumption to the environment as “human transformations of material and energy,” yet failed to move consumption initiatives into public policy (Murphy & Cohen, 2001, p. 6). Social sciences tend, on the other hand, to examine consumption from a viewpoint of dematerialization, advertising and consumerism and how and why people purchase commodities, rather than link resource consumption to planetary limits (Jackson, 2009).

Private consumption is defined by national income accounts, a narrow measure encompassing priced goods and services to quantify standards of living. In economics, consumption is perceived as a theory of demand, equivalent to individual cost-minimizing behaviour, or utility with fixed commodity prices. The consumer is presented as a self-employed firm choosing preferences based on price and income constraints. This neoclassical economic outlook is vastly different from an ecological economic perspective that adopts the goal of

sustainable development as the primary basis for making decisions about natural resources and the environment (Freeman III, 2001). The economy is treated as a subsystem of the ecosystem with an emphasis on preserving the land, air, water and living organisms to more accurately value natural capital and link these values to economic policy options.

The field of neoclassical economics also extends the meanings of consumption to encompass goods and services for the gratification and well-being of human desires as each individual is assumed best suited to judge satisfaction in a given situation (Hawken, 2007, p. 248). The dominant economic outlook devotes extensive literature to consumer theory and estimating demand curves but fails to connect consumption patterns to social and environmental issues (Conca, Princen et al., 2001). Consumption spans the full range of goods and services contributing to human well-being, not only with items produced by households or purchased in the marketplace but with amenities and intrinsic ecological values (Myers, 1997).

Other social sciences have until recently neglected the social study of consumption practice when compared to the study of production (Miller, 1995b, p. 1). Psychology is concerned with consumption through areas such as product marketing and materialism. Sociology and geography have linked the social practice of consumption to post-Fordism, where mass markets become saturated and producers respond to new market niches (Cloke, Philo et al., 2005; Whitehead, 2007; Bell, 2009;).

Hobson (2004) argues that sustainable consumption is defined by three of sustainability's three facets: environment, economy and society. Social

sustainability highlights gross inequities that link sustainable consumption to social justice and community mobilization. Economic growth advocates stress continued or increased consumption practices through improving resource efficiencies and “greening” business by adopting win-win outcomes with tools like consumer labelling, ISO 14001 or the Action at Work Program of the UK’s Global Action Plan (Gershon & Gilman, 1991).

Cohen, Comrov et al., (2005) discussed sustainable consumption activities within a North American context through social and political protest, lifestyle groups and public policy initiatives. They determined that efforts to treat consumerism problematically did not result from environmental concerns, but are influenced by issues of working hours, leisure time and family life.

While academic fields debate conceptual qualities of consumption, international gatherings and events have highlighted the field of “sustainable consumption” over the past 40 years. Consumption discourse started gaining momentum in the 1970s when concepts of sustainable development began to germinate. Global population and increasing amounts of natural resources heightened environmental degradation levels (Meadows, Meadows et al., 1972). Affluent nations avoided confronting how domestic consumption practices were deteriorating the global common good by placing the blame on population growth (Cohen & Murphy, 2001; Cohen, 2005; 2010). Consumption nonetheless failed to capture the world’s attention in 1972 at the UN Conference in Stockholm. The politically precarious agenda item was considered too sensitive and pessimistic in light of highly touted green technologies. New environmental management strategies were launched onto the world stage with pomp and

circumstance, embodied with promises for incremental change from within (Cohen, 2005).

The Brundtland Report in 1987 outlined how less industrialized nations were expected to follow a similar economic trajectory toward prosperity as Northern nations. The report highlighted the destructive process that Northern nations had embarked upon, marking an unprecedented shift in international policy by distinguishing between needs and desires (Brundtland, 1987). It failed, however, to provide an analysis of inequality or address the systemic causes of poverty, remaining silent on whether projected and ongoing economic growth for future generations was biophysically possible. Brundtland failed to address exponential economic growth rate increases and potential rebound effects, as resource consumption levels continued to increase despite improvements in technology (Wackernagel & Rees, 1996).

The 1992 Rio Summit produced Agenda 21, the main policy document and action plan for global, national and local sustainable development plans for the 21st Century. Principle 8 of the Rio Declaration on Environment and Development highlighted the need to “reduce and eliminate unsustainable patterns of production and consumption” (UN, 1992; Cohen, 2005; 2010; Barber, 2005) and galvanized support for sustainable development in Agenda 21 (Thorpe, 2010). After extended deliberation, Chapter 4 of Agenda 21 identified unsustainable production and consumption patterns, particularly in Northern industrialized countries, as the primary cause of global environmental deterioration (UN 1992: para 4.3; Cohen 2005; 2010; Barber, 2005; 2007; 2010).

While Chapter 4 elaborated on reducing environmental degradation to meet basic needs of the poor, a close reading implies the need to rethink unlimited economic growth policies and to craft new definitions for prosperity (Barber, 2005; 2010). The document instructs industrialized countries to assume new roles and responsibilities in the development of national level sustainable consumption strategies and policies while encouraging and assisting less industrialized nations to adopt greener technologies and new values associated with consumerism (UNDESA, 1992; Barber, 2005; 2007; 2010).⁶ While a mandate to form national-level sustainable consumption policies now exists, national governments continue to exhibit a reluctance to regulate consumption's various flows (Cohen, 2010).

The Rio Summit marked the first time that targeting consumption patterns appeared in multilateral negotiations (Barber, 2005; 2010), which also targeted discussions of institutional actors such as the OECD, independent researchers and other bodies (Stern, Dietz et al., 1997; Cohen & Murphy, 2001; Conca, Princen et al., 2001; Cohen, 2010). A key corollary from Agenda 21 was a working group led by Nordic countries to reach consensus on sustainable consumption strategies (Nordic Council of Ministers 1995; OECD 1997a; Cohen, 2010). The working group got sidetracked by production-oriented responses, and green technologies (industrial ecologists, pollution prevention, sustainable manufacturing, etc.) assumed centre stage, confining sustainable consumption

⁶ Specific recommendations include new and renewable energy sources (4.18d); pre- and post-recycling (4.19b); reducing product packaging (4.19b); expanding environmental labeling and product information (4.21); providing information on the consequences of consumption choices and behaviour (4.22a); legislating and labeling health and environmental impacts of products (4.22b); improving government procurement policies (4.23); using economic instruments to influence consumer behaviour (4.25); promoting sustainable consumption education and public awareness programs (4.26) (see Local Agenda 21, Chapter 4 in UNCSD, 1992 and Barber, 2005).

initiatives to voluntary green-product labelling schemes, such as the eco-label Nordic Blue Swan (OECD, 1997b; Cohen, 2005).⁷ Eco-efficiency, clean production, and other environmental impact measures consummated the role of eco-efficiency down a business as usual, albeit slightly greener path, toward economic prosperity (OECD-MIT 1994; Ropke & Reisch, 2004). Critiques about population-growth quandaries, particularly in developing countries, were linked to Northern industrialized nations' appetite for consumerism, yet remained silent on the role and impact of advertising (UNGA, 1997; UNEP, 2002c; Barber, 2010).⁸

The OECD and World Business Council of Sustainable Development (WBCSD) began development of sustainable consumption and production into a work program in the mid-1990s (OECD-MIT, 1994, Clark, 2007), but they continue to rely on supply-oriented orientations (OECD, 1998; Cohen, 2005). While the United States opposed the initiative, Southern countries weighed in, armed with graphs and statistics showing how their Northern counterparts generated the lion's share of greenhouse gas emissions (Cohen, 2005). Concurrently, civil society formed a global coalition based on principles of revalue, restructure, redistribution, reduction, reuse, and recycle that culminated with the "Treaty on Consumption and Lifestyle" (Barber & Luskin, 2009).

⁷ The Nordic Blue Swan was an eco-labelling scheme introduced by Norway and Sweden in 1989 that other Scandinavian countries have since adopted. The labeling scheme helps consumers make environmentally friendlier choices and encourages manufacturers to develop products with greater environmental sensitivities (see OECD, 1997b). The Blue Swan label is available for 50 product groups including dishwasher soap and furniture (see Intelligent Energy, 2006).

⁸ The UNEP is one international agency engaged in voluntary sustainable consumption initiatives with marketing and public relations agencies such as the European Association of Communication Agencies, the World Federation of Advertisers, and the World Association of Opinion and Marketing Research Professionals (see Cohen, 2005, p. 4.).

The UNEP with assistance from an OECD research program initiated development of the Marrakech Process during the mid-1990s, a process forming a ten-year framework of programs on sustainable consumption and production that was launched in anticipation of the Johannesburg Summit (OECD, 2002a; 2002b; 2002c; 2002d; Clark, 2007). The Marrakech Process has included global and regional meetings by task forces of consumption and production experts (UN, 1998; 2010; UNCSD, 1996; 1997a; 1997b; 1998a; 1998b; 1999; 2001; 2002; UNDP, 1998; UNEP, 2001; 2002a; 2002b; 2002c; 2002d; UNGA, 1997; 2001; Worldwatch Institute, 2002; WSSD, 2002; Clark, 2007; Barber 2010; Cohen 2010).

The Marrakech Process elevated the status and development of the field and assisted the development of national sustainable consumption and production (SCP) plans in countries such as Germany, Finland and the United Kingdom (Clark, 2007; OECD, 2007; 2008a; 2008b). Infrastructure Canada's Office of Consumer Affairs established an SCP initiative in 2009 and participated in the North American SCP consultations in November 2008, in Washington, DC and Ottawa, ON in February 2011 (One Earth, 2011). Nevertheless, while evidence of initiatives evolve in North America (Cohen, Comrov et al., 2005), sustainable consumption remains virtually ignored by local government authorities, a distant blip on most municipal radar screens (Hendrickson, 2010). In a similar way that sustainable development has assumed tangible meaning at the local level (e.g., Local Agenda 21), opportunities exist to articulate sustainable consumption policies in local community plans, policies and strategic outcomes (Cohen, Comrov et al., 2005. Hendrickson, 2010; Berg, 2011). Attempts have also been made to identify key groups, networks, industry associations and

nonprofits engaged in advancing sustainable consumption and production in North America (Prinet, 2011).

2.4 Building Sustainable Housing

Within the field of sustainable consumption, housing is of primary importance due to its impact on material consumption. Some researchers are interested in variations of patterns and volumes of consumption between various living situations (Hoyer & Holden, 2001; Spangenberg & Lorek, 2002), while others are interested in how sustainable consumption relates to low-carbon housing (Holden & Norland, 2005; Jensen & Gram-Hanssen, 2008; Seyfang, 2010), or energy consumption and green buildings (Newsham, Mancini et al., 2009; Chwiedu, 2010).

Historically, building regulations in many countries are inconsistently applied and prescriptive, impede innovation and limit the adaptation of new technologies. Building regulatory systems are enacted to protect the public and are run by various levels of government. Successful reforms often coincide with political and economic conditions contingent upon broader regulatory changes in government. For example, the Nordic Committee on Regulations (NKB) established a program to coordinate building regulations for Denmark, Finland, Iceland, Norway and Sweden in 1963. Reforms in the UK commenced in the 1960s but were not enacted until 1983 (Oleszkiewicz, 1994).

In Canada, regulating energy consumption and building performance commenced with the 1941 National Building Code. The National Building Code is a “model” building code that forms the basis for provincial building codes

with authority to create codes or supplement laws and regulations.⁹ Since 1960, revisions to the National Building Code have occurred about every five years. The first performance-based building code was established in 2005.¹⁰

The agency responsible for housing is the Canada Mortgage and Housing Corporation (CMHC). Founded after World War II, CMHC responded to a housing shortage by offering low-cost mortgages to returning soldiers.¹¹ In the 1970s, CMHC's mandate shifted to housing affordability, but the crown corporation only started to concentrate on energy efficiency and resource conservation in the 1990s. In part, this may have been due to a building science and trade bias to focus on specific equipment or construction costs, rather than lifecycle assessments or integrated building operational systems (Reinhard, 2003; Lutzendorf & Lorenz, 2006; Retzlaff, 2008).

Community design principles to encourage smart growth and compact neighbourhoods that emphasized resource-consumption practices commenced in North America during the 1990s (Calthorpe, Katz et al., 1991; Bothwell, Gindroz et al., 1998; Duany & Plater-Zyberk, 1998; Downs, 2005; Calthorpe, 2010). Smart growth is an urban planning theory that concentrates growth in compact, walkable urban centres that are not as dependent on single occupancy vehicles. Smart Growth rose out of the New Urbanism movement (Calthorpe, Katz et al.,

⁹ The law also applies to municipalities, yet Vancouver is thus far the only Canadian municipality to enact its own building codes.

¹⁰ Complementing building code updates was Ottawa's Institute for Research in Construction, which published a series of technical reports dealing with moisture, air leakage, thermal loss, and durability (see Leslie, 2008).

¹¹ In 1954, the federal government changed the National Housing Act by removing direct mortgage financing of private housing projects from federal responsibilities to private banks. Throughout the 1950s and 1960s, CMHC's mandate was to approve and manage urban renewal projects. Its current mandate is to provide insurance for residential mortgage loans. See CMHC. (2011). History of CMHC. Retrieved February 1, 2011 from <http://www.cmhc-schl.gc.ca/en/corp/about/hi/index.cfm>.

1991; Calthorpe, 2010), which promotes neighbourhoods that contain a range of housing and job types.

From a housing perspective, resource consumption was critiqued from consumerist designs (Whiteley, 1993), eco-design (Van der Ryn & Cowan, 1996; Brezet & van Hemal, 1997; Gertsakis, Lewis et al., 1997), by-product lifecycle approaches (Nissinen, Grönroos et al., 2007; Jones, Kammen & et al., 2008) and more recently toxin and health issues (Wargo, 2010). Nonetheless, building design innovations and policies continued to maintain a focus on less resource-intensive production, rather than integrate household-lifestyle patterns (Thorpe, 2010). High performance certification systems have led to expert-focused technologically oriented consultations, yet this excludes workers and occupants from playing a role in monitoring consumption of their building (Bordass, Leaman et al., 2002; Spinks, 2011).

On the other hand, housing as a social practice started to involve occupants in feedback mechanisms that looked for ways to organize households in varying configurations. These developments first started as a way to build community, yet are evolving towards ways to minimize resources through sharing personal possessions and converting consumer activities and commodities to returnable products and services (Mont, 2004; Eriksson, 2009, Botsman & Rogers, 2010, Gansky, 2010; Lietaert, 2010). This evolution as related to sustainable housing can be categorized in two divergent streams: the development of high performance buildings and housing as a social practice.

2.4.1 Building Performance

The history of green building rating systems first started in the UK by the Building Research Establishment (BRE), a British government-funded research laboratory. It established a voluntary measurement rating system for green buildings, BRE Environmental Assessment Method (BREEAM), which evolved into various entities internationally including LEED in North America, Green Star in Australia and the Haute Qualité Environnementale (HQE) in France.

While BREEAM was initiated in Canada after a conference at the University of British Columbia in 1989, it is better known in Europe than North America.¹² The United States saw the formation of green building performance and certification in the 1990s with the establishment of the United States Green Building Council (USGBC), which developed the LEED rating system in 1998 to evaluate a building's resource efficiency and environmental impact in attempts to remove ambiguity in building terminology associated with sustainable design and green building ratings (Kibert, 2007). LEED has gained prominence in the United States and throughout the world. The Canada Green Building Council (CaGBC) was created in 2003 and an increasing number of municipalities in BC, including Vancouver, require LEED standards or equivalent for all new developments.

The USGBC and CaGBC have or are developing LEED third-party rating systems for various building types.¹³ Certification is based on a total point score

¹² BREEAM helped usher in other building certification programs and tools used in North America including the Green Building Challenge, GBTool, C-2000 Program for Advanced Commercial Buildings, GreenGlobes, Building Owners and Managers Association (BOMA) Go Green, and LEED (see Leslie, 2008).

¹³ LEED has undergone several iterations in its short existence with a suite of certification systems for buildings including LEED-Existing Buildings (LEED-EB), LEED Core and Shell (LEED-CS), and LEED for Commercial Interiors (LEED-CI), LEED for Homes, LEED for Neighbourhood

achieved, following an independent review and an audit of selected credits. There are four levels of possible certification (certified, silver, gold and platinum). The Canadian rating systems are an adaptation from those of the US Green Building Council (USGBC) that are tailored to Canadian climates, construction practices and regulations. Green buildings, such as certified by LEED, are proving to add value to real estate (Kats, 2003; RICS, 2005), yet require ongoing monitoring (Issa & Rankin, 2010). One study determined green buildings cost 2.5% more on average than conventional buildings, but half of the buildings recouped these costs within five years or less through utility cost savings (Kats, 2008).¹⁴

The LEED- NC (New Construction) certification program recognizes performance in six areas of prerequisites and credits: sustainable site development, water efficiency, energy efficiency, materials selection, indoor environmental quality, construction, innovation and design process expertise. By 2010, 3,448 buildings received LEED-NC certification in the US (USGBC, 2010) as did 217 buildings in Canada (CaGBC, 2011).

LEED has established a growing number of national building councils in just a few years and continues to update iterations of certification requirements through public consultations. Nevertheless, flaws exist with the market-based certification system. Some refer to LEED as an “addendum to the building code”

Development (LEED-ND), LEED for HealthCare, Schools, LEED for Retail and LEED for Laboratories (forth-coming).

¹⁴ Kats analysed 150 buildings in 33 US states and ten countries built from 1999-2008 and estimated that the present value of 20 years of energy savings in a conventional green office building ranged from \$7-\$14/sq ft per year more compared to a green office building that averaged \$3-\$8/sq ft. He also reported that green buildings created domestic energy efficiency, construction and renewable energy employment opportunities. A typical green office created one-third of a permanent job per year, or \$1/sq ft of value in increased employment compared to a similar non-green building (see Kats, 2008).

that lacks evidence-based results, uses an inflexible weighting system for energy and resource consumption and subscribes to a “level of gamesmanship” to attain desired certifications (Kilbert, 2007, p. 3; Bauer, Möslle et al., 2010; Korkmaz, Riley et al., 2010, Wargo, 2010). Others voice concerns about high accreditation fees along with equipment and building performance inconsistencies and geographical discrepancies (Newshaw, Mancini et al., 2009; Scofield, 2009; Retzlaff, 2009; Landers, 2009).

LEED tends to follow other building assessment systems that focus on environmental issues rather than social concerns such as affordable housing, public amenities, education or equity issues (Pitt, 2007; Retzlaff, 2008).

Environmental issues tend to be measured through performance-based results, yet criteria are broadening (Cooper, 1997; 1999; Todd, Crawley et al., 2001; Cole, 2005; 2010; Kaatz, Root et al., 2005; Hoes, Loomas et al., 2009) as building design and density issues are connected to socio-economic patterns of the urban form (Norris, 2006; Retzlaff, 2008; Hoffman & Henn, 2008; Jorgensen, Finkbeiner et al., 2010; Sahakian, & Steinberger, 2011).

An assessment system related to LEED, but used locally at the University of British Columbia (UBC) is the Residential Environmental Assessment Program (REAP). UBC developed its own REAP in 2005 (Cole, 2005; Retzlaff, 2008), a voluntary certification standard based on the LEED rating system to encourage and measure green building practices for market-based residential dwellings, since no comparable rating system then existed, particularly for four-story, wood-framed buildings. Each REAP project is assessed in seven areas of environmental impact: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality,

construction, innovation and design process.¹⁵ REAP includes more mandatory credits in environmental categories than LEED, except in the materials and resources category where there are no required credits and 27 optional credits.¹⁶ REAP certification generally exceeds performance requirements when compared to LEED certification. (see Table 1). No post-occupancy evaluations are routinely performed or required on REAP certified buildings.

Table 1 Comparison of LEED and REAP Certification Systems¹⁷

System	Distribution of Mandatory Credits	# of Total Mandatory Credits	% of Total Mandatory Credits
LEED	Sustainable Sites - 1 Water Efficiency - 0 Energy + Atmosphere - 3 Materials + Resources - 1 Indoor Environmental Quality - 2 Construction - 0 Innovation + Design Process - 0	7	10

¹⁵ In 2006, REAP 2.0 was released and updated in 2009 to increase energy and water efficiency requirements. Developers submit a completed checklist and supporting documentation that is verified for compliance by UBC staff. Developers must comply with mandatory credits and earn sufficient optional credits to achieve one of five performance levels: basic compliance, bronze, silver, gold, and platinum. REAP was piloted in nine residential projects in 2005 and version 2.0 was released in 2006. REAP 2.0 is mandatory for all residential construction on UBC's Vancouver campus. In 2009, UBC released REAP 2.1 after changes were made to energy and water efficiency requirements in the BC Building Code.

¹⁶ To receive optional REAP credits within the material and resources category, reused building materials must encompass 5% of total building costs (two credits) or 10% of total building costs (three credits) and 20% of the material costs must be locally manufactured building materials and products that are assembled or manufactured within a radius of 800 km (two credits). Of the locally manufactured materials, 50% must be locally harvested, extracted or salvaged, such as rapidly renewable flooring (i.e. bamboo) or hardwood flooring certified by the Forest Stewardship Council (FSC) or the Sustainable Forestry Initiative (SFI). Recycled-content materials specify and use building materials with the following recycled content levels (one point per recycled material, with a bonus 10th point for including all nine materials): common area carpet with a minimum 25% recycled content; dimensional wall lumber with a minimum 75% recycled content; drywall with a minimum 15% recycled content; batt insulation with a minimum 40% recycled content; doors must contain a minimum of 15% recycled material; concrete with a minimum of 20% fly ash content, excluding suspended slabs; concrete with a minimum of 40% fly ash content, excluding suspended slabs; cabinetry with a minimum 20% recycled content; medium-density fiberboard (MDF) products with a minimum of 50% recycled content. See UBC Sustainability. (2009, July). Residential Environmental Assessment Program (REAP), Version 2.1 Reference Guide.

¹⁷ Adapted from Baines, T., Aloisio, A., (2009). UTown@UBC: A Community of Green Homes. University of British Columbia, Campus and Community Planning. Retrieved February 1, 2011, from www.planning.ubc.ca/smallbox4/file.php?sb4adcefe70de9a p. 4.

REAP	Sustainable Sites - 5 Water Efficiency - 3 Energy + Atmosphere - 11 Materials + Resources - 0 Indoor Environmental Quality - 4 Construction - 6 Innovation + Design Process - 1	30	33
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2.4.2 Social Practices in Housing

One aspect of social practice in housing related to building performance merits particular consideration, the rise of intentional communities. The social practice of housing is concerned with governance practices to mitigate household consumption through occupants' behaviours, lifestyles and satisfaction levels. Before the green building movement was established, multi-generational rural homesteads transformed into nuclear families living in single-family suburban dwellings (Leafe, 2003). "Intentional communities," also referred to as communes, eco-villages, housing cooperatives, residential land trusts, student co-ops, monasteries, kibbutzim, spiritual communities and co-housing developments catapulted into greater prominence in the late 1960s.¹⁸ An intentional community is a group of people who have chosen to live together or live in close geographical proximity with a common purpose to create a lifestyle that reflects shared core values (Kozeny, 1996). Intentional communities grew out of the cooperative community movement (Morgan, 1943) and 3,000-4,000 currently reside in North America (Marriage and Family Encyclopedia, 2011)

¹⁸ Intentional communities with official associations include Fellowship for Intentional Community (www.ic.org); The Cohousing Network (www.cohousing.org); Ecovillage Network of the Americas (www.ena.ecovillage.org) and the Northwest Intentional Communities Association (www.ic.org/NICA).

Co-housing is an example of an intentional community that combines strong social networks with potential to lower environmental impact (McCamant & Durrett, 1994; Williams, 2003; 2005a; 2005b; Meltzer, 2005; Mulder, Contanza et al., 2006). Co-housing members usually have their own private living quarters, but share common space and often some social activities and meals. The community is not dependent on any one person, there is not a primary income source for residents, and there is no shared communal economy (McCamant & Durrett, 1994). The model is based on strata ownership and is more prevalent in Denmark than in North America.

Co-housing principles include:

1. Residents participate in the planning and design of the development in the community so that it directly responds to their needs.
2. The physical design encourages a sense of community as well as maintaining the option for privacy.
3. Each household owns a private residence with a kitchen, but shares common facilities with the larger group. Common facilities are designed for daily use; they are an integral part of the community and typically include a dining area, sitting area, children's play room, guest room, garden, and other amenities.
4. After move-in the residents, rather than a professional property manager, manage the site.

Poley and Stephenson (2007), Meltzer (2005), Williams (2003; 2005a; 2005b), Marcus and Dovey (1991) and Fromm (1991) document how co-housing promotes strong social networks and economies of scale by sharing some common space, goods, and services. Williams (2003) reports co-housing households in the United States reduce consumption of space by 31%, electricity by 57%, and goods and services by 8%, compared to buildings in which occupants previously lived. Meltzer (2005) found a reduction in the ownership of cars, freezers and gardening and repair tools through pooling some resources, compared to where occupants had previously lived. Residents also reduced ownership of washing machines, tumble driers and freezers by 25% once residents moved into co-housing, where many residents made use of common laundry and kitchen facilities.

Co-housing developments may offer higher levels of social cohesion among neighbours and promote more sustainable behaviour to reduce consumption levels (Cohen & Morris, 2005; Kennedy, 2005; Williams, 2005a, 2005b; Mulder, Contanza et al., 2006; Florida-Central, 2008; Eriksson, 2009; Genser, 2010; Lietart, 2010). Additional investigation is needed to examine how social cohesion and resource sharing can alter consumption levels (Ferrante-Roseberry, 2002/2003; Williams, 2005b; Meltzer, 2005; Renz, 2006a; 2006b; Poley & Stephenson, 2007). Besides the potential for reducing consumption, co-housing can enhance reciprocity and community building and, when built near existing municipal services, fortify transportation efficiencies and augment utility infrastructure (West Coast Environmental Law, 2002; Choi, 2004; Gold 2005; Lakeman, 2008).

Recent studies bemoan a lack of sufficient data about linkages between social practice and performance indicators related to household consumption (Stiglitz, Sen et al., 2009; Hoes, Hensen, et al., 2009; Stevenson & Leaman, 2010; Stevenson & Rijal, 2010; Schrader & Thøgersen, 2011). Households affect the environment through routine decisions about their need for goods and services, decisions on where to live and work, what kind of dwelling to live in, how to manage waste, and where to go on vacation (Hoyer & Holden, 2001; Christensen, Godskesen et al., 2007; Tukker, Cohen et al., 2010). Impacts are set to grow in the next generation when measured in absolute levels of the volume of goods and services consumed and discarded (Gram-Hanssen, 2008; Jensen, 2008; Tukker, Cohen et al., 2010).

2.5 Post Occupancy Evaluation and Post Occupancy Assessment

POE originated from environmental psychology during the 1960s with reference to mental hospitals and prisons that were seeking to resolve four questions: How is the physical building performing? Is the performance intended? How can it be improved? And how can future building design be improved (Sommer, 1981)? The prominence of POE increased in the 1980s, particularly in response to the “sick building syndrome.”¹⁹

POE employs the physical monitoring of buildings and the use of occupancy satisfaction surveys, but rarely is quantitative and qualitative

¹⁹ Sick building syndrome is a term first used in the 1970s, referring to the symptoms of a significant number of people occupying a particular building are associated with their presence in that building. In most cases sick building syndrome occurs in office buildings, although it may also occur in other communal buildings such as schools and apartment buildings. See The Environmental Illness Resource, (n. d.). Sick Building Syndrome. Retrieved February 1, 2011, from <http://www.ei-resource.org/illness-information/related-conditions/sick-building-syndrome-%28sbs%29>.

feedback compared and integrated with building science and social science (Gieryn, 2002; Leaman, 2007; Stevenson & Leaman, 2010). Standardized commercial building-data benchmarks were established in the Post-Occupancy Review Of Building Engineering (PROBE) studies the 1990s²⁰ (Leaman, Bordass et al., 1997; Leaman & Bordass, 1999a; 1999b; Cohen, Standeven et al., 2001; Bordass, Cohen, et al., 2001; Bordass, Leaman et al., 2001; Leaman & Bordass, 2001) that acquired international certification in 2006. In North America, the Centre for the Built Environment at the University of California-Berkeley first developed indoor air quality POE instruments.²¹ The US Federal Facilities Council also funded a POE study in cooperation with 21 federal agencies to assess responsibilities for large building inventories. It identified POE programs that worked well in terms of impact, longevity and user satisfaction, yet noted deficiencies in data-collection strategies such as occupant interviews and survey instruments (US Federal Facilities Council, 2001). While environmental costs and human-health benefits in commercial buildings are receiving considerable attention, there continues to be a lack of research examining post-occupancy evaluation within residential multi-unit housing types in North America (Macintosh & Steemers, 2005; Turner, 2006; Liu, 2007; Wenman, Hofer et al., 2008; The Benningfield Group, 2009; Crofton, 2009; Dator, 2010).

Use of POE for benchmarking progress toward measuring consumption of the built environment remains rudimentary (Cooper, 2001). Reasons why POE has

²⁰ The Probe studies in the UK benchmarked building performance surveys for 16 commercial and institutional buildings in the 1990's. It addressed the efficient operation of buildings, generated information about various green building strategies and identified how users coped with poorly performing buildings (see Leaman, Bordass et al., 1997).

²¹ The Centre for the Built Environment works with the building industry on new technologies and design techniques concerned with indoor-air quality through on-line formats (see Zabgreus, Huigenza et al., 2004).

not flourished as a routine building procedure include a lack of checks and balances, regulatory responsibilities for commissioning a building and evaluation cost discrepancies (Cooper, 2001; Andreu & Oreszczyn, 2004). Other barriers POEs face involve fragmented incentives within procurement and operation processes, lack of consensus on indicators, potential liability issues and exclusion of POE from professional training curricula (Zimmerman & Martin, 2001; Meir, Garb et al., 2009). Challenges administering POE techniques include potential liability and confidentiality issues, costly assessments and management difficulties across buildings (Leaman & Bordass, 1999a; 1999b; US Federal Facilities, 2001, Preiser & Vischer, 2005). These barriers fail to consolidate feedback loops to inform designers about building performance, which often results in lost potential to learn from the iterative nature of building construction (Innes, 2005; Grogolewski, 2005). Incorporating POE techniques into building trades and facility-management culture calls for a “new professionalism” to inform future iterations of housing development (Leaman, Stevenson et al., 2010). While establishing professional and legislative guidelines are laudable from a household-consumption perspective, POE continues to meet resistance from property management, homeowner associations and the development community (Eley, 2001; Gonchar, 2008; Stevenson & Leaman, 2010).

POE surveys can identify recurring post-occupancy problems (Meir, Garb et al., 2009). While many aspects of energy use, design layout, storage facilities, thermal comfort, ventilation, lighting, acoustics and spatial considerations can be quantifiably assessed, most POE approaches tend to focus on physical rather than social characteristics (Todd, Crawley et al., 2001; Macintosh & Steemers, 2005; Preiser & Vischer, 2005; Guy & Shove, 2007, Leaman & Stevenson, 2010).

While households act as the nexus of analysis that influence mobility infrastructure, local food nodes and public space, a more seamless integration into building sites can reframe building performance and enhance user-feedback (Cross & Küller, 2004; Cross, 2007). This will require greater communication among disparate building disciplines to develop occupant-focused interventions.

Although housing-related resource consumption has been evaluated on performance-centred standards such as the National Building Code or LEED, housing as a social practice has thus far operated on the fringe and failed to demonstrate how green upgrades affect consumption behaviour (Leaman & Bordass, 2007). While evaluation methods such as POE, incorporate occupant feedback into building operation and performance, they have thus far failed to focus more prominently on the social processes of occupants within units and buildings (Nicol & Roaf, 2005; Gill, Tierney et al., 2010; Gupta & Chandiwala, 2010). Due to this conundrum, resource consumption continues to escalate within urban environments, under the guise of a “sustainable building.” Until green development reflects occupants living within natural ecosystems, we must be careful “not to conflate efficiency with sustainability” (Carolan, 2004, p. 252).

This study attempts to adapt post-occupancy *evaluation* principles into post-occupancy *assessment* by incorporating quantitative and qualitative evidence into social practices that affect residential multi-family housing (Cole, 1999; Turpin-Brooks & Viccars, 2006). It applies performance and actor-centred indicators into an integrated assessment strategy to more accurately identify drivers of household consumption. I do this by not only assessing housing and occupant satisfaction with their buildings more traditionally used in POE surveys, but also examine behavioural aspects to reduce household

consumption. For instance, I examine levels of socializing amongst neighbours, livability issues and governance structures as strategies to reduce household consumption.

PART 2: RESEARCH DESIGN AND METHODS OF INQUIRY

CHAPTER 3: IF THESE WALLS COULD TALK: USING POST OCCUPANCY ASSESSMENT

3.1 Site Selection

To assess consumption practices for different types of households, I first selected three principal types of MURBs for unit analysis: green, co-housing and typical. To this end, neighbourhoods in Metro Vancouver were scanned for similar types of dwellings within the three categories, and some trade-offs were made to obtain an appropriate sample within the scope, time, geographical and budgetary constraints of the study. Typical buildings were selected based on comparable number of units and proximity to other developments under investigation. Ideally, all case sites would be located in the same neighbourhood with a similar number of units (Table 2).

Table 2 Housing Types

Housing Type	Units	Description
High-performance Green Development		
LEED-NC Building²²	67 units	Concrete, 16-storey, mixed-use
REAP Building²³	55 units	Wood-framed, 4-storey, residential
Co-housing Development		
	22 units	Wood-framed 4-storey, residential
	19 units	Wood-framed, 4-storey, mixed-use
Typical Development		
	80 units	Wood-framed, 4-storey, residential

²² Leadership in Energy and Environmental Design (LEED) - NC (New Construction).

²³ Residential Environmental Assessment Program (REAP).

	77 units	Wood-framed, 4-storey, residential
	68 units	Concrete, 15-storey mixed-use
	74 units	Concrete, 9-storey, mixed-use

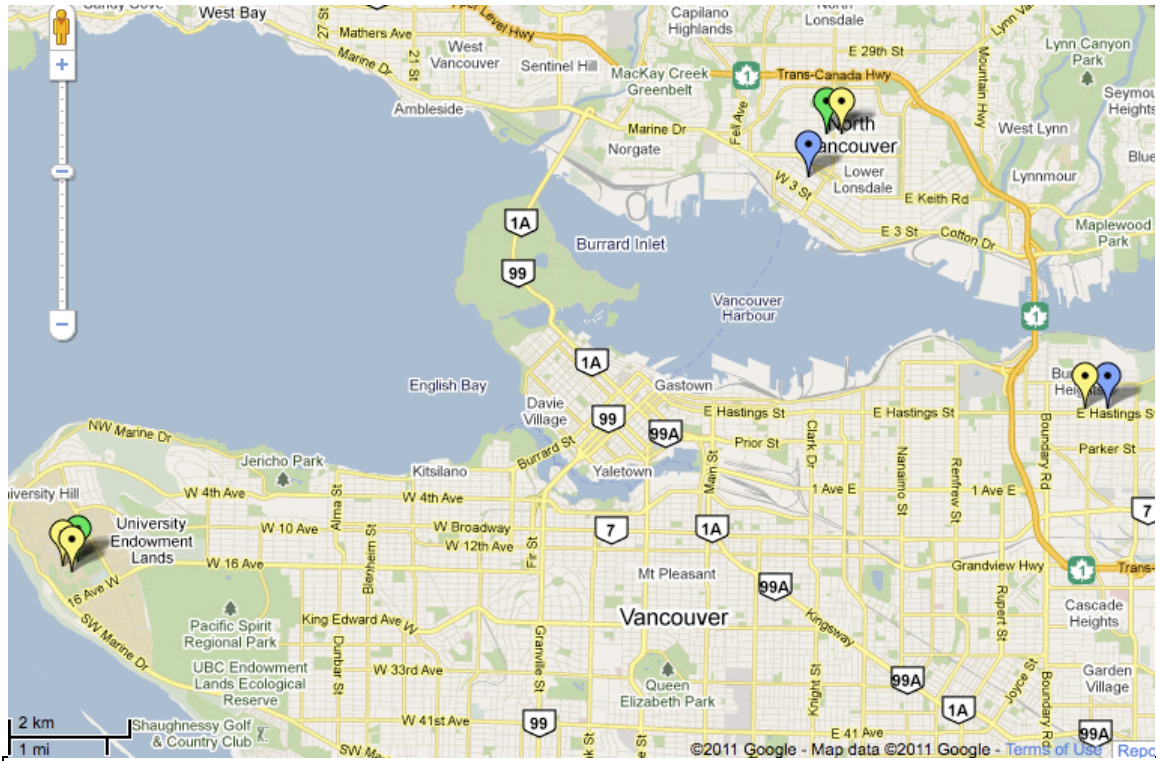
Examples of all three housing types were located in one neighbourhood in North Vancouver, within an eight-block radius. In a second neighbourhood, two typical buildings and one green building were located within one block of each other on the UBC Endowment Lands. The final two buildings in the study sample were located within a one-block radius in Burnaby, BC, a suburb of Vancouver (Figure 2).

The following sites were selected:

- 1) High-performance green buildings: one LEED certified, Silva, North Vancouver, 67 units; and one REAP-certified, Clements Green, UBC, 74 units.
- 2) Co-housing developments: two buildings, Quayside Village, North Vancouver, 22 units, and Cranberry Commons, Burnaby, 21 units.
- 3) Typical condominiums: four buildings Reflections, UBC, 80 units; Journey, UBC 75 units; Symphony, North Vancouver, 51 units; Carleton Terrace, Burnaby, 74 units.

Six of the developments are four-storey, wood-framed or concrete structures and two (one green and one typical) are 17-storey high-rise concrete towers (see Appendix 1).

Figure 2 Site Locations in Greater Vancouver



Site Location Types	
Green Sites (2)	Green
Co-housing Sites (2)	Blue
Typical Sites (4)	Yellow

In British Columbia, MURBs are managed by voluntary executive boards of building homeowner associations known as strata corporations. Under BC’s *Strata Property Act* (Government of British Columbia, 1998), once the strata corporation receives an occupancy permit, the unit owners of the strata corporation elect a strata council to manage the development. These boards (strata councils) act as the managing body for the strata corporation, make day-to-day policy decisions for the smooth operation of the strata corporation, subject always to restrictions created by the Act, its regulations, strata bylaws or a majority vote of the owners. The strata council prepares an annual budget, which must be approved by a majority vote of the strata lot owners. All developments

are managed under the *Strata Property Act* of BC, although the co-housing units strive to govern by consensus rather than a majority vote of their Strata Council.

3.2 Indicator Definitions

For the purpose of the POA survey, I defined the various indicators as follows:

- Households refer to a unit of accommodation within a MURB to which residents may have individual access to their building by a common hallway, foyer, or main entrance. The person asked to fill in the survey was over 18 years of age, responsible for paying household bills, and could be either male or female. In cases where adults were mutually responsible for paying bills, the household self-selected who was to respond to the survey.
- The physical characteristics of housing involve the three different residential building types, including the heating system and type of controls in the unit. Respondents also assessed the appearance of their buildings.
- Mobility is linked to energy consumption in relation to the distance between home, work, and other destinations, which influences fuel consumption and commute times. Mobility refers to the movement of people and goods, and conventionally assumes that “travel” means person-kilometre-minutes; “trip” means person-vehicle trip and assumes that an increase in speed or decrease in time benefits society. Ideally, the intent is to move toward more sustainable mobility that is primarily concerned with a lower-carbon movement of people and goods that

reduces reliance on fossil-fuelled motor vehicles. Sustainable mobility includes walking, cycling, ride-sharing, public transit, fixed rail, as well as teleworking.

- Food consumption refers to meals that are eaten inside or outside of the home by the reference person. Grocery purchases are assessed by price, brand/appearance, locally grown (i.e., within BC) or organic in content. Organic food is grown, processed and/or preserved without chemical toxins and is labelled organic by the vendor.
- Solid waste is the discarded material disposed from the housing unit by a household member. Resource recovery, commonly referred to as recycling, is material intentionally collected and separated for reprocessing into other commodities. Compost is the kitchen green waste intentionally collected for aerobic decomposition into organic matter, either in the unit, building or off site.
- Social capital is the creation of informal civic participation and networks to foster civic cohesion (Coleman, 1988; Putnam, 1993; 2000; Portes & Landolt, 1996; Portes, 1998). At the household scale, living environments can influence bonds and norms that may affect household consumption (Michalos, 1999; Stø, Vittersø et al., 2004; Jensen, 2008).
- Sustainable behaviour is the degree of social and ecological impacts associated with purchasing decisions and actions to mitigate climate change (Gifford, 2002, pp. 64-65). Of particular relevance are purchasing decisions that influence households to select environmentally friendly materials, products and services associated with their home.

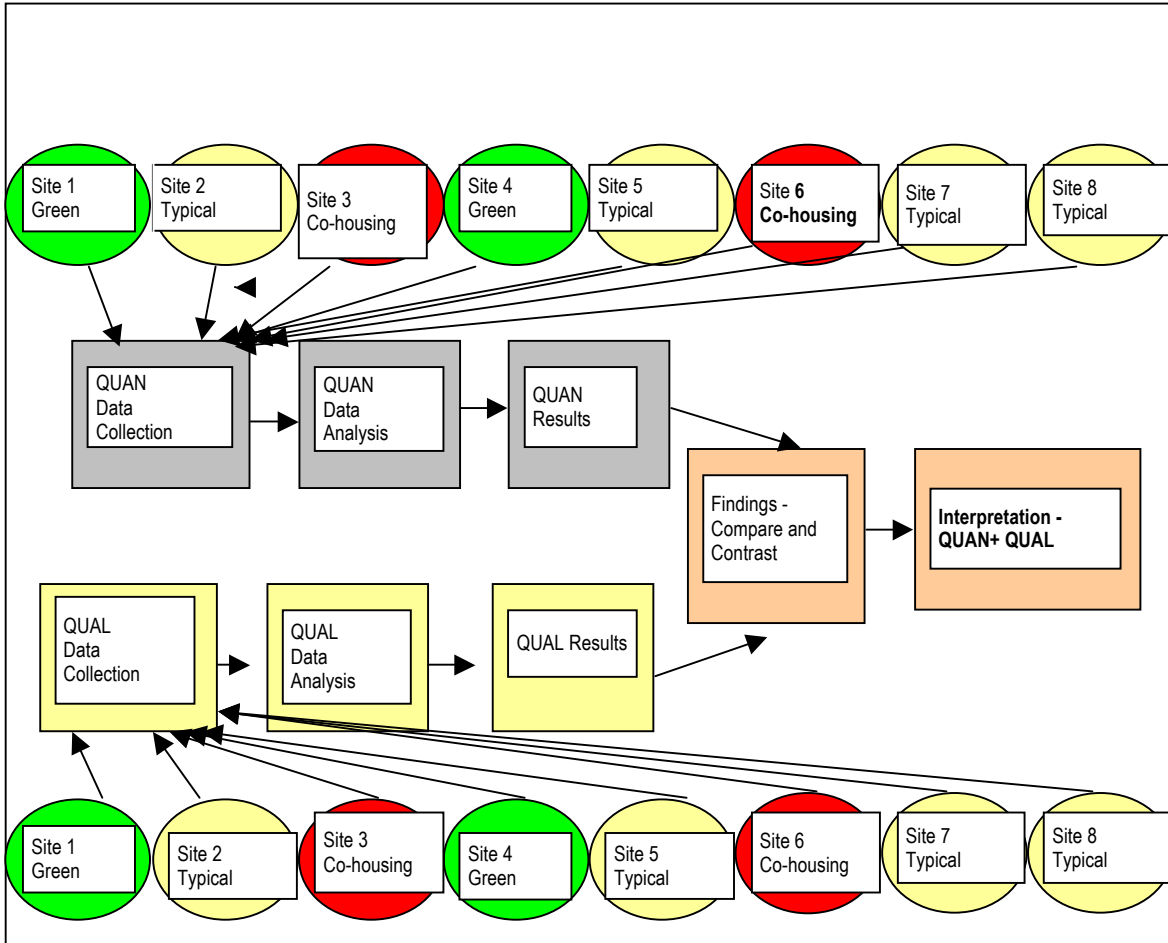
- Livability pertains to the occupants' satisfaction with their home environment and includes site location, interior space layout and overall comfort. It is also influenced by neighbourhood characteristics, location and general municipal geography. I use three criteria to assess livability: (1) the quality, use, maintenance and management of the occupants' dwelling, building amenities and common space; (2) occupant lifestyles in relation to housing style preferences; and (3) positive physical and social characteristics that inspire occupant confidence (Hortulanus, 2000, p. 216). Livability is assessed in two sub-categories: storage capacity and noise levels.

3.3 A Mixed Methods Approach

Combining qualitative and quantitative methods in various phases of the research process yields different but complementary data on the same topic. A single-phase design involves concurrent but separate data collection and analysis in order to understand the research question from multiple perspectives (Creswell & Plano Clark, 2007). A single-phase design refers to the convergence model (Figure 3) and relates to the timing of the data analysis rather than data collection (Creswell, 1994). After collecting the quantitative data, I also collected the qualitative data before analyzing both data types during the interpretation stage of the inquiry when different findings were compared and contrasted. The advantage of using convergence includes an intuitive and efficient data collection procedure in roughly the same time-period prior to analysis. Since much social science research is founded on either quantitative or qualitative research, it may suffer from limitations associated with a single method or from a specific application. Comparing and contrasting qualitative and quantitative findings in a

mixed method approach offers the prospect of enhanced confidence (Bryman, Lewis-Beck et al., 2004).

Figure 3 Convergence Model



In developing a POA instrument for this study, I was assisted on design and analysis by Building Use Services, a consulting firm in the UK that used a more traditional POE for commercial buildings, which I transformed into a POA instrument for the use of residential occupants. The POA instrument I developed differs from most POE applications by focusing on residential housing scenarios, governance and social connectivity. Based on community-design principles, it seeks to measure how governance, neighbour interactions, management

practices and urban form relate to and influence occupant-consumption levels, and how households might more effectively mitigate consumption (Hendrickson & Wittman, 2010; McIntosh, Gray et al., 2010; Seyfang, 2010; Gray, Gleeson et al., 2010). The POA does this by providing both quantitative and qualitative data with reference to the following indicators: housing, mobility, food, solid waste, social capital, sustainable behaviour and livability. In turn, these findings, complemented by qualitative interviews and observational notes, were used to inform policy recommendations (Table 3 and Table 4).

Table 3 Data Collection Procedures

Site Types (Green, Co-housing, Typical)
POA Survey
Interviews
Site Observations
Compare, Contrast and Interpret
Public Policy Focus Group
Indicator Areas: (Housing, Food, Mobility, Solid Waste, Livability, Social Capital, Sustainable Behaviours)
Policy Implications

Table 4 Research Timeline

Research Phase	Time Period	Calendar
Household Spending Analysis	9 months	March – December 2007
Confirming Sites	7 months	September/07 – March/08
Survey Dissemination	2 months	March – April 2008
Interviews	3 months	April – June 2008
Data Analysis	7 months	June/08 – January/09
Peer Review Focus Group	2 months	October – December 2009

MURBs present different assessment challenges from commercial buildings, where questionnaires are disseminated and collected in person during office hours. Contacting residents in their private homes is more difficult, given the need to gain building access, find times when occupants are home to deliver and collect surveys and respect privacy and property laws. For the present study, I first contacted property managers for permission from building strata councils to survey occupants and obtain the necessary mailing lists. Respondents who agreed to participate were then asked to sign consent forms and provide contact information for the survey and schedule a follow-up interview (see Appendix 2).

3.4 Quantitative Data Collection

I mailed the POA survey out to respondents between March to June 2008, I collected information about age, gender, tenancy and length of time residing in the dwelling. Respondents rated their dwelling using Likert scales of 1 (unsatisfactory) to 7 (very satisfactory) regarding the building design, image, cleanliness, storage and living facilities, their perceived health in the building, thermal comfort, ventilation, lighting, noise and spatial perceptions about their unit and building. The survey took approximately 10 to 15 minutes to fill out. Open-ended questions asked respondents to describe their daily routines, personal consumption patterns, social activities, solid waste and food purchasing behaviour, social connections and perceived livability in their unit and building.

As an inducement to participate in the survey, the names of all respondents were entered in a draw for an iPod portable media player (Appendix 3). All questionnaires were pre-coded to track subsequent mailings; second and third mailings included similar letters and information. A

questionnaire in simplified Mandarin accompanied the second mailing in hopes of attracting non-English speaking Chinese immigrants (see Appendix 4). After each interview, any personal information was stripped for each respondent and the data manually entered into a spreadsheet and double-checked for errors. The questionnaire was mailed to 437 households (n=437), and 109 owner-occupants responded for a response rate of 24.9% (Table 5). Six questionnaires were undeliverable and returned. POE literature records a 20-25% response rate for cold postal sampling for MURB studies (Stø, Vittersø et al., 2004; City of North Vancouver, 2008).

Table 5 Survey Response Rates and Interviews

Building Type	Total Surveys Sent	Surveys Delivered	Surveys Returned & %	Interviews Conducted
Green				
Site 1	67	65	19 (29%)	7
Site 6	55	55	16 (29%)	6
Sub-total	122	120	35 (29%)	13
Co-housing				
Site 3	18	17	13 (76%)	6
Site 5	22	21	12 (57%)	8
Sub-total	40	38	25 (67%)	14
Typical				
Site 2	74	73	12 (16%)	4
Site 4	51	50	6 (12%)	2
Site 7	77	77	16 (21%)	4
Site 8	79	79	15 (19%)	5
Sub-total	281	279	49 (17%)	15
Total	443	437	109 (24.94%)	42

3.5 Quantitative Data Analysis

After calculating summary statistics, a multiple regression analysis using STATA software investigated relationships between the three housing types and the dependent variables (see Table 6 and Appendix 5). A research assistant performed linear, ordered logit, probit, logit or multinomial logit regressions as appropriate for each case.²⁴ Ordered logit was used to establish statistical significance because it imposed more structure on the statistical model as to location, space, and storage variables. Probit modelling was more appropriate when categories reflected an underlying normal distribution of the dependent variable, even with only two categories— such as whether households composted kitchen waste (yes/no). Multinomial logit was used when dependent variables could not be ordered in a meaningful way (i.e., nominal), such as when food was ranked by price, brand, appearance, BC grown and organic.²⁵ Next, I highlighted the numeric variables that showed the strongest statistically significant estimates and most interesting insights to compare and contrast with the qualitative data.

Table 6 Dependent Variables

Dependent Variables		
Housing	Space Heating	Electric baseboard, natural gas radiant heat, or natural gas forced air. Thermostat control - manual, programmable, and how many.
	Clothes Washer/Dryer	Private washer/tumble dryer, common washer/dryer, and/or clothesline

²⁴ Research assistant Michele Battisti, PhD Candidate in Economics, SFU performed the multiple regression analysis.

²⁵ Raw input and output summary data and regressions are available from the author.

Mobility	Driving, Taking Transit, Walking/Cycling	Frequency (more, less, or the same when compared to where previously lived) to work, school, and social activities. Distance (nearer, farther, same when compared to where previously lived) to work, school, and social activities.
	Vehicle Parking	Number of personal vehicles, option to purchase stall separately from unit.
	Personal Air Travel	Total amount of flights and time (hours) from lift-off to landing during the past 12 months (work-related or partly personal and partly work-related air flights excluded).
Food	Food Preparation	How often household prepares food per week compared to where they lived previously.
	Food Preference	Food ranking based on price, brand/appearance, local, or organic preferences.
	Supermarket Choice	Frequency, distance, mode of travel for shopping to supermarket, large format retail outlet, and/or both.
Solid Waste	Waste Generation and Resource Reduction	Volume of household waste disposed weekly and recycled weekly. Whether kitchen waste was composted and if so where; whether unit had a garburator and how often used.
Social Capital	Socializing with Neighbours	Frequency household socialized (more often, less often, or the same amount) with neighbours over food/drink than where previously lived.
Sustainable Behaviour	Active Citizenship	Number of environmental and/or social justice organizations the reference person donated money or time to per month.
Livability	Interior Lighting	Lighting control ranked with Likert scale.
	Occupant Comfort Level	Comfort control ranked with Likert scale.
	Storage	Storage capacity within unit and within building with Likert scale.
	Noise	Interior acoustics and exterior noise levels with Likert scales.
	Health	Perceived health of occupant within unit and building with Likert scale.

3.6 Qualitative Data Collection

I conducted in-depth follow-up interviews with a sample (n=42) from the eight sites (see Table 7 and Appendix 6). In the absence of socioeconomic and demographic household census data (most buildings did not exist before the

2001 Census), a purposeful, stratified sample provided a measure of confidence for comparing the three building categories. Criteria for maximizing variable differences in the stratified sample included housing type, site location, gender and ethnicity.

Table 7 Field Site Interviews

Housing Type	Green		Co-housing		Typical			
Site	Silva	Clements Green	Cranberry Commons	Quayside Village	Reflections	Journey	Carleton Terrace	Symphony
Male	3	4	5	4	2	1	2	1
Female	3	1	3	3	2	4	3	1
Ethnicity ²⁶	1	3	0	1	0	1	1	0
Total Interviewed	6	5	8	7	4	5	6	2

3.7 Qualitative Data Analysis

Once the interviews were transcribed,²⁷ I used an iterative coding process for the content analysis. I first defined a preliminary set of ten meta code families and 56 sub-codes before analyzing the data (see Appendix 7) based on the interview protocol. Once I coded the data in the pre-determined code families that shared similar characteristics, I coded the data again and developed 89 additional sub-codes that emerged from the data (see Appendix 8) (Crang, 2005). Memo writing helped unify my coding strategy with theoretical notes, commentaries, revision dates and personal reflections to identify linkages

²⁶ I define ethnicity as a group of humans whose members identify with each other, through a common heritage that was real or assumed based on common ancestry. See Banks, M. (1996). *Ethnicity: Anthropological Constructions*. London, UK: Routledge. p. 151.

²⁷ Karen Corr transcribed the interviews.

between relationships and actions of household occupants and their environments

The interview protocol consisted of 81 open- and close-ended questions that I pretested three times with friends or colleagues. In hindsight, I would ask fewer questions as the data analysis became too complex and some variables were discarded because of validity concerns (see below). Responses regarding unit square footage and utility bill data, for example, were sometimes not verifiable during the interviews.

A protocol provided organized observations for each case site during a walk-through of the landscaped grounds, underground parking garage, common garbage and recycling area, interior foyer, main entrance, stairs and elevator(s). Photographs of common areas helped document each site setting (see Appendix 9).

I compared the qualitative and quantitative findings to explain more fully the richness and complexity of occupant behaviour by examining the data from more than one method (Creswell & Plano Clark, 2007). I first analyzed the quantitative data from the 113 variables in the POA survey and highlighted the strongest correlations found in the quantitative analysis. I attempted to use only variables that achieved a level of statistical significance but sometimes had to rely on the summary statistics due to small sample size. Rather than perform a comprehensive cross-check for validity between quantitative and qualitative findings, I condensed the analysis into 23 explanatory quantitative variables and the 89 qualitative themes. I interpreted the research using a holistic, flexible and inductive approach. I compared and contrasted the qualitative and quantitative findings across the three housing types (green, co-housing, typical) in attempts to

highlight pertinent issues to provide a more complete set of findings than could be arrived at through the administration of one method alone. These findings were then filtered through the building-site observations (Appendix 9) to develop further analysis for household behaviours.

I wrote and circulated a draft discussion paper three weeks prior to a policy-focus group in November 2009 (see Appendix 10).²⁸ The discussion paper consisted of policy implications within housing expertise, buildings, municipalities and regional, federal jurisdictions based on the potential opportunities and barriers interview respondents raised on the topic of shifting household consumption. Invited focus-group participants were selected based on their municipal, regional, provincial government or non-profit experience, housing expertise and interest in the research topic. I aimed for a representative cross-section of governmental and civil society positions, gender and geographical diversity from within the Lower Mainland of BC. Participants were invited by email and follow-up telephone calls to confirm attendance. Participants offered verbal comments about the paper during the half-day focus group. One participant provided written comments on the paper and another offered supplemental household-consumption materials. Two invited participants did not attend due to illness.

The focus group began with a brief presentation of 15 minutes about the research and session goals and guidelines on November 18, 2009. The objective of

²⁸The public policy focus group consisted of Ms. Magdalena Szpala, Sustainability Analyst, BC Housing Corporation; Mr. Tony Gioventu, Executive Director, Condominium Home Owners' Association (CHOA); Mr. Emmanuel Prinet, Executive Director, One Earth; Ms. Celina Owen, Manager of Communications & Administration, REFBC; Ms. Bev Grieve, Manager of Planning, City of New Westminster; Dr. Mark Roseland, SFU; David Hendrickson, SFU; and Michelle Murvai, note-taker. The focus group took place at SFU.

the session was to respond to whether the policy implications from the discussion paper were on target, practical and realistic.

While findings derived from the semi-structured occupant interviews converged with data from the focus group, triangulation for cross-verification was not the intent in this context. Instead I used the qualitative findings from the resident interviews to frame the discussion paper and expand on the opportunities and barriers to shift consumption patterns. I also framed and evaluated the usefulness of the POA in the discussion paper as a series of policy innovations that were described in order to elicit responses. I facilitated and moderated the group using a focused conversation format, which explores many facets of a question or series of questions in order to design effective responses and solutions. Focused conversation allowed participants to work together to answer questions on four different cognitive levels and enabled discussants to access and deepen insights gained from earlier responses (Stanfield, 2000).

Focused conversation seeks objective, reflective, interpretive and directive questions. Objective level questions are about facts and external realities. Reflective level questions call forth immediate personal reactions to the data or an internal response that may sometimes convey emotions or feelings, hidden images or associations. Interpretive level questions draw out meanings, values, significance and implications; and decisional level questions can help groups elicit resolutions and formulate closure on topics and discussions (Stanfield, 2008, p. 18) (Appendix 10).²⁹ Discussants prioritized top-tier policy applications

²⁹ Examples of the four question levels include: what exactly does it propose (objective); what are your initial responses to the policy (reflective); will this type of policy shift consumption patterns (interpretive); what kind of priority should this initiative have and how important is it when compared to other initiatives that we have discussed (decisional)?

in no preferential order. A note-taker simultaneously transcribed the discussion. New sections were added to the discussion paper on industrial land, urban displacement and stakeholder roles and responsibilities that were derived from the focus-group participants. Policy implications were then framed to support theoretical concepts, offer practical recommendations and assist in dissemination of findings.

3.8 Data Limitations

Mixed method approaches involve selecting appropriate types of data, sampling and design protocols for recording, administering and analyzing findings. The selection of participants is an issue that lacks clear consensus when applying a concurrent form of quantitative and qualitative data collection (Creswell & Plano Clark, 2007). I followed a common practice in the research procedures that selected the same participants for both quantitative and qualitative data collections in order to facilitate comparable data convergence. Since the qualitative sample was purposely selected to provide a level of representation, smaller sample-frame disparities limited comparisons within the data sets. A limitation in relying on the regression analysis in this case was the relatively small sample size available to determine relationships that may affect the validity of the data. I addressed this obstacle by focusing discussion on areas of stronger empirical correlations and compared with qualitative findings.

Discussing coding bias periodically with colleagues helped to identify potential bias issues. A level of bias formed from interactions between the researcher and co-housing strata councils, due to their less formal organizational structure and accessibility. It is difficult to assess whether participant responses

or response rates changed due to these interactions. By contrast, the property managers at three sites showed a distinct lack of interest or refused to organize an introductory research meeting, but those site participants were nevertheless included in the analysis. Sometimes several months passed between the initial meeting with a strata council and permission granted for the survey mail-out. Volatile petroleum prices and public policy tax shifts (i.e., the BC Government's carbon tax) during this period may have compromised internal validity (see below). While residents may have wanted to appear helpful, it is possible that some residents may have responded less than honestly in their surveys or interviews. These factors have implications for the analysis, yet it is difficult to determine precisely how much they influenced bias and validity. Incomplete or missing data can also affect findings, as can assigning scores to missing data (Babbie, 2001). For this reason, summary statistical mean scores were calculated twice, once with average scores for each variable substituted for a non-response, and then again substituted with blanks and missing responses, but without zeros. The unaltered analysis was scrutinized with the averaged analysis for anomalies, but no substantial deviations were found.

A limitation deserving further discussion is research validity. Validity refers to the extent an empirical measure adequately reflects the conceptual meaning under consideration through agreement and representation (Babbie, 2001, p. 143). Baker (1999, p. 109) refers to validity by asking, "Am I measuring what I think I am measuring?" Five aspects of validity are relevant to this study: face validity, criterion validity, construct, content and internal validity.

Face validity determined common understandings and methods of measurement based on defining key terms. Some abstract terms made it more difficult to establish face validity because of broad definitions. For example, I defined and determined definitions, such as social capital, by the extent to which the indicator conveyed its intended meaning (e.g., the number of neighbours known on a first-name basis).

Criterion validity (or reality) involves researchers drawing incorrect inferences from the sample data to other persons, or past and future situations (Creswell, 1994, p. 171). A validity issue arises from generalizing conclusions beyond the targeted groups to other groups not investigated. For example, the results in this study are preliminary and merit further investigation into POA techniques. I limit inferential comments about the research findings to the actual investigated groups and sites although policy implications in Chapter 5 are intended for a wider audience. Validity issues concerning policy implications should therefore be considered with this caveat.

Construct validity is an important test for interdisciplinary social science based on the extent to which what is to be measured was actually measured (Baker, 1999). It relates to how theoretical concepts are perceived and the variables are determined to measure what I intended to measure. In this case, my goal was to document actual household behaviour and routines rather than a respondent's intent because intent does not necessarily correlate with personal action. For example, some respondents expressed concern about climate change, but when probed during interviews resisted changes to their routines.

Content validity refers to the extent a measure covers the range of meanings captured within a concept. To address content validity, I defined key terms to describe appropriate meanings as precisely as possible. I also compared various household practices to provincial or national averages when data was available to compare environmental impacts with the research occupants.

Internal invalidity occurs when findings may not accurately reflect what actually happens and is present whenever anything other than the housing type affects consumption behaviours and patterns (Babbie, 2001, p. 226). Participant responses, for example, may have matured between responding to the survey and conducting follow-up interviews due to a time lag of several weeks. In this case, survey design and interview protocols remained unchanged once the study commenced, yet the fact remains that internal invalidity may still exist. There is also the possibility that respondents responded favourably to some questions due to the nature of the topic rather than their personal actions.

3.9 Conclusion

Using POA in residential buildings is in its infancy in North America and requires further refinement along with systematic and regular re-assessments to monitor a building's function over time. POA compels occupant users and residential buildings to merge building characteristics with social practice. Applying an occupant-centred approach to investigate household consumption widens the scope of assessment boundaries in relation to measuring housing types, occupant behaviour and preferences. These characteristics complicate the ability to empirically assess household consumption. Subsequent chapters discuss the study's findings and point toward using POA to influence household

consumption through feedback and communication between occupants and developers.

PART 3: FINDINGS, ANALYSIS AND CONCLUSIONS

CHAPTER 4: UNRAVELLING CONSUMPTION'S GORDIAN KNOT: FINDINGS AND ANALYSIS

4.1 Introduction

Metrics have limited value in assessing household consumption because economic growth and community well-being are often entangled like the proverbial Gordian Knot. This chapter uses performance and actor-centred indicators to examine household consumption in housing, mobility, food, solid waste, social capital, sustainable behaviour and livability. I compare and contrast quantitative and qualitative findings to portray some of the complexities relating to household consumption behaviours and routines. Occupants of typical dwellings serve as the reference group for the regression analysis unless otherwise stated.

4.2 Demographics

Households in the study are complex social units, consisting of single adults, numerous unrelated housemates, nuclear families and extended family members. Reference points of analysis are an occupant's age, gender, ethnicity, number of household members, length of time living in the unit and reasons why occupants moved in. I determined household tenure and size by calculating the number of units occupied, the number of household members in each, the length of time each household had lived in their unit and the reason(s) why they had moved to their current dwelling.

Of those responding to the survey, 23% lived in green developments, 31% lived in co-housing and 46% lived in typical developments (see Table 9).

Caucasians comprised 70% of respondents, 53% were women, 50% lived alone (m=1.65) and 72% had additional household members over 18 years of age living at home (m=1.31).³⁰ Green and typical households were more likely to consist of singles or couples (rather than nuclear or extended families, for example), while green respondents in the 40-49 age category represented a more prominent proportion of the population (see Table 8, Figure 4 and Table 9).

Table 8 Household Size by Building Type and Gender of Respondent

# of Additional Household Members (beyond survey respondent)	Typical	Co-housing	Green	Total
0	15	8	11	34
1	16	8	13	37
2	12	4	8	24
3	2	5	2	9
4	2	0	0	2
5	2	0	0	2
6	1	0	0	1
Total	50	25	34	109
Male	23	11	15	49
Female	23	14	19	53
Responses Left Blank	4	0	0	4
Total	50	25	34	109

³⁰ In 2006, 26.8% of Canadians lived in one-person households, while 8.7% had households of five or more persons. See Statistics Canada. (2008). Market Research Handbook. Section 5: Housing and Household Characteristics No. 63-224-X. Retrieved February 1, 2011, from <http://www.statcan.gc.ca/pub/63-224-x/2007000/5006461-eng.htm>.

Figure 4 Housing Type by Age of Respondents

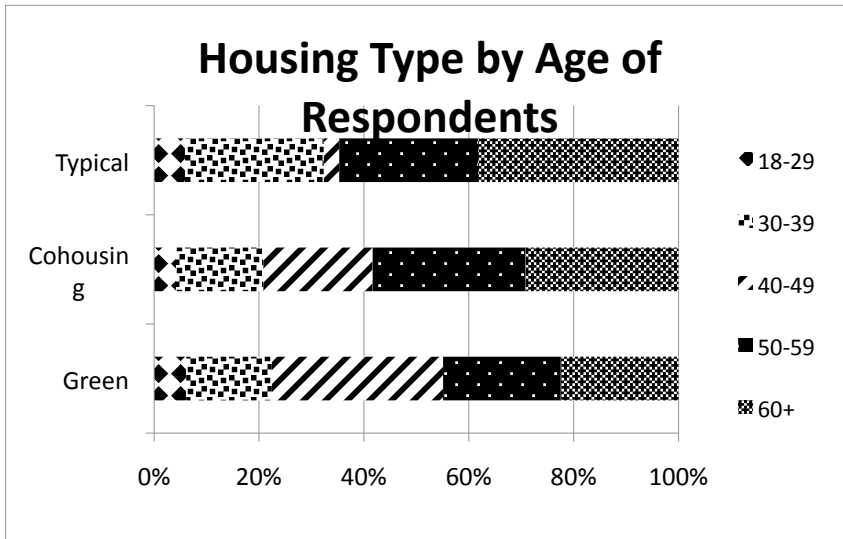


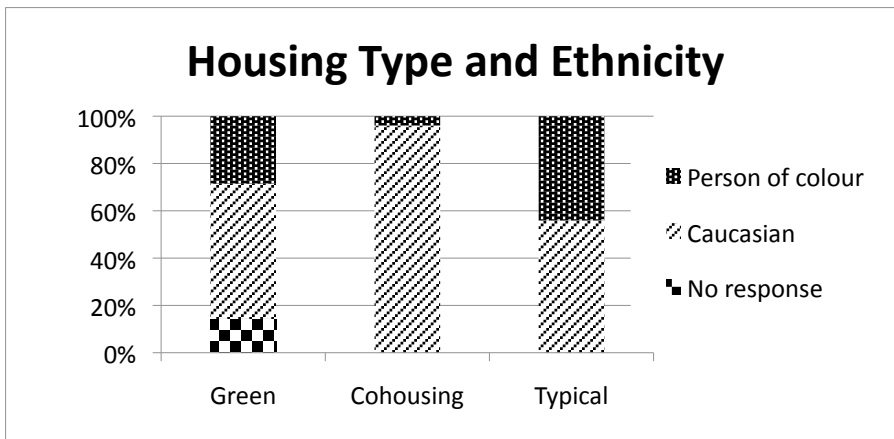
Table 9 Housing Type by Age of Respondents

Housing Type and Age of Respondent (in years)	Green	Co-housing	Typical
18-29	3	1	2
30-39	8	4	9
40-49	16	5	1
50-59	11	7	9
60+	11	7	13
Total	48	24	34

The primary reasons that occupants reported moving to their current home included location, price, unit layout and downsizing to a smaller dwelling. Respondents living in the UBC neighbourhood expressed a desire to be closer to the university, near green space and away from heavy motor traffic. Co-housing households indicated their top priority for moving was to form community, but finding a preferential site was contingent on proximity to central services and public transit.

Respondents were also asked to report their ethnicity, which is defined as a group of humans whose members identify with each other through a common heritage that was real or assumed based on common ancestry (Banks, 1996, p. 151). They were allowed to identify themselves by more than one group and were divided into Caucasian (70%) or persons of colour to simplify the analysis, i.e., anyone who self-identified themselves as not Caucasian. Co-housing households were more ethnically homogenous when compared to green and typical households (Figure 5).

Figure 5 Housing Type and Ethnicity of Respondents



4.3 Physical Characteristics of Households

Housing was then differentiated by physical characteristics using sub-areas of housing types (green, co-housing or typical), space heating (electric baseboard, natural gas radiant heat and natural gas forced air) and thermostatic interior heating controls. Generally, there was little variation among housing types concerning perceived exterior building appearance. In other words,

differences in preferences reflected judgements based on specific characteristics as opposed to external aesthetics.

Space heating and cooling normally consume the largest amount of energy in households and contribute the greatest amount of greenhouse-gas emissions (US Department of Energy, 2009). Six of the eight MURBs investigated used electric baseboard heat. Cranberry Commons installed natural gas radiant space heating, and Clements Green used geothermal technology for domestic hot water, which reduced the energy demand for hot water consumption by 50-60%.³¹ None of the units had air conditioning, which is not uncommon in the BC Lower Mainland.³²

Information technologies that focus on occupant feedback and energy-control such as thermostats can affect household-energy consumption (Wood & Newborough, 2007; Burgess & Nye, 2008; Tukker, Cohen et al., 2010; Grønhøj & Thøgersen, 2011). Most residents (37/42) interviewed controlled their heat by manual electric thermostats, and some had as many as six or seven thermostats in their unit. Some occupants remembered to turn manual thermostats down or off when leaving a room, but most did not (7/42). One green occupant (#3) discovered the thermostats in his unit were defective:

I wasn't so surprised, I guess, but at the same time the thermostats that they had were really bad. They were very poorly calibrated. I had

³¹ Enerpro Systems Corporation estimated three-year operational savings in Clements Green when compared to a comparable-sized building with reductions in natural gas consumption (36%), greenhouse gas emissions (116 tonnes), and domestic hot water consumption (54%) when compared to the national average hot water energy consumption of 344 litres/day of water, (40-45% hot water). See Enerpro Systems Corp. (n.d.). Project: Clements Green-UBC Campus, 6268 Eagles Drive, Vancouver, BC Client: UBC Properties Trust, Vancouver, BC. Retrieved February 1, 2010 http://www.enerprosystems.com/project_clementgreen.html.

³² The BC Lower Mainland is the geo-climatic region that extends from Horseshoe Bay south to the Canada-United States border to Hope, BC at the eastern end of the Fraser Valley.

one room, for example, that was probably about 15 degrees Celsius. I had the thermostat turned down to maybe five degrees in that room and the heat was still coming out [at night time]. . . and I know in other units that happened as well. I went in and helped some people to calibrate, to adjust theirs.

Faulty thermostats and the need for up to seven thermostats in a condominium suggest quality control issues and inefficient heating practices because occupants often forget to turn down thermostats when leaving their room or unit (Ehrhardt-Martinez, Donnelly, et al., 2010; Ehrhardt-Martinez & Laitner 2010). Surprisingly, programmable thermostats were absent even in the green developments unless they had been independently installed by occupants. Thermostats that can be programmed on a weekly schedule can reduce energy consumption by 10% (US Department of Energy, 2009), but they often feature complicated and arcane interfaces.

One co-housing respondent (#27) mentioned that converting temperatures and kilowatts to dollars might help make energy use more meaningful to the homeowner:

I think that what is probably more effective is a meter that shows in dollars and cents what you save by doing this, that, and the other by pointing out and giving out some guidance as to how to save and reduce your energy consumption. Just in terms of your lifestyle choices, okay, and real-time feedback on what this particular thing [condo] is costing you.

Besides not necessarily understanding energy consumption, energy costs were not always linked to frequency of use. For instance, three buildings bundled

utility costs into monthly strata/maintenance fees, but in the other sites occupants paid their own individual heating costs. A co-housing respondent (#24) explained that her building did not have individual natural gas meters but received a 40% bulk rate discount from Terasen Gas. A typical respondent (#40) emphasized why paying for heating individually encourages energy conservation:

I'm paying for the gas myself here, which I think is a good thing because when you're accountable you don't leave it [the heat] on for extended periods of time. Now I guess what is different is in my old building, I had two air purifiers there just running continually so my electric consumption was high because of those, but I didn't have to pay.

When individual units qualify for commercial rate reductions, there is little financial incentive to conserve energy. Likewise, when buildings collectively distribute heating costs, there is less motivation to reduce energy consumption. Other energy conservation efforts reported by occupants included replacing incandescent lights with compact fluorescent bulbs and drawing window blinds to conserve heat in winter.

4.4 Mobility

Suburban dwellers have higher automobile dependency due to relatively low-density settlement patterns and fewer services and amenities in close proximity (Ewing & Cerveri 2001; Sanne, 2002; Jackson, 2003; Ewing & Rong, 2008; Oswald & McNeil, 2010; Tukker, Cohen et al., 2010). Energy consumption is linked to household mobility in terms of distance, time and mode of transport

between home, work and other destinations. Once travel decisions are made based on time, cost and convenience, they become part of a household's routine, as evidenced by the majority of households (58%) that commute up to 20,000 kilometres annually (Statistics Canada, 2008). Gunton (2005), for instance, calculated that Canadians increased travel distances 13% from a decade earlier and drove 9,400 kilometers per capita in 2002 for an annual cost of \$8,000.³³

I calculated mobility by comparing an occupant's current travel modes (auto, public transit, cycling/walking) by frequency and driving distance, compared to those where he/she previously lived. Mobility is responsible for a substantial proportion of the environmental impact from household consumption, yet those who walk, cycle or take public transit on a regular basis generally have smaller carbon footprints (Holden, 2007; Tukker, Cohen et al., 2010).³⁴ While public transportation tends to be less expensive than private automobile ownership, accurate comparisons of environmental efficiencies depend on whether savings are spent on less environmentally impact-intensive areas (Ornetzeder, Hertwich et al., 2008).

Typical respondents reported they drove to work, on average, more often (3.16) compared to co-housing (2.96) or green households (2.79) than where they previously lived. Green commuters averaged shorter distances to work (2.53) than typical (2.74) or co-housing commuters (2.92) than where they previously

³³ Transport Canada estimates vehicle costs in Metro Vancouver were 56.4¢/km or \$8000 per year (based on 2000 statistics from the Canadian Automobile Association). See Transport Canada. (2006). *The Cost of Urban Congestion in Canada*. Retrieved February 1, 2011, from www.tc.gc.ca/pol/en/acs/EconomicAnalysis/docs/summary.pdf.

³⁴ It is noted that while some North American studies indicate a decrease in household consumption due to living in closer proximity to urban centres, some Australian studies present a counter perspective. Using household expenditure data, fuel statistics and motor vehicle surveys, researchers found that higher population densities in urban centres had additional consumption impacts when compared to rural statistical local areas (SLA). See, for example, Dey, Lenzen et al., 2003; Dey, Berger et al., 2007; or Lenzen & Peters, 2010.

lived. Co-housing occupants drove less often than typical occupants and were more likely to drive shorter distances for shopping than where they previously lived. Table 10 lists the results of the driving distances and frequencies (mean) to work (than where previously lived) and an ordered logit model of the statistical significance of green and co-housing occupants compared to the typical occupants (the reference group). Respondents reporting “not applicable” were excluded from the analysis.

Predicted probabilities were then determined of driving frequency compared to where people formerly lived. Results indicated green households had a 46% lower probability to drive for shopping, an 18% lower probability to drive the same amount and a 28% lower probability to drive more than the typical group compared to where they lived previously. Overall, green and co-housing households were more likely than typical occupants to drive less frequently and over shorter distances than where they formerly lived. Statistical significance was not detected in typical households, probably due to the small sample size (see *p* values in Table 10).

Table 10 Ordered Logit Regression for Driving Frequency & Distance to Work

Frequency Driving to Work (than previously lived)	More	Less	No Change	Mean	Total	Coef. (SE)
Typical (base)	3 17.65%	7 41.18%	7 41.18%	3.16	17 100%	
Green	6 26.09%	8 34.78%	9 39.13%	2.79	23 100%	-.283618 (.6333496)
Co-housing	3 17.65%	3 37.5%	2 25%	2.96	8 100%	-.5999914 (.7814132)
N	12 25%	18 37.5%	18 37.50%	109	48 100%	
Distance Driving to Work (than previously lived)	Further	Shorter	No Change	Mean	Total	Coef. (SE)
Typical (base)	3 17.65%	7 41.18%	7 41.18%	2.74	17 100%	
Green	6 26.09%	8 34.78%	9 39.13%	2.53	23 100%	-.2271274 (.5921866)
Co-housing	3 37.5%	3 37.5%	2 25%	2.92	8 100%	-.8402971 (.7975205)
N	12 25%	18 37.59%	18 37.59%	109	48 100%	

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0$.

The City of Vancouver’s 2009 modal splits³⁵ for cycling (3.7%), walking (12.2%), and public transit (12%), suggest there are significant barriers to leaving one’s car at home, and I found significant difference in how often building occupants used public transit, cycled or walked, compared to where they previously lived. Some respondents expressed interest in having transit further subsidized (10/42), especially in the downtown core and for the elderly. A green occupant (#10) complained, public transit was infrequent, slow and expensive:

³⁵ See Dobrovoly, D. (2009, Feb. 17). Traffic and Transportation Committee Administrative Report. RTS. Number 7905. Retrieved February 1, 2011, from <http://vancouver.ca/engsvcs/transport/cycling/stats.htm>.

Transit is too infrequent and inconvenient, and yet, you know, here is a five-billion dollar transit system that's been built and I've got to wait half an hour? Half an hour back, that's an hour? You know, an hour out of my day of 24 hours? That's a big chunk of time, so, from that point of view it doesn't work.

Others, such as typical respondent (#34), spoke about inconvenient and expensive parking that deterred driving patterns; "If I ever have to go downtown, 99% of the time I take the bus. So I won't, I don't take the car downtown. Parking is too expensive. It's a hassle."

When asked about ride-sharing or "pay as you go" car service, three respondents brought up licensing and liability challenges. A co-housing respondent (#17) related why ride-sharing was financially undesirable for some motorists:

. . . You've got a couple of kids and one or two days a week you need a minivan. So you get a minivan. The other five days a week you don't [need it]. But sure you could have another car. But they're \$1,200 a year to insure or more, right? Depending on how much coverage you carry, right? You can't, so what do you do, you go on not wanting to spend the next couple, three hundred bucks a month to have a fuel-efficient vehicle. I'll just drive my minivan everywhere because it costs me less in gas even though I'm driving around this great big thing. Right?

While automobile use is the most common and convenient form of mobility, for longer distances people are choosing to travel by air. Canadian domestic passenger air travel has increased passenger flight distances from 33 to

37 billion kilometres between 2000-2004 (North American Transportation Statistics, 2007). At present there is no widely accepted methodology to rank or allocate aviation emissions to sub-national levels (Wood, Bows et al., 2010).

The majority of responses (70% of green, 60% of co-housing and 53% of typical occupants) reported taking a flight for personal leisure travel in the 12 months preceding the survey. I defined personal leisure travel as the total number of flights and hours in an aircraft from lift-off to landing. Such flights did not include work-related or partly work related flights. Green dwellers averaged 1.6 fewer flights and 3 hours less flight time than typical respondents, and co-housing occupants averaged 2 fewer flights and 17.5 hours less travel time than typical occupants (see Table 11).

Table 11 Housing Types and Number of Personal Flights

Housing Type and Total # of Flights	Green	Co-housing	Typical	Total
0	12 27.91%	8 34.78	12 38.71%	32 32.99
1	12 21.74%	5 21.74	5 16.13%	22 22.68%
2	8 18.6%	5 21.74%	4 12.9%	17 17.53%
3	2 4.65%	2 8.7%	2 6.45%	6 6.19%
4	4 9.30%	1 4.35%	2 6.45%	7 7.22%
5	0 0%	0 0%	2 6.45%	2 2.06%
6	2 8.70%	1 3.23%	1 3.23%	4 4.12%
7	1 2.33%	0 0%	0 0%	1 1.03%
8	2 4.65%	0 0%	0 0%	2 2.06%
10	1 2.33%	0 0%	1 3.23%	1 2.06%
14	0 0%	0 0%	1 3.23%	1 1.03%
18	0	0	1	1

	0%	0%	3.23%	1.03%
Total	43 100.00%	23 100.00%	31 100.00%	97 100.00%
Constant (Average of Typical)	-1.603* (0.921)	-2.007 (1.092)	4.474*** (0.725)	65

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Applying an ordered logit regression analysis using the number of flights and flight hours as continuous variables (see

Table 12), those reporting zero flights were excluded. Conditional probabilities indicated that typical occupants averaged 4.5 flights ($p > .10$; see Table 12).

Table 12 Housing Type and Number of Personal Flight Hours

Housing Type and Total # of Hours in Flight	Green	Co-housing	Typical	Total
0-10	24 55.81%	14 60.87%	16 51.61%	54 56.25%
11-20	6 13.96%	4 17.39%	4 12.90%	14 14.58%
21-30	7 22.59%	1 4.35%	7 22.59%	13 13.54%
31-40	3 6.98%	0 0%	0 0%	3 3.13%
41-50	3 6.98%	2 8.70%	3 9.68%	8 8.33%
51-60	0 0%	0 0%	3 9.68%	3 3.13%
61-70	0	0	0	0
71-80	0	0	0	0
81-90	0	0	0	0
91-100	1 2.33%	0 0%	0 0%	1 1.04%
101-120	0 0%	0 0%	1 3.23%	1 1.04%
121-300	2 4.66%	0 0%	0 0%	2 2.08%
Total	43 100.00%	23 100.00%	31 100.00%	96 100.00%
Constant (Average of (Typical)	-3.019 (12.08)	-17.49 (14.60)	34.63 *** (9.508)	64

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Overall, there were large variations across housing types, but green and co-housing occupants reported a slightly lower number of flight hours (not statistically significant) compared to typical occupant fliers. Of those who reported taking flights for personal reasons, typical respondents averaged 34.6 hours, green occupant passengers averaged 31.6 hours and co-housing passengers averaged 17.0 hours. The findings did raise questions warranting further inquiry. It is unclear, for example, if air travel was scrutinized by occupants as much as other types of transportation, and if short-distance flights were taken at similar frequencies as long-distance flights.

4.5 Food

Increasing awareness about climate change has led to promoting local and organic food consumption as a way to reduce the distance food travels and the use of toxins in food production (Carlsson-Kanyama, 1998; Duchin 2005; Tara 2008; Weber & Matthews 2008a; 2008b; 2008c; Bausch-Goldbohm et al., 2009; Tukker, Cohen et al., 2010). While these approaches can reduce environmental impacts, much debate concerns the definition of “local” (Renting, Marsden et al., 2003; Smith, Watkiss et al., 2005; DuPuis & Goodman, 2005; Feagan, 2007). No North American government guidelines, for instance, currently define parameters for what local food means (Blake, Mellor et al., 2010).

Complicating matters further is categorizing carbon- intensities of different food groups. For instance, Sonesson et al., (2005) estimate red meat is about 150% more GHG-intensive than chicken or fish, yet calculations are dependent on grass-fed versus grain-fed cattle, supply chains and distribution

centres (e.g. regional, national or global). Transport of food stocks from retailer to household also contributes to environmental impacts (Sonesson, Anteson et al., 2005), as does the extent to which households compare grocery prices, quality and selection (Glen & Hertwich, 2006; Vermeir & Verbeke, 2008; Sharkey, Horel et al., 2009).

Cooking in restaurants is more environmentally friendly than cooking at home because large commercial kitchens utilize energy more efficiently than personal kitchen appliances (Druckman & Jackson, 2005), yet little is known about household grocery shopping habits, such as the preparation and frequency of meal portions or the frequency and duration of food storage (Sonesson, Anteson et al., 2005).

Ranked food indicators included household food preparation and preferences, and local and organic food choices. I calculated food preparation by estimating how often occupants prepared food, and whether that was more or less frequent than where they previously lived.

Households reported eating more frequently at home than Canadians in general, particularly typical households, which contradicts national trends³⁶ (Statistics Canada, 2006a) (see Figure 6 and Table 13). I asked respondents to rank their food preferences on a scale of 1-4, based on price, brand/appearance, BC grown and organic. An ordered logit model assessed the predicted probability of the green and co-housing groups compared to the typical group (see Table 14).

³⁶ According to Statistics Canada, households visited a restaurant for a meal or snack 520 times on average, per year (see Statistics Canada, 2006a).

Figure 6 Food Preparation

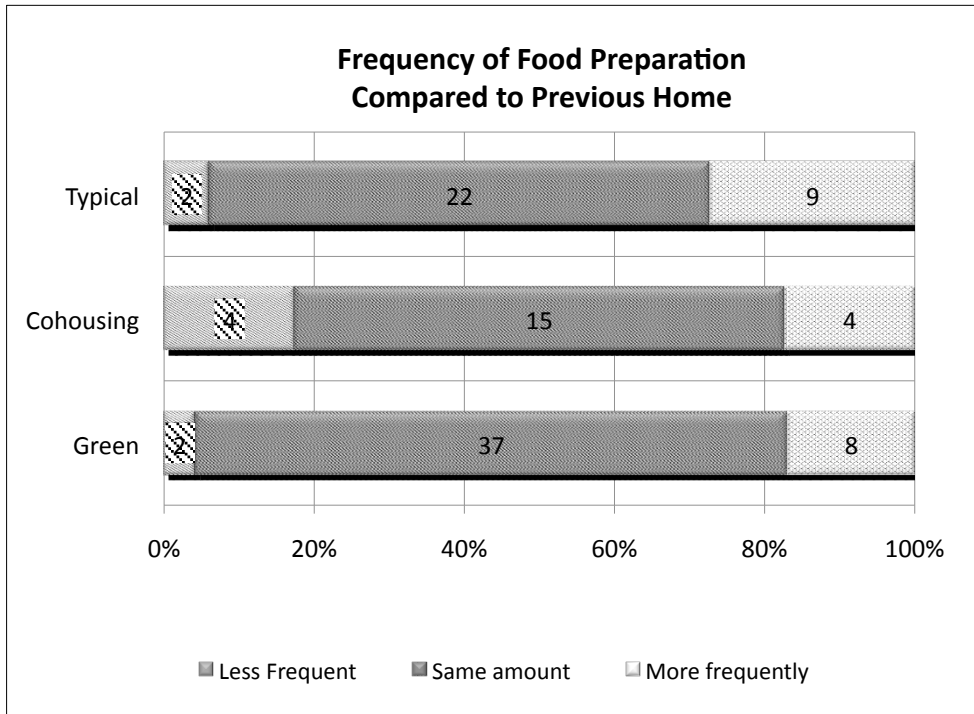


Table 13 Housing Type and Food Preferences

Housing Type and Food Preference	Typical (constant)	Green	Co-housing	Total
Price	16 61.54%	21 46.67%	6 26.09%	43 43.74%
Brand/Appearance	5 19.23%	9 20.00%	3 13.04%	17 18.09%
Coef. (SE)	-1.163151 (.5123482)	.3158529 (.649023)	.4700036 (.873219)	
BC Grown	4 15.38%	8 17.78%	6 26.09%	18 19.15%
Coef. (SE)	-1.386294 (.5590177)	.4212135 (.6965055)	1.386294 (.8036381)	
Organic	1 3.85%	7 15.56%	8 34.78%	16 17.02%
Coef. (SE)	-2.772589 (1.030745)	1.673976 (1.119335)	3.060271 (1.163659)	
Total	26 100%	45 100%	26 100%	94 100%

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14 Predicted Probabilities for Food Type

Site Type	Price	Brand/Appearance	BC Grown	Organic
Green	-17.7%	-1.4%	0.5%	18.7%
Co-housing	-38.0%	-10.0%	4.3%	43.7%
Typical (Base group)	61.5%	19.2%	15.4%	3.9%

Results indicated that overall, green and co-housing households were less likely to list price or brand/appearance as their top priority, and were more likely to rank organic highest when compared to the typical group. When co-housing was compared to typical occupants, estimated deviations in the weightings assigned to price averaged 61.5%, brand/appearance 19.2%, BC grown 15.4% and organic 3.9%. In other words, digressions from typical households suggested green households were 17.7% less likely on average to report price and 1.4% less likely to report brand/appearance as their first priority when selecting food from the supermarket. Co-housing households were 38% less likely to report price as their first priority and 10% less likely to report brand/appearance as their first choice. Gaps between co-housing and typical households were particularly large across the food categories, indicating strong correlations between food choices and the respective housing types.

Some respondents (14/42) indicated they bought organic food for flavour, quality, freshness and health reasons, while others (11/42) were sceptical about labelling and organic certification. A co-housing respondent (#16) observed:

Sure, absence of pesticides is good but they can be poorly managed, they can be unattractive, they can be overripe, they can be high in cadmium. There are lots of things that can go wrong. [Be grown road-side and get] lead in them. There's just too many things. So we're not against it, but if

organics are going to be higher priced just to get that name. We don't buy it. If we think the quality is there and the price is reasonable we'll be happy to pay it.

A green respondent (#11) questioned what organic food means;

Now, the question is what is the definition of organic? Organic means there's no pesticides by definition. Okay? That's the overall perception. That may be true or may not be true, but organic is--- organic. So---that area has not been really well defined. . . what we really need is some kind of criteria to explain what organic actually means.

Concerns over definitions and labelling were timely as Canada passed a new organic certification process and logo in 2009, standardizing the use of natural fertilizers in production and products, and stipulating that contents must contain at least 95% organic ingredients, that animal conditions must "mimic nature," and that food content be approved by the Canadian Food Inspection Agency.

Others, such as typical respondent (#34), were more concerned about price for groceries than food cultivation practices and origins:

You know, I go down to [grocery store chain A] and I see what's on special there and if they've got four tins of salmon on for five bucks I'll buy four tins of salmon. And then I'll go to [independent grocer] and if they've got asparagus on for \$1.99, and [grocery store chain B] has

got it on for \$4.99 I'll buy it there [independent grocer]. So there's no special place that I shop. And because it's all, you know, within 15 minutes of walking, and the prices vary by shit. Sometimes 40%. You know? So I don't favour any one over any other because I look and I say, okay, who's got the best price? So I shop around. And so I look for the best prices.

Households create a growing demand for convenience food products to save time and effort yet express concern about food naturalness, nutrition and preparation (Brunner, van der Horst et al., 2010). Others are interested in price over other qualities in their quest to find cheaper food items. In order to simplify food-consumption impacts, Weber and Matthews (2008b) suggest it may be easier for households to shift to chicken, fish, eggs or a vegetable-based diet rather than attempt to buy all organic or locally-sourced food in Northern climates.

4.6 Solid Waste

Canadian households produced 13.4 million tonnes of residential waste in 2004. Nearly three-quarters of this waste was sent for disposal and 27% was recycled. Each British Columbian disposed, on average, 256 kg of residential waste (Statistics Canada, 2007). Recycling rates were 51% in BC (Metro Vancouver, 2007) and 55% in Metro Vancouver (City of Vancouver, 2009). Within multi-residential buildings, residential recycling rates are estimated at only 16% (Metro Vancouver, 2007).

I quantified solid waste by asking respondents to report the number of filled plastic grocery bags (volume = 9.46 litres) they disposed of each week and the amount of organic material composted. Waste recovery, on the other hand, was determined by the material intentionally collected and designated for reprocessing, the volume (9.46 litres per bag) of which (number of plastic bags) was placed in recycling receptacles each week, as estimated by the respondents. Open-ended questions asked respondents about ideas and barriers they experienced in disposing of their waste.

Results indicated that living in a green or co-housing site was likely to reduce the amount of garbage that ended up in a landfill. Most households in typical buildings threw out 2-3 bags per week, on average, while green and co-housing households averaged 1 bag (see Table 15). Using the typical group as the reference group and the number of bags as the dependent variable, deviations were measured from the typical households. The conditional probabilities indicated that green households had a 17% higher probability of having just one bag per week than typical households, and were 17.4% less likely to throw out more than 2 bags. Comparing typical to co-housing occupants showed a similar pattern but of even stronger magnitude. Occupants of co-housing had a 49% higher probability of declaring just one bag, a 52% lower probability of disposing of only 2-3 bags and were 11% less likely to report 4-5 bags of garbage per week. The estimates show that living in a green development had a negative effect on the number of bags generated while co-housing occupants had a similar, but stronger and significant case. Overall, there was a slight difference in the quantity of garbage produced between green and typical households when controlled for number of family members (not statistically significant) and an

even larger difference, which was statistically significant, when comparing co-housing to typical households. Based on the responses, adding another household member added 87% of a category to the quantity of waste produced. This finding could indicate there was a certain threshold of garbage that 1-2 person households generated in green and co-housing sites that varied little when other household members (i.e. children) were added.

Table 15 Solid Waste Rates

Number of Garbage Bags Disposed Weekly (per household)	0	1	2-3	4-5	6 or More	Total	# of Garbage Bags Disposed (controlled for # of household members)
Typical	0 0%	10 31.6%	17 53.1%	4 12.5%	1 3.13%	32 100%	
Green	0 0%	22 44.9%	18 36.7%	7 14.3%	2 4.08%	49 100%	-0.706* (0.452)
Co-housing	1 4.35	17 73.9%	4 17.4%	1 4.35%	0 0%	23 100%	-2.521*** (0.664)
Members in Household							0.870*** (0.180)
N							104

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Analysis of household recycling behaviour indicated 54.6% of co-housing households reported recycling 4-5 grocery bags per week and 31.8% reported recycling six bags or more. In order to evaluate relationships between recycling and housing types, an ordered logit regression used the typical group as the reference group to measure deviations of the recycling amounts generated from the green and co-housing households, which were controlled for household size, to compare waste generation with recycling rates and probed the relationship

between recycling behaviour and housing types. The results (Table 16) show that co-housing households were 43.5% more likely to report recycling “a lot more” (rather than “less” or “a similar amount”), compared to practice in their previous home. While recycling is considered a preferable household practice to reduce waste, the volume of household solid waste generated in relation to how much gets recycled must be taken into consideration.

Table 16 Recycling Rates

Number of Bags for Recycling Weekly (per household)	0	1	2-3	4-5	6 or More	Total	Number of Bags for Recycling (controlled for # of household members)
Typical	0	1 3.13%	19 59.38%	10 31.25%	2 6.25%	32 100%	
Green	0	5 10.42%	20 41.67%	15 31.25%	8 16.67%	48 100%	0.316 (0.432)
Co-housing	0	0	3 13.64%	12 54.55%	7 31.82%	22 100%	1.787*** (0.530)
Members in Household							0.073 (0.167)
N							102

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

While the recycling findings indicated household size influenced waste recovery volume, the overall results were not statistically significant. Although predicted probabilities for recycling were higher for both green and co-housing households compared to typical occupants, the results were statistically significant only for co-housing occupants compared to typical dwellers. Based on the responses, adding another household member added 7% of a category to the quantity of recycling produced. These results revealed that 38.9% of co-housing households were likely to recycle more than four bags per week than typical

households. This finding may be explained by the availability of recycling options at each building. The co-housing households had developed greater options to recycle various materials which created "economies of scale" that would potentially increase recycling quantities.

In summary, co-housing households recovered a higher percentage of household waste in relation to the other housing types. The analysis sought to identify why co-housing residents behaved differently from both typical and green housing development residents. The interviews and site visits unveiled a "residential champion" in one co-housing development who had developed a comprehensive recycling system for the building that source-separated 20 different materials. There was also a high level of awareness among interviewed residents who viewed waste as a resource rather than something to be thrown away with practical implications that included collecting second-hand items to donate to thrift stores.

North Americans are accustomed to co-mingling recyclables (or using single-stream recycling) at their residences rather than separating them at source. Co-mingling, or mixing together various materials designated for recycling, is more convenient but can increase contamination rates, overall processing costs and reduced marketability of recyclables due to associated processing costs (Barr, Gilg et al., 2005; Barr & Gilg, 2006; Scozzafava, 2007; Container Recycling Institute, 2008; City of Vancouver 2009). Single-stream recycling proponents suggest this method achieves a higher diversion rate through the elimination of sorting at the point of waste generation (UK Waste & Resources Action Programme, 2008). Single-stream recycling presents an opportunity to improve collection efficiency through the use of automated vehicles, but the increase in

cost to process commingled materials and lack of local processing capacity are potential barriers in the region (Container Recycling Institute 2009). A co-housing respondent (#19) summed up the paradox:

The addition model is to put everything into one container and the solution is going to never [co-mingle recycling materials]. And for North Americans, we're used to having it as easy as possible and that means one bin for all.

Despite whether households were co-mingling or source-separating recyclable materials, most typical respondents (75%) thought they were doing an adequate job of reducing waste within their unit and building. Typical respondent (#42) explained:

We improvised and we got a container that we put the recyclables into under the sink and then when that gets full we take them outside into the bigger bin and then we take those downstairs. There's a dumpster for cardboard and a dumpster for garbage and then we have all the other recycling, like, newspaper, mixed paper, cans, plastics. It's all there.

Most households (approximately 90%) that recover items for recycling and composting do so in kitchens or closets and periodically transfer them to receptacles elsewhere in the building. Recycling receptacles were installed in both green building units, but one green occupant (#4) questioned their efficacy:

... in one of the cupboards, they have one with a slide out, ah, two quite large bins. It took up the whole cupboard. And I just found it was too, for one person it was too much. I could see it as a family

but for one person it was just too much. Took up too much space.

So I took it out and I just keep it under the sink.

The design of MURBs often limits a resident's ability to separate materials for recycling within a building because of space constraints, poor ventilation and fire hazards. Receptacles for mixing plastics #2, #4, and #5, mixed paper, cardboard and sometimes glass are usually located in underground parking areas next to the garbage dumpster. Most residents (approximately 80%) in the three housing types reported a lack of adequate collection space, and were not willing to deviate from standard collection items from lack of knowledge and the time involved in returning non-standardized items to appropriate venues. Refundable cans and bottles that contained deposits were an exception.

Compost refers to kitchen produce and other organic matter intentionally collected by households for aerobic decomposition. By weight, organic kitchen waste comprises the largest portion of residential waste, accounting for 22% of recycled materials from all sources in Canada,³⁷ approximately 38% of residential waste in Metro Vancouver (Technology Resource Inc., 2008). Within Vancouver, organic kitchen waste in multi-family residential buildings consists of approximately 20% of household waste (Technology Resource Inc., 2008) and most organic waste is landfilled in Metro Vancouver.³⁸ The limited capacity of sewage treatment plants combined with a shortage of large composting facilities reflects a culture of ambivalence to processing household food waste.

³⁷ Statistics Canada notes that information on waste recycled by type of material is unavailable at the residential level. See footnote 5 at Babooram, A., & Wang, J. (2008, November 21). Recycling in Canada. Statistics Canada, Ottawa, ON. Retrieved February 1, 2011, from <http://www.statcan.gc.ca/pub/16-002-x/2007001/article/10174-eng.htm>.

³⁸ Vancouver started collection of kitchen organic waste in single family dwellings and some low-rise buildings in 2010. While there are some pilot organic diversion audit projects in multi-family residences in Vancouver, diversion rates have not been published. See Moffat, L. (2011, January 29). Personal Correspondence, Solid Waste Management, City of Vancouver.

I asked respondents whether they composted kitchen waste and, if so, where they distributed the contents. I asked and observed during interviews whether the household’s kitchen sink contained a garburator and how often it was used. I also asked the occupants to identify any barriers they encountered toward composting.

Every co-housing household, 30% of greens, and 7% of typical respondents reported composting kitchen organic matter (see Table 17). Both green and co-housing households reported a higher predicted probability of composting than typical households.

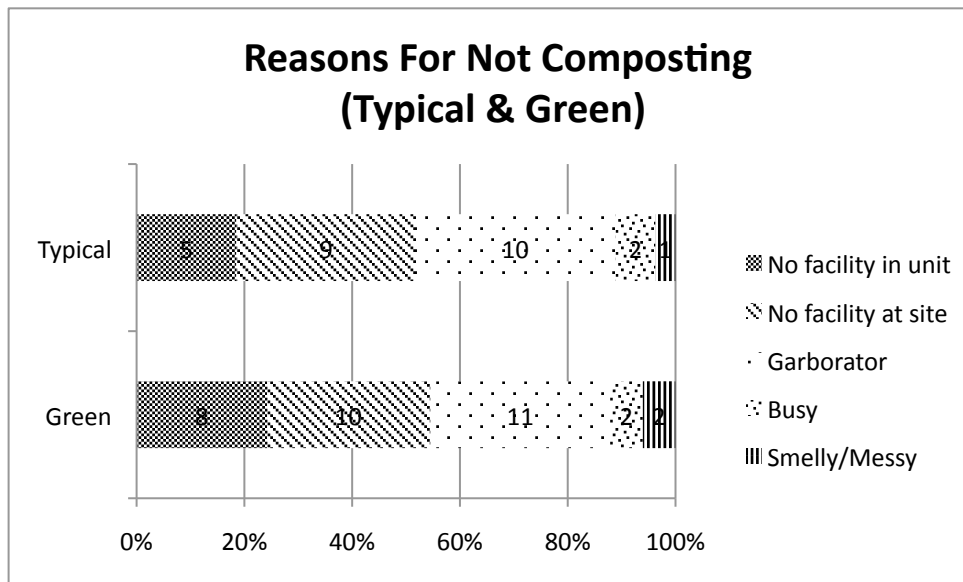
Table 17 Respondents Who Compost

Building Type	Percentage of Respondents that Compost	Number of Respondents that Compost	Probit Model for Probability of Respondents that Compost
Co-housing	100%	25	0
Green	30%	14	0.231** (0.092)
(Baseline Average for Typical)	7%	2	0.067*** (0.073)
N		39	77

Standard errors in parentheses † $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Non-composters in green and typical buildings lacked compost facilities in their buildings or units (e.g., worm composting). They felt they were too busy or that kitchen scraps were too messy and smelly or they relied on a garburator (see Figure 7). Interview findings (23/42) suggested that supplying appropriate facilities would encourage more composting.

Figure 7 Reasons for Not Composting (Typical and Green)



Rather than reducing kitchen waste, garburators simply transfer waste from the kitchen directly to the sewage system for processing. Besides expending energy, garburators also tend to conceal the volume of kitchen waste generated on a daily basis. A typical respondent (#33) stated:

And it shocks you, I mean, I eat lots of fruit and vegetables, but it shocks you how much gets left. I mean, it's like, oh my God. With the garburator you tend to garburate everything. But of course being in a building for that long garburators tend to wear out. . .

Setting up a composting system within a multi-family building is not without physical design and cultural challenges. Co-housing respondent (#27) stated:

I've known at least three people who live in condos who've attempted to set it up. Who've attempted to set up a building-wide compost and it's been very, very difficult. There's two components to it. One is the physical structure and the other is the social

construction. And the neglected part is the social infrastructure, the strata says to the [owner] we have no mechanism to address it. At this point, it is the rare commercial or multi-residential that actually has the space for it.

A green respondent (#6) at UBC spoke about accessibility of compost receptacles to enable convenient composting of organic kitchen waste:

There is compost collection. They look like recycling bins--the big blue ones, except they're green and that's for compost and they're all over campus so when I first moved here I had to go almost to the student union building to find them or behind the agricultural sciences building. They had them, but now they're everywhere.

Household-waste recovery is oriented towards a "one-size-fits-all" strategy constrained by physical space limitations in MURBs. Tote receptacles for mixed-plastic, glass, mixed paper and newsprint are usually located in the basement next to the waste disposal dumpster.

Effective resource-recovery strategies included having a personal champion, single-stream separation rather than co-mingling materials, orienting new residents to the waste-recovery system, providing multilingual signage and maintaining on-going communication between management and occupants. Quayside Village Co-housing saved \$400/year in garbage pick up fees by recovering 75-90% of its weekly household waste.³⁹ On-site composting at co-housing sites, or the pick-up of organic matter as initiated by some UBC residential buildings, resulted in higher recovery rates than sites that did not

³⁹ Quayside Village paid \$ 23.75 per unit for municipal waste collection compared to \$70 per unit at Journey, a typical site at UBC.

have composting facilities or pick-up. More knowledge is also necessary regarding kitchen waste to understand the complex interactions between packaging size, shopping frequency, and wastage (Sonesson, Anteson et al., 2005; Barr, Gilg et al., 2005; Barr & Gilg, 2006; Tudor, Robinson et al., 2011)

Municipalities are faced with inconvenient waste and recovery collection systems, technology stagnation and industrial objectives at odds with recycling targets. Organic matter comprises about one-third of municipal solid waste, yet until lately is rarely included in a municipality's curbside recycling program. Nevertheless, MURBs are almost always exempt from municipal organic matter collection programs.

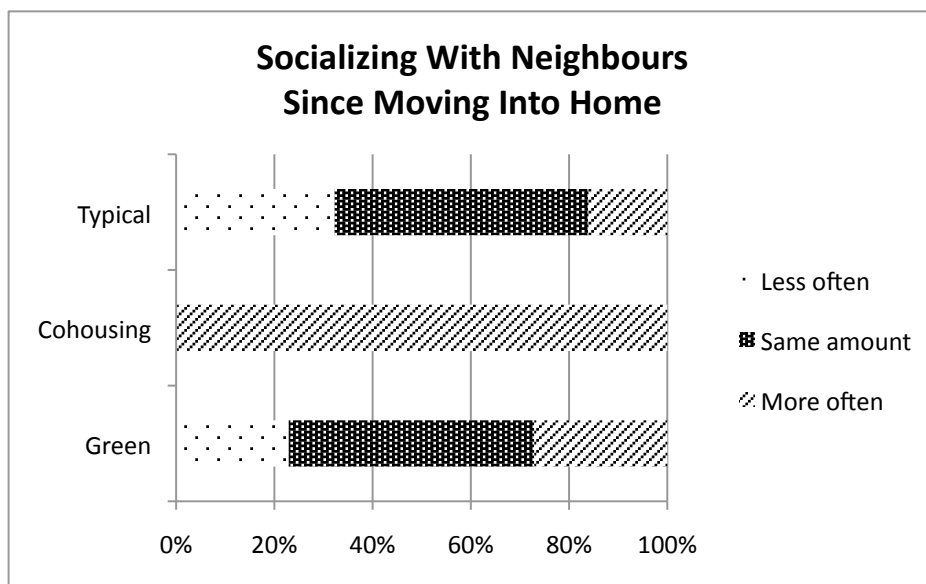
4.7 Social Capital

Social capital, a form of community asset observed within multi-family buildings for enhanced neighbourly interaction, reciprocity and trust (Woolcock, 2001), can also contribute strategies to reduce household consumption (Thoyre, 2011). The analysis of social capital in this study included the degree to which occupants socialized with neighbours, their normal interaction in community living, and security and safety issues.

Community living involves the regular interaction of neighbours within a multi-family building on a social basis or task-oriented function. Respondents were asked how often they socialized with other occupants in their building compared to where they previously lived. Every co-housing household (100%) reported they socialized more than where they previously lived, compared to green households (27%) and typical households (16%) (see Figure 8). One third of typical households reported they socialized less than in their previous homes. I

asked respondents how many neighbours they knew on a first-name basis. Cohousing respondents (who had generally known each other longer than residents at other sites) knew all of their neighbours by first name (46 occupants) whereas green respondents recognized between 2-20 people, and typical respondents recognized between 1-18 people on a first name basis.

Figure 8 Socializing with Neighbours



Respondents were asked to comment on perceived barriers to community living, and ways to increase access and interaction among neighbours within their building. In green and typical buildings, community living revolved around a small group of committed individuals who met monthly at strata council meetings. Most councils organized one or two social functions a year and hosted annual general meetings. Canine and child-friendly households also tended to “find each other.” A typical occupant (#39) related:

I’d say that a major connection, probably the biggest connection around here are our dogs. Walking dogs and playing with dogs.

That's probably one of the biggest community builders because that's the one thing that everybody does every day that's got a dog and so the people that we know on a first-name basis usually the first thing we know is the dog's name and then the person's name. And that's who we get to know and that's not necessarily in this building. That's in two to three buildings in this neighbourhood. So anything spontaneous like that would have to do with dropping by to see if you want to go for a walk or occasionally we have, for example, a friend across the way that sometimes offers to take [Rover] for a walk without us.

Co-housing sites, in contrast, held weekly potluck dinners (where everyone contributed a dish to share), monthly community meals (where members took turns cooking for the larger group), committee meetings, work bees and recreational activities such as gardening, lectures, yoga and music. A co-housing respondent (#25) explained, "You know, it's up to you. However much you want to be in contact with people or you want to withdraw yourself." Another co-housing occupant (#24) added,

... what I think co-housing gives you is incredible opportunities for whatever you want. You know, a group can do incredible things. And you not only share the space, but you share social things, you share your skills, your knowledge, your information.

On the other hand, typical and green householders were less likely to interact and when they did, it was on a more formal basis with strata business or the annual holiday party. When asked about neighbourly interactions, green respondent (#5) replied:

No social activity other than me being on the executive council, like you know we meet once a month and we have an annual general meeting once a year.

The degree of formal interactions among the different building types could influence the frequency and degree of informal interactions. Co-housing communities practiced consensus-based decision-making as opposed to majority-rule voting by the typical and green strata councils, which hired professional managers. Reaching consensus involves negotiating the best collective solution, rather than emphasizing ownership of an individual idea. Reaching consensus often takes longer, requires higher levels of trust and a group is forced to defer when someone voices strong objection and proposes an alternative solution. Spending more time involved in managing the building could increase or decrease the level and quality of neighbourly cohesion.

Security and safety refers to how safe building occupants feel in relation to personal safety, awareness about crime issues, the likelihood to report suspicious activity, the safety and protection of personal property and proactive action taken by residents to reduce crime or the fear of crime (Block Watch of BC, n. d.). While one typical building had plans to install a video-surveillance system on the premises (typical occupant #29), co-housing households deterred crime instead by a standardized protocol that informally introduced any new household member to the larger co-housing community.

Co-housing groups strive not to exceed 45 units (the investigated sites had only 21 and 22 units each), in contrast to a typical high-rise building that contained 80 units. Unlike typical buildings in which many occupants often admitted not knowing neighbours on their own floor, co-housing members knew immediately

whenever a non-resident entered the premises. This “recognition factor” was relied upon to strengthen community ties and also to deter theft. A co-housing member (#19) related, “. . . we absolutely know . . . the minute someone walks in, . . . and they don’t even realize that you know.”

Safety concerns influenced the ability to enter and exit typical and green buildings and monitored activity with cameras. Some typical respondents, for instance, complained about buildings requiring key fobs to open doors and elevators. While these security devices safeguarded residential access to the building, they also impeded children and bicycle users without their key fobs from entering through an underground parking entrance. A typical occupant (#29) found security regulations by a strata council in the UBC neighbourhood to be irksome:

And they keep putting in new video cameras and stuff like that. So then our strata fees go up and I think we’ve had like one break-in and nothing was stolen from that. So I don’t know why they’re so paranoid about it and now they have a security company that comes and drives through the parkade every night. And so it just seems like we’re living in Fort Knox and I don’t know why because this is such a low-crime location. I don’t think it’s necessary.

A green respondent (#8) felt that security precautions in her building discriminated against children contacting neighbours and going outdoors. She explained:

They [the management] prefer safety; you need your key or they won’t hold a spot for the elevator. It’s like all these barriers are put into place just for safety’s sake. And they [her children] need a key

to see their friends on different levels. And they can't unlock the doors which are also very heavy. So I think we have all these barriers.

Typical and green buildings followed a growing trend for surveillance and restricting certain on-site activities. Residential alarm monitoring revenue for the US home security industry increased from \$2.5 billion in 1992 to \$8.2 billion in 2006 (Security Growth Conference, 2006). Co-housing's philosophy, on the other hand, relies primarily on social connections and trust to deter crime and suspicious behaviour.

4.8 Sustainable Behaviour

Green procurement has increased almost 100% in North America since 2005 (TerraChoice, 2007) and 38% of Fortune 100 companies institute a sustainability purchasing policy (Kearney, 2007). Consumers in the United States spent almost \$300 billion on Lifestyles of Health and Sustainability (LOHAS) related products and services in 2008 (Natural Marketing Institute, 2010). Part of this trend includes green residential construction, which was a \$36-billion-a-year industry in 2008 (Melaver & Mueller, 2008) and is expected to reach \$135 billion by 2015 (McGraw-Hill Construction, 2011).

Sustainable behaviour is defined as the extent to which individuals accept personal responsibility in relation to social and ecological impacts associated with purchasing decisions (Gifford, 2002, pp. 64-65) to reduce consumption levels. While households generally reported high levels of satisfaction with their homes (m= green 5.8, co-housing 5.9, typical 5.9/7), when I probed green occupants during interviews, the aspect of purchasing green features per se was not deemed

a “dealmaker.” A green respondent (#4) admitted:

I think it’s a feel-good. I think it’s like having granite countertops. Really, if it’s a LEED, oh, we can feel good about ourselves living in a LEED building because, I think that the owners don’t have a direct connection to what it means to be a LEED building. . . . It had no impact on their lifestyle. But it’s great marketing. So therefore it’s a good thing probably.

This insight raises important implications for green technological upgrades because residing in green buildings does not necessarily change consumption behaviour. Green building assessment systems, such as LEED and REAP, measure inputs for building design, technology and performance but pay little attention to the performance of occupants residing within these buildings (Heerwagen, 2000). Besides “greening” building materials and reducing the material infrastructure in construction practices, one needs to address how residing in designated “green” buildings constitutes actually consuming less (Georg, 1999).

Communicating value by emphasizing quality and artisanship over living space square footage may help trigger sustainable behaviour. Some occupants, for example, downsized from single-family dwellings to their current condominiums, as did a green respondent (#11):

At the margin . . . the quality of the finishings in this building are much better than pretty much everything else I saw. So I decided to sacrifice space and made a deliberate decision to radically downsize.

Profiling resource-efficient products can reinforce legitimacy and decrease scepticism about environmental benefits of a product or service. As more buildings are retrofitted, demonstration projects exemplifying good practices can help influence household behaviour. Nevertheless, green certification systems currently focus on the ecological inputs and outputs so occupants need not concern themselves with the green building process. This separation disconnects the activities of professional building trades from residential occupants (Heerwagen, 2000; Cidell, 2009; Spinks, 2011).

Showcasing environmentally preferential products and promoting the long-term benefits of lifecycle costing were other ways household occupants experienced increased value and potential market demand. A green respondent (#4) explained,

My friends actually bought toilets, the Australian [brand-name] toilets, the same as mine, when they were doing renovations because they liked them that much. And they felt that they were a good product for saving water and energy. Some of the lighting as well, they went with that, too.

For typical households, price and location were the most important considerations rather than use of environmental materials or energy efficiency. For example, typical respondent (#39) explained his family's circumstances:

Most people make sustainability choices after they've considered other things that they feel are more practical or more necessary, which often have to do with finances. So, I mean, we live here because we both work and we were able to make a down- payment

for this, otherwise we would still be renting in some tiny basement apartment. That came first before any environmental consideration for sure.

Some respondents suggested the value of prominently displaying energy-conservation features in buildings through signage or other communication displays (van Dam, Bakker et al., 2010; Cooperman, Dieckmann et al., 2010). Some building web sites educated residents about innovative building performance and expected responsibilities. Display monitors or dashboards at main entrances can help monitor energy savings, greenhouse-gas emissions, resource-recovery programs, non-toxic applications and alternatives to single-occupancy use of automobiles (Darby, 2010). A co-housing respondent (#18) suggested, “green buildings should learn a lesson from the petroleum industry, which displays the price of its product on many street corners (i.e., gas stations).” A similar approach could communicate a building’s carbon emissions.

4.9 Livability

Livability was assessed by determining occupants’ satisfaction with their home environment, using Likert ratings to rank degrees of satisfaction with site location, interior space layout, storage capacity, building aesthetics, noise levels, individual utility controls and overall comfort. These characteristics did not exhibit strong correlations between the three housing types within the statistical analysis. I asked open-ended questions about why respondents selected their home, neighbourhood characteristics and general geographical location. I divided livability into sub-categories of storage and noise levels.

Households are accumulating more possessions than ever and are running out of space to store items, even though houses are larger than in previous generations. The US self-storage industry grew 740% between 1985 and 2007 when nearly one in ten households rented self-storage (Self Storage Association, 2008). Home size is a prime criterion in assessing environmental impact since additional space correlates with more construction materials, energy consumption, home décor and furnishings (Wilson & Boehland, 2010). Defining storage as designated storage space for personal belongings within the unit, building, or basement-storage lockers, I asked respondents to rank their home's storage capacity according to a Likert scale. I also asked open-ended questions during interviews about their storage capacity and preferences.

Household occupants in green and typical buildings rated the availability of storage capacity higher than did respondents in co-housing buildings (m= green 5.7, co-housing 5.2, typical 5.6/7) probably because co-housing did not have underground-storage lockers. Storage space increases the cost of total marketable floor space in a building, but can also foster a culture of accumulation. A co-housing member (#21) reflected on the lack of storage:

For me personally I think it's great because you don't accumulate things. And the idea of storage, I think I'd rather have places for people rather than things, because when you have things in storage you don't even know what you've got there half the time and then what's the point? Although there are some difficulties for people who are much more outdoorsy and then have a lot of other kinds of equipment.

Typical occupants tended to be more concerned about upgrading their condo's appearance than storage issues. When asked in a follow-up question about why she was more concerned about equipment and material upgrades rather than the availability of storage space, typical respondent (#29) commented on her upgrades; "The only thing I really did was sort of cosmetic things. Like the backsplash in stainless steel, appliances, hardwood floor--I only did hardwood floor in the kitchen and upgraded the carpets." While green respondents were generally not as concerned about basement storage, they were vocal about their unit's interior storage capacity. Upon a tour of his suite, green respondent (#10) commented:

The layout is, I'll show you, it's not a bad use of space. It's well laid out. You've got some towel storage space behind here. It's good. In new condos? Nothing. This bit here. You've got one or two basins. It's nice to have the two. More storage space for a child's bedroom. We put in an ironing board. This washroom's good. No problems with that. The space is okay. I wouldn't want it any smaller. You've got storage space on this wall . . .

While ample storage space may act as a liability from a resource conservation perspective, storage lockers can enhance livability and provide greater flexibility for downsizing to smaller homes, an important consideration within a North American context because most residents prefer single-family dwellings to condominiums.

Noise is defined as unwanted sounds from interior building acoustics and the degree of external noise outside the building that is heard by occupants. Complaints about noise were reported by residents in all three housing types

caused by running water in pipes, air-ventilation issues and people moving through hallways and elevators. I asked occupants to rank acoustics and noise levels on Likert scales. Green and co-housing occupants reported noisier environments than typical households ($p > .05$ for co-housing). An ordered logit model analyzed predicted probabilities of noise frequencies. Predicted probabilities indicated that co-housing buildings were 43% less likely to rate interior acoustics at 5/7 or higher when compared to typical occupants. North Vancouver respondents in all building types complained about street traffic, noisy back lanes and the lack of traffic-calming measures, which I observed during interviews and site visits. One green respondent (#10) complained,

The noise at times is unbelievable. They've got the sirens set to a highway and they put them on all the time. Apparently it's some local bylaw or something. So it's a major issue because of the noise. It's terrible. I've lived in many cities in many different countries all over the world and this is the worst place I've ever been for noise.

Typical occupants at UBC, such as (#28), spoke about moving to the area to avoid high density and traffic noise: "Ah, a lot of density and a lot of noise, street noise. But we don't have that here. We've got a mall, a walking mall. There isn't too much traffic here." A co-housing resident (#27) spoke about ways to mitigate traffic noise levels;

I was of course thinking maybe they could make more calming measures, like traffic calming. Make it one-way or have bigger humps that cars have to drive over much slower so that it makes it a lot more of a pain in the ass for them to take that alleyway so that cars don't have to sit there and blare or beep their horns like the

security alarms. [laughs]. That's, one of my biggest issues here is just the noise factor.

Some developments mitigate obtrusive sounds by erecting walls for sound barriers, planting trees or installing fountains. One typical development installed a running water feature beside its main entrance that successfully used "white noise" to muffle the street traffic.

4.9 Discussion

Indicator monitoring systems typically focus on the state of resource use rather than its causes, as evident in household-energy calculations, number of vehicles driven or percentage of garbage recycled versus amounts disposed. This performance-based approach disconnects systemic household consumption issues from standards and metrics. For this reason, actor-centred indicators emphasizing demand-side responses can work in tandem with performance indicators (Bonneville & Rialhe, 2006) (see Table 18). Calculating household waste disposal or energy consumption, for example, does not resolve issues related to carrying capacity, distribution or equity. When respondents reflected on the nature of how the garburator concealed the amount of waste generated by their household (e.g. #2, 18, 19, 22, 26), or why their strata council did not allow clotheslines within their building (e.g. #29, 39), a more nuanced understanding reveals how household behaviour interacts with appliances and frameworks for regulating personal behaviour.

Table 18 POA Indicators

Area	Sub-Area	Performance Centred Indicators	Actor Centred Indicators
Household occupants		Reference person's age, gender, ethnicity, when household moved in & household size.	Reasons why household moved in.
Physical characteristics of housing	Housing types	Green, co-housing, or typical MURBs.	
	Space heating	Electric baseboard, natural gas radiant heat, or natural gas forced air.	Thermostat control: manual, programmable, and how many. Ideas/barriers to reduce energy consumption.
Mobility	Driving, public transit, cycling/walking	Frequency (more or less, or the same when compared to where previously lived), taking public transit, walking/cycling, driving to work, school, and social activities. Distance (nearer, farther, same when compared to where previously lived), taking public transit, walking/cycling, driving to work, school, and social activities.	Ideas/barriers to reduce single occupancy driving.
	Personal air travel	Total number of flights and time (hours) in the aircraft from lift-off to landing during the past 12 months (work-related or partly personal and partly work-related air flights excluded).	
Food	Food preparation	How often household prepares food per week compared to where they lived previously.	
	Food preference	Ranked food preferences based on price, brand/appearance, BC grown, or organic.	Reason(s) for choosing (or not choosing) local and/or organic food.

Solid waste	Waste generation and resource reduction	Volume of household waste disposed weekly and recycled weekly. Whether kitchen waste was composted.	If kitchen waste was composted, where composted? Whether unit has a garburator and, if yes, how often used; and barriers encountered toward waste reduction.
Social capital	Socializing with neighbours	Since moving into the current home, did the household socialize more, less, or the same amount with neighbours than in previous home.	The number of neighbours the respondent knew on a first name basis
	Community living		Strategies, ideas, and barriers toward community living within a MURB and/or a neighbourhood ideas to increase access and interaction with neighbours.
	Security and safety		Practices toward increasing notions of personal safety and deterring crime in building.
Sustainable behaviour	Green purchasing		Self-reported behaviours to green purchasing. Open-ended questions.
Livability	Storage	Storage capacity in unit and building ranked with Likert scale.	Open-ended questions.
	Noise	Interior acoustics and exterior noise levels with Likert scale.	Open-ended questions.

Green buildings and associated monitoring instruments are less effective at reducing environmental impacts of their occupants than advocates often claim (Macintosh & Steemers, 2005; Leaman & Bordass, 2007; Newsham, Mancini et al., 2009). The POA approach builds on current household-consumption behaviour as an inseparable part of daily practice (Seyfang, 2006; Christen, Godskesen et al., 2007; Jensen & Gram-Hanssen, 2008; Tukker, Cohen et al., 2010). It examines how people interact with technological issues related to household operations, building design and the urban form. If living in green buildings does not necessarily shift or reduce material-consumption behaviour, planners, designers

and policy makers should look for more effective ways to involve their users in the design and to develop and apply appropriate tools, practices and protocols.

Because the development industry has focused on performance (e.g. using LEED, REAP and other third-party green certification schemes) to increase efficiency levels instead of how performance is affected by household social practices, occupant behaviour often gets overlooked. Unless building and associated professional trades take these matters into account, material consumption levels could continue to increase. Green certification schemes fail to question why household consumption rates continue to increase despite the latest generation of technological advances (Spinks, 2011). For instance, furnace and appliance upgrades to curb energy use are promoted while disregarding the growing array of electrical appliances and electronics in the modern household (which include an average of 25 electronics per household that use stand-by power in Canada) (Song, 2008). Integrating social practices into building design by applying performance and actor-centred indicators provides a corrective to this approach by aligning household activities to global drivers that link resource consumption to the household mindset. My POA approach considers contextual issues because conventional household operations and resource boundaries often extend beyond the front door of the home.

Analysis of the seven indicator areas suggests that social capital influenced resource consumption in all three housing types but especially in co-housing developments because of its potential to lower household consumption levels. Faulty thermostats in a green building were fixed by a neighbour rather than relying on a building maintenance professional or an electrician. Learning about neighbours' travel needs facilitated ride-sharing and collective parking

arrangements at the two co-housing developments. Green and co-housing households were more likely to initiate a bulk-buying program with a farmer. Composting in all three housing types was more likely when programs were initiated by a passionate individual(s) to institutionalize change that over time convinced other occupants to shift their behaviour toward waste. Co-housing also accommodated recycling more effectively within their building due to their flexibility in how they used their common spaces (such as parking) and adapted collection areas for tote receptacles.

Strata councils are pivotal actors in managing household consumption, providing a nexus of information exchange and communication between the building environment and its occupants. Because they are made up of volunteers with little experience in building maintenance and performance, they often hire a professional manager to perform tasks mandated under the act, including preparing annual budgets and maintaining adequate reserve funds for maintenance and repairs. The degree of a strata council's level of engagement, sophistication and knowledge can significantly influence household consumption, yet there is no incentive structure to educate or guide members in attaining more sustainable objectives. The internet and electronic communication offer strata councils powerful means to heighten awareness among occupants about building operations. Ecological building features can help educate and reinforce expected practices, but strata councils remain major players in mobilizing action.

The findings reveal many opportunities for households to interact more meaningfully with building management. Of the three housing types investigated, co-housing has the most sophisticated strata council in terms of

consumption due to its holistic approach toward management issues and decision-making. In the absence of on-site managers, occupants were expected to share in committee work designed to maintain their complex. In addition, co-housing respondents exhibited stronger altruistic characteristics and a greater disposition to volunteering, which kept maintenance fees lower than for typical or green buildings.

While green procurement practices in the green buildings highlighted energy-efficient appliances and finishings, the household technological innovations often failed to impact their occupants' purchasing, travel or food consumption habits. Typical and green occupants had basement-storage facilities while co-housing opted instead to add common space instead and have occupants either downsize or store their possessions off-site (e.g. #15, 17, 19).

4.9.1 Vignettes

Key characteristics of the different housing styles are highlighted in three vignettes. They are presented to provide an overview of the contrasting lifestyles that were observed and documented in the green, co-housing and typical housing sites during the resident interviews and site visits.

Judy (not her real name) lives with her partner in a high-performance green building they bought, based on the best price for the location and the view from the 10th floor. Because they travel a lot with their work, they also wanted a “maintenance-free” home where their vehicle, a 2010 Toyota Prius Hybrid, would be safe. They love the layout of their unit and the abundant direct sunlight they receive from their floor to ceiling windows, although they sometimes notice a loud clanking sound from their vent above the kitchen when water is turned on

upstairs. Though they have thermostats in each room of their unit, they mostly use their gas fireplace for heat, liking the ambiance of live flames leaping about. They keep the fireplace on for 8-10 hours per day when at home during the winter months. They enjoy entertaining guests, and several friends have commented on their granite table top and top-end German appliances. They did not know much about LEED before they bought their unit, but have had enough conversations with friends to be able to point to key building environmental features like fly ash in the concrete and their roof-top garden. They are one of a handful of households that compost in their building and take their bucket up to the green roof where they were fortunate to get one of the building's six garden plots. They are thinking about growing vegetables there next summer but currently have an array of flowers. They shop regularly at Capers, a high-end organic grocery store, and stop in at nearby Starbucks for their morning latte ritual. Judy would like to use public transit, but finds it takes too long to get to work, where she receives free company parking; her vehicle gets twice the fuel mileage her last car did so she feels that she's earned the convenience. She regularly donates to the World Wildlife Federation and is looking forward to her upcoming trip with an old high-school classmate to Mexico.

Unlike Judy, Susan lives with her two children in co-housing and is content with her home. She is one of a few remaining families that moved in when the development was built 10 years ago. She is interested in staying in her unit past her retirement as she intentionally chose a ground floor unit where she would not have to worry about climbing stairs or taking the elevator. She takes the bus to work; the bus stop is only a 3-4 minute walk away, and uses a shared Co-op car that is located a half-block away when she needs to do errands and

buy groceries. She converted her laundry room into a little office nook because her family uses the building's common laundry facilities. In the summer she hangs her clothes out to dry on clotheslines. Her family regularly eats once a week at the scheduled "co-housing meal," saving her time in dinner preparation after coming home from work. The last co-housing meal was a "100 mile diet" dinner where everyone brought local food to share. She gets her beef from a buying club that her neighbours formed to purchase local beef and poultry every few months. She composts and likes the way her kitchen scraps rejuvenate the garden's soil each spring. When her daughters were young, Susan was part of a child-minding co-op with other young families in the development. She doesn't know anything about computers but is thankful her neighbour Steve does. When she has a problem with her computer, he helps her trouble-shoot, and she rewards him with a batch of fresh-baked cookies. Susan doesn't work on Fridays but volunteers at her daughter's school library, which needs assistance since it recently had its budget cut.

George lives in typical housing and is generally complacent about his consumption patterns. He pays for his mortgage, utility bills and strata fees but is constrained in his ability to change his unit's heating temperatures due to a lack of information and know-how. He feels safe in his building and neighbourhood yet doesn't know many of his neighbours, besides saying good morning as he heads to the basement parking garage and drives to work. He could have applied for another parking stall when he purchased his unit, but since he lives alone he considers one stall sufficient. He makes sure to carry his keys with him wherever he goes as he already was locked out of his building once and had to call the property manager to gain entry. He likes the look of his building and its tidy

image. He agrees with keeping personal items off the balcony or at least out of sight from ground level. He purchases groceries at the large retail-format “box” store on the way home from work about once per week because it is convenient and he gets the best variety for the price. He recycles his paper, cardboard, plastic containers and bottles but doesn’t feel composting is necessary because he has a garburator. His only complaint upon move-in was the “new building smell” that took about six months to dissipate.

4.10 Conclusion

The POA approach emphasizes how both the physical structures and social interaction of its occupants influence household-consumption levels. Within the sites investigated, co-housing’s use of shared space and holistic approach to consensus-based decision making are the most innovative. Co-housing occupants also enjoyed higher levels of satisfaction with their living conditions and consumed differently (and in some instances less) when compared to green or typical households. Occupants in green and typical developments consumed comparable amounts of resources, but in some cases green occupants attempted to “buy” a more sustainable lifestyle without any corresponding change in consumption patterns.

Once causes of consumption are more fully exposed, households can proactively plan for a future without fossil fuels, rather than passively wait for technological breakthroughs. Quayside Village, for example, constructed its own on-site recycled grey water system with future aspirations to undertake a carbon neutral retrofit. Mobilized households can form critical economies of scale to

undertake initiatives like renewable energy projects or regenerative design, based on greater levels of cooperation, trust, financial investment, and risk-taking.⁴⁰

⁴⁰ I borrow the term “regenerative design” from Van der Ryn and Cowan, who use the phrase for creating buildings, infrastructures, and landscapes that are truly restorative rather than merely diminish the rate at which things deteriorate to a worse state. See Van der Ryn, S., & Cowan, S. (2007). *Ecological Design*. Washington, DC: Island Press.

CHAPTER 5:

5.1 Policy Implications for POA and Sustainable Consumption

The need to focus on consumption, metaphorically the belly of the beast, represents the major challenge to adopting more sustainable lifestyles. If greener practices can save humanity from consuming itself to death, socio-cultural perspectives must coalesce more fully with the physical environment, because innovation has failed to move us fast enough in a sustainable direction (Boothroyd, 2000, p. 160). This is, in part, due to an emphasis on supply-side discussions that shape the built environment and tend to refrain from addressing the increasing stress on the Earth's carrying capacity and life support systems that disproportionately affect the poor (Millennium Ecosystem Assessment, 2005; UNEP, 2007). Nonetheless, innovation that targets demand-oriented measures to shift household consumption is usually limited to performance-based approaches to measure resources in a building (Cooper, 1999; 2001).

By using quantitative and qualitative evidence, POA examines ways to mitigate household consumption from demand-side perspectives and provides insights into how occupants routinely interact in the built environment (Cole, 1999; 2010). Due to disparate gaps in communication (Heiskanen, Lovio et al., 2010), among the building design and construction, professional trades and service providers and occupants, additional strides are necessary to assist in the uptake and efficacy of policy interventions (Brown, Chandler et al., 2008; Brown, Chandler, et al., 2009; Timmerman, Prinet et al., 2009; Gill, Tierney et al., 2010;

Gupta & Chandiwala, 2010). POA can assist in monitoring consumption while drawing linkages between buildings and the social practices of their users.

Besides directly affecting resource consumption in the building sector, a lack of feedback from those working and living in buildings creates a chronic “workforce knowledge gap” (Brown, Chandler et al. 2009, p. 10). Buildings have become fragmented into an assortment of specialized building types, trades, associations and financial servicing sectors that create unique challenges to stakeholders and decision makers involved in a building’s design, construction, finance and occupancy (Stevenson & Leaman, 2010; Ehrhardt-Martinez, & Laitner, 2010). Merging a traditionally low-tech, brick and mortar industry (Lowe & Oreszcyn, 2008) with the modernity of socio-technological processes and behaviours, the building industry challenges its physical infrastructure boundaries and disciplines to form integrated realms of understanding (Cole, 1999). The marginalization of the household in the building process often leads to daily activities being set aside from contemplation (Hoyer & Holden, 2001; Macintosh & Steemers, 2005; Guy & Shove, 2007; Gill, Tierney et al., 2010). POA is my attempt to monitor these activities through seeking ways to rethink and merge socio-technical tendencies with occupant behaviours in housing environments.

Multi-unit residential buildings require a different building approach from single family dwellings because of the use of different construction materials, ventilation and energy requirements, ownership structures and issues of scope, scale and tenure. MURBs also differ from commercial buildings due to contrasting occupancy periods, building purpose and potential privacy and security concerns. These discrepancies result in few developers or trades people

with sufficient training on the latest technologies, standards, regulations or best practices unique to MURBs. A phenomena that is also prevalent is building-code officials and property managers lack skills to evaluate compliance or maintain optimal levels of efficiency in buildings (Brown, Chandler et al. 2009; Gill, Tierney et al., 2010). These realities are enhanced by outdated and insufficiently enforced building codes that can inhibit the development of markets for high performance building design and construction (Brown & Southworth, 2008).⁴¹

Besides a culture of outdated building codes, the building sector faces other barriers that inhibit effective targets for resource consumption. Incomplete information about emerging technologies and their cost-effectiveness to gain market penetration is met by financial providers adverse to change (Brown, Southworth et al., 2005, Brown, Chandler et al., 2008).⁴² Government backed incentive and rebate programs often communicate mixed-messages due to price signals that on one hand heavily subsidize fossil fuels, but then on the other offer marginal tax-credits or rebates for renewable energy (Dator, 2010; Wolff & Schönherr, 2011; Hendrickson, Lindberg et al., forthcoming). Households are often not cognisant of payback periods, or length of time to recoup a capital investment, when making long-term improvements.⁴³ Meanwhile, the lack of financing to access credit for energy-efficient upgrades by private developers,

⁴¹ In the United States, for example, nine states have residential energy codes that are more than a decade old or do not follow a residential energy code. See Brown, M. A., Southworth, F. and Stovall, T., (2005). *Towards a Climate-Friendly Built Environment*. Arlington, VA: Pew Center on Global Climate Change. Retrieved March 1 2011, from http://www.pewclimate.org/docUploads/Buildings_FINAL.pdf.

⁴² Brown, Chandler et al., (2008) state that “insufficient validation” is often equated with “technical risk” for slow adaptation of the latest building technologies.

⁴³ Brown and Southworth (2008) suggest that most energy efficient equipment and appliance technology can succeed if efficiency improvements offer an eight-year payback period (or shorter), provided that other customer-valued features, amenities and conditions are maintained.

public agencies and households creates further inertia. On a national level, greenhouse-gas emissions policy related to future energy prices and the carbon legalities result in a reluctance to innovate.

These market and regulatory barriers conceal the habitual consumption patterns of households and detract from formulating comprehensive strategies to target consumption as related to the urban form (Southerton, Chappells et al., 2004). Physically, the building environment “locks-in” obsolete technologies that accompany set behavioural patterns at home (Sanne 2002). Due to these barriers, performance and actor-centred approaches can help frame a selection structure by using collective social context and conditions promoted by appropriate policy drivers rather than resort to personal preference (Barr & Gilg, 2006; Guy & Shove, 2007; Jensen, 2008; Lovingood, Stamminger et al., 2011).

The preliminary evidence presented in this study demonstrates that household behaviour and routines require further investigation in the building sector (Bordass, Leaman et al., 2001; Stevenson & Leaman, 2010; Leaman, Stevenson et al., 2010). It does this by measuring performance and actor-centred approaches to develop a context for how greater social cohesion, governance and resource sharing can promote conditions for reducing consumption. It also suggests that municipal, provincial and federal jurisdictions need to target household consumption, but governmental inaction and blurred jurisdictional boundaries make it difficult for governments to respond effectively (Kaatz, Root et al., 2005). For example, mobility patterns are not just about measuring distances and times, but involve attitudes and social processes about travel convenience and comfort, and ecologically benign methods to move people and goods (Lund, 2003; Holden, 2007). They are covered by federal fuel-efficiency

regulations, provincial driving laws and regional or municipal transit policies. Likewise, conventional economic analysis often assumes a neutral stance toward household behaviour (UNEP, 2011). For example, consumer behaviour is dictated by unlimited utility and complete information.

When socio-cultural factors are integrated into building design, household boundaries extend beyond the front door to the basic structure and governance of communities (Cole, 1999; Bordass, Leaman et al., 2001; Wolff & Schönherr, 2011). Gardening, for example, may be viewed as a favourite pastime, yet is increasingly perceived as a food security issue that connects residents to the natural environment, offers seasonal food variations and contributes to dietary knowledge (Comstock, Dickinson et al., 2010). Gardening inventions may, however, be affected by federal mandates from Agriculture and Agri-Food Canada or Health Canada, provincial jurisdictions from the Ministry of Agriculture, Ministry of Health and Ministry of Education, or locally within social planning or policy departments. These somewhat arbitrary jurisdictions along with ineffective policies create piecemeal programs working at cross-purposes to get local food onto dinner plates (Seyfang, 2006).

5.2 Physical Characteristics of Housing

The POA approach examined physical characteristics of housing that compared the three housing types, space-heating varieties (electric baseboard, natural gas radiant heat, and natural gas forced air) and thermostatic interior heating controls. POA should focus greater attention on energy due to its central role in greenhouse-gas emissions and climate change. Methodological challenges

to overcome include data access to residential utility bills and verification of interior space.

The POA survey instrument did not differentiate common and collective energy uses within the unit or building that allowed for detailed energy calculations. Obtaining individual unit square footage and utility bills from building managers is challenging due to confidentiality issues and some occupants did not know the exact size of their units. MURBs that bundled energy consumption using master-metered configurations for controlling temperature provided households with less ability to control their temperature settings and track energy use with the POA approach. This irregularity was problematic because there is less incentive to turn off heat when occupants are not individually responsible for their heating bills. For instance, it is cheaper for a developer to install a single-monitor gas fireplace system than provide individually monitored inserts. Households then keep fireplaces lit out of self-interest because they view the heat as a shared but limited resource. Having no incentive or penalty to turn off the fireplace results in overuse and waste, and the “tragedy of the commons” gets played out in living rooms throughout the building.

Policies that focus on physical characteristics of housing should focus on making energy more “visible” and emphasize ways to reduce and profile energy consumption rather than solely measure energy usage. Energy’s invisible nature is one reason why the amount of electricity use goes largely unnoticed (Brown, Chandler, et al., 2008; Brown, Chandler et al., 2009; Ehrhardt-Martinez, Donnelly et al., 2010; Gram-Hanssen, 2010; Grønhøj & Thøgersen, 2011). In a country of

climate extremes such as Canada, the amount of energy required to heat and cool homes consumes a significant portion of a household budget, one-quarter of the nation's energy consumption, yet few feedback mechanisms monitor, evaluate or intervene when the energy grid nears capacity or becomes more expensive to use. An important consideration considering utility costs represent 25 to 35% of controllable costs in MURBs (US EPA, n. d.).⁴⁴

Information technologies that focus on direct occupant feedback and energy- control such as thermostats can affect household-energy consumption (Wood & Newborough, 2007; Burgess & Nye, 2008; Tukker, Cohen et al., 2010). Nevertheless, Brown et al., (2008) suggest that temperature feedback alone is unlikely to maximize household-energy savings. Adapting human dimensions to energy use can enhance motivational effectiveness and change cultural norms and social practices (Schultz, Nolan et al., 2007; Nolan, Schultz et al., 2008; Gram-Hanssen, 2010, Ehrhardt-Martinez & Laitner, 2010; Grønhøj & Thøgersen, 2011). For this reason Natural Resources Canada's Office of Energy Efficiency should work with provincial utilities, such as BC Hydro and Terasen Gas, to redesign thermostat interfaces that make it more intuitive for people to conserve energy (Thaler & Sunstein, 2008).

A proliferation of smart meters and digital home dashboards that display energy consumption through real-time tracking has entered the market. Past evidence suggests that these digital displays will not provide the appropriate

⁴⁴ Reducing energy use by 15% in a typical 250-unit building will increase net operating income, and can enhance asset value by over \$1 million (using a 6% capitalization rate). In a similarly sized individually metered community, this same savings may increase asset value by over \$130 per unit or \$200,000 annually. See US EPA. (n. d.). Energy Star for Multifamily Housing. Retrieved March 1, 2011, from http://www.energystar.gov/index.cfm?c=multifam_housing.bus_multifam_housing

contextual information, non-financial incentives and user mechanisms to work independently to reduce home energy (Brown, Chandler et al., 2009). Television screens or computer monitors are used to display complex and interactive consumption data (Ueno, Inada et al., 2005; Benders, Kok et al., 2006). The Google PowerMeter, for example, can indicate how much it costs to leave a television or computer on, but it requires logging on to the internet to do it. Installing a monitor can convert kilowatts and kilojoules into more readily comprehensible dollars and cents, suggesting ways to reduce heating, cooling and water-consumption costs by making them more transparent (Fischer, 2008). Perhaps more effective would be the placement of electronic monitors in high traffic areas. Reported savings typically range around 10% for relatively small panel displays (Mountain 2006; US Department of Energy, 2009; Darby, 2010). Profiling energy consumption in this manner could be an important advancement over traditional practice of hiding utility meters in obscure corners of basements, boiler rooms or building exteriors.

Smart meters can provide instant information, but how much, and under what circumstances, do they actually change behaviour (Darby, 2010; van Dam, Bakker et al., 2010; Grønhøj & Thøgersen, 2011)? A more intuitive approach using ambient information may be used to monitor energy consumption (Martinez & Geltz, 2005; Palm & Ellegård, 2011). Ambient information does not show text or numbers, but alerts the occupant to the fact that energy consumption has changed (Darby, 2006). One study provided utility customers in California with a glass orb programmed to change colours as the price of electricity increased during peak periods. Households so equipped reduced

peak-period energy use by 40%, suggesting that user feedback may be more susceptible to subtle but continuous messaging (Thompson, 2007).

When utility bills are received, the primary instruction is to pay the bill. A homeowner lacks feedback on individual equipment performance, energy leaks or ways to conserve. Indirect feedback such as monthly utility bills can show trends over time and how heating or cooling is spread throughout the year. Utility bills can also be used to compare the present period with the previous year to determine fluctuations due to new occupants, extreme weather or equipment upgrades (Darby, 2006). Nevertheless, the use of direct debiting for making payments implies many miss out from receiving feedback.

Home-energy reports can provide occupants with engagement mechanisms for occupants to learn incrementally about energy. Strategic information and advice associated with upgrading appliances or how to apply for rebates can invoke social motivations to reduce consumption (Ehrhardt-Martinez, Donnelly et al., 2010). For example, Efficiency 2.0⁴⁵ designs customized savings plans to increase occupant knowledge, information, goal-setting and feedback engagement in energy decisions. Utility bills or variations of energy-saving plans or reports do not require advanced metering hardware, but focus on tailored behavioural recommendations to engage occupants in the energy-saving actions (Ehrhardt-Martinez, Donnelly et al., 2010).

Regulatory building code changes should ensure individual metered grids are installed in MURBs rather than a common meter for an entire building to encourage individual cost and energy savings. Until renewable fuels and energy

⁴⁵ See Efficiency 2.0. (2009). Residential Energy Efficiency. Retrieved March 1, 2011, from <http://www.ency20.com>.

efficient technologies are cost-effective, installing inefficient electrical baseboard heating will remain the norm (Lawrence, Mullen et al., 2005). Working with property-management companies to monitor a building's consumption data on a monthly basis could benchmark and compare energy usage on a building by building basis and prioritize those requiring more immediate retrofits and upgrades. Clear, reliable information about building-energy performance is critical toward increasing energy-efficiency initiatives. Information can also be reported to householders through energy labels on buildings (Cooperman, Dieckmann et al., 2010). In the European Union, buildings must track and display energy performance when built, sold or rented.⁴⁶ These practices should be mandated by housing authorities in the rental sector, such as BC Housing, to identify the housing stock most needing repair (Forty Percent House, 2005). North American municipalities could look for collaborative methods to display their energy consumption or greenhouse gas emissions at a neighbourhood level to influence social norms, compete with other locations and showcase collective conservation practices.⁴⁷

5.3 Mobility

The POA methodology compared an occupant's travel modes by driving frequency and distance to where occupants previously lived and investigated personal air travel. While respondents' reported location was of primary

⁴⁶ See the European Commission's Directive on the Energy Performance of Buildings that requires an energy performance certificate be made available to the owner in case of new construction, or to a prospective buyer or tenant in case of rent or sale European Commission Energy. (2011). Energy Efficiency. Retrieved March 1, 2011 from http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm.

⁴⁷ For example, the City of Vancouver's district community energy utility at SE False Creek installed a coloured LED lighting to indicate different degrees of energy consumption in the neighbourhood (see Hendrickson, 2010).

importance, distance, frequency and cost influence modal shifts as well as population densities (Pushkarev & Zupan 1977; Pushkarev & Zupan 1982; Frank & Pivo, 1994; Steg & Gifford, 2005).⁴⁸ Rather than resort to detailed travel logs that exceed the scope of the POA, a simplified process should focus on assessing a household's distance, time, convenience, comfort and cost to public transit and work destinations.

Federal policy interventions, such as the US Environmental Protection Agency's Clean Air Act, require limits to internal combustion engines that create greenhouse-gas emissions and affect air quality in the US (Hoyer & Holden, 2001; van Diepen & Voogd, 2001; Holden, 2004; Brown & Southworth, 2008; Perkins, Hamnett et al., 2009). Single-occupancy vehicle travel is prolific because of its convenience and relative cheapness, but insufficient attention is directed at the environmental impact of fuel, road, insurance and parking subsidies.

Most developments ensure that parking is abundant, and that each residential unit has at least one stall. Developers often view ample parking as an important marketing feature for their projects. Flexible parking standards, on the other hand, can reduce resources and save costs when residents are encouraged to leave their cars at home and take public transit. Dockside Green in Victoria, BC, for example, allocates one co-op Smart™ car per MURB, offers a \$25,000 discount to households that opt out of a parking stall, and subsidizes a bus to connect their immediate community to city transit. Provincial building codes should establish maximum parking requirements in MURBs rather than minimum parking requirements.

⁴⁸ The average person in North America is willing to walk five minutes to transit (see Condon, 2010).

Municipal authorities can offer developers incentives to reduce the need for parking stalls, and make it more expensive to park on streets. Some municipalities in Metro Vancouver, for example, have introduced bylaws enabling developers to reduce parking ratios by three parking spaces for every ride-share vehicle and associated stall. Toronto has approved its first car-free condominium rising 42 stories along with 315 bicycle stalls (Vincent, 2009). Strata councils can charge higher fees for parking stalls in their buildings. Changing public perception about parking is needed to offset growing pushback from real estate marketers who may be more reluctant to modify existing regulations.

Besides looking at vehicle-parking capacities, driving insurance should be modified to reward less driving with reduced fees. Limited-use insurance options could encourage motorists to travel less or in smaller vehicles. Instead, the Insurance Corporation of British Columbia (ICBC) opts for a flat-rate approach that encourages driving rather than encouraging sustainable travel modes or pay-per-charge.⁴⁹ Ride-sharing vehicles within parking garages or in close proximity to MURBs could reduce parking stall numbers. ICBC should implement pay-as-you-go driving insurance that has been piloted in Oregon.⁵⁰

⁴⁹ For example, the Cooperative Auto Network (modo) and Zip Car™ are ridesharing services in Metro Vancouver, yet remain marginalized due to the popularity of car ownership. For example, CAN has approximately 2,500 members (2010) compared to the 271,398 small and large passenger cars, light trucks, vans, and sports utility vehicles in the City of Vancouver alone. See Government of BC. (2010, June). Vancouver City: Updated 2007 Community Energy and Emissions Inventory. Retrieved June 25, 2010, from http://www.env.gov.bc.ca/cas/mitigation/ceei/RegionalDistricts/Metro-Vancouver/ceei_2007_vancouver_city.pdf.

⁵⁰ Oregon encourages pay-as-you-go automobile insurance by offering tax credits for insurance companies with a mile-based or time-based rating plan. Three of 134 companies offer "pay as you drive" options for personal-use autos. See Oregon Gov. (n. d.). Pay as You Go Auto Insurance: Available in Oregon? Retrieved March 1, 2011, from <http://insurance.oregon.gov/consumer/auto-insurance/pay-as-you-go.html>

Mobility is also related to land- use and accounts for 35% of a city's ecological footprint, so an important action for municipalities to take is to minimize fossil-fuel consumption (Wilson & Anielski, 2004). Households located in core-area neighbourhoods produce fewer greenhouse gases from weekday urban trips than those in dispersed neighbourhoods (Holtzclaw, Clear et al., 2002; Dunphy, 2004; Renne, 2008, Gray, Gleeson et al., 2010). Residents in Canadian urban neighbourhoods, for example, average 36-60% lower vehicle-related GHG emissions than those residing in outer areas (IBI Group, 2002).

Municipalities that are geographically more compact are also less costly to service and these savings should be passed on to residents. Existing communities can be made more efficient by adding infill development on vacant land, allowing mixed uses that reduce transportation requirements and building new pedestrian and bicycle paths to encourage non-motorized travel (Brown & Southworth, 2008; Gray, Gleeson, et al., 2010). Compact development is estimated to save 8% in development costs in the US, which by itself could reduce local government deficits 10% by 2025 if recouped (Burchell, Downs et al., 2005). Jobs in close proximity to residents also contribute to shorter commute times and local economic development if people opt to live near their job (in a Canadian context). One study compared a Vancouver neighbourhood to a suburb in the Fraser Valley, finding 38% of Vancouver homes were within a kilometre of rapid transit and 252,000 jobs were within a 5-kilometre radius. Only 3% of homes in the Fraser Valley suburb were within a kilometre of rapid transit and 26,000 jobs within a five-kilometre radius (IBI Group, 2002). Another study revealed that when using lifecycle-costing analysis to estimate development costs, high density neighbourhoods were as much as 50% more cost

efficient than low density neighbourhoods (Dillon Consulting Limited, IBI Group et al., 2005).

Sustainable mobility modes of walking, cycling and using public transit are more viable when destinations are close to home and pedestrian and cyclist infrastructure exists. One US study estimated that doubling density would reduce travel-related greenhouse-gas emissions by 5% (Ewing, Bartholomew et al., 2007), with urban households spending half as much on travel expenses as those in the suburbs (Hagler Bailey Services, 1999). MURBs in compact areas conserve resources, save municipal expenses and create economies of scale to implement more favourable actions with greater service-to-volume ratios (Punter, 2003). Nevertheless, the property-tax system favours single-family dwellings in suburban areas over higher density compact communities (Holtzclaw, Clear et al., 2002; Brown & Southworth, 2008). British Columbia Assessment could replace the assessed market value of residential properties with a Location Value Charge (LVC). The LVC will capture increased land value that results from infrastructure and development financed by the surrounding community. LVC separates property assessments from building and land values. Instead of paying tax on the total value of property, only the unencumbered value of the land parcel is charged, without taking into account the value of any improvements or buildings.⁵¹

Development Cost Charges (DCC) are another example of ways to reflect

⁵¹ Pittsburg, PA implements a type of LVC and variations are proposed by the Green Party of Ontario. See Dye, R. F., & England, R. W. (Eds.). (2009). *Land Value Taxation: Theory, Evidence, and Practice*. Cambridge, MA: Lincoln Institute of Land Policy, and De Jong, F. (2008 February 12). Tax land, not Homes, *Ottawa Citizen*, Retrieved March 1, 2011, from <http://www.canada.com/ottawacitizen/news/opinion/story.html?id=97ccfb95-1f45-4356-bd92-a79b2611b84>. Also see George, H. (1879). *Progress and Poverty*. New York: D. Appleton & Co.

differential costs for buildings to better reflect the true costs of roads, water lines, drainage and other community amenities. Areas well serviced by transit and with higher density development (e.g., MURBs) should have lower charges than in greenfield development sites that require higher servicing costs. Provinces should mandate municipalities to ensure DCCs reflect the internalized cost of development and refrain from spreading out higher costs of greenfield development across its jurisdiction.

Local government bylaws increasingly facilitate compact development, yet many still inhibit the development of compact communities (Curran & Leung, 2000). Zoning bylaws have historically created barriers by restricting infill housing or artificially separating commercial from residential usages (Curran, 2003). Development standards, for example, often restrict narrower road standards or reroute natural drainage systems.

Dockside Green aims to be greenhouse gas-neutral, treat its own wastewater and sewage, provides public amenities and obtained LEED Platinum certification (Dockside Green, n.d.). Although the development has generated much public attention, this development became attainable only after the municipality's commitment to adopt alternative bylaws and comprehensive zoning. The provincial government should encourage alternative bylaws and comprehensive zoning within the legislative provisions of the *Local Government Act*.⁵²

Besides land-use issues, air travel is an increasing high impact greenhouse

⁵² The *Local Government Act* was established in 1996 to modernize legislation and give municipalities and regional districts in BC more autonomy to meet community needs and expectations. See Government of BC. (1996). *Local Government Act*. [RSBC 1996] Chapter 323, Victoria, BC: Queen's Printer. Retrieved March 1, 2011, from http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/96323_00.

gas emission issue often overlooked when investigating household mobility (Lynas, 2007; Goodall, 2007; Holden, 2007). The POA survey calculated hours of personal travel and queried personal air-travel behaviours. Air-travel quotas may prove to be increasingly significant as voluntary carbon-offset purchases and personal carbon-quota frameworks develop (Fleming & Chamberlin, 2011). A carbon offset allows an individual to mitigate climate change by making a financial contribution to offset his/her own carbon emissions. In exchange for this contribution, carbon-offset suppliers invest in projects to reduce carbon emissions, such as renewable energy and reforestation projects (Jacobsen, 2011). Carbon offsets are an increasingly popular option that offset 10.2 million metric tons of carbon in 2007.⁵³ Voluntary carbon quotas are currently being proposed to allocate personal carbon quotas on a capita basis when using fossil fuel within national carbon budgets (Hillman, Rajan et al., 2008; Fawcett & Parag, 2010). Individuals emitting at a level above their initial allocation would be able to purchase additional credits from those using less, creating a market for households that emit at a level below that permitted by their initial allocation (Fleming & Chamberlin, 2011). Transport Canada's should work in conjunction with Statistics Canada, the International Civil Aviation Organization (ICAO) and the ICAO's Committee on Aviation Environmental Protection (CAEP) to develop sub-national emission levels and standards for the reduction of greenhouse-gas and air-pollutant emissions from aviation sources.

⁵³ Estimated amounts were purchased through Carbonfund.org, an organization that has various quality-assurance measures (see Jacobsen, 2011).

5.4 Food

POA indicators ranked household-food preparation by estimating how often occupants prepared food at home, and whether it was more or less frequent than where they previously lived. While eating outside of home is deemed more efficient, food and customer travel to restaurants affect impacts (Sonesson, Anteson et al., 2005), as well as nutritional aspects of eating outside the home that should be considered when assessing food qualities (McCrary, Fuss et al., 1999; Kearney, Hulshof et al., 2001; Burns, Jackson et al., 2002; Guthrie, Lin et al., 2002; Nielsen, Siega-Riz et al., 2002; Nielsen & Popkin, 2003; Kant & Graubard, 2004; Jabs & Devine, 2006). Household preferences based on price, brand/appearance, BC grown and organic food choices are important considerations to consider, yet the term “local food” continues to lack clarity (Renting, Marsden et al., 2003; DuPuis & Goodman, 2005; Smith & MacKinnon, 2007; Feagan, 2007). The amount of red meat consumption should be another aspect included in POA approaches (Weber and Matthews, 2008b).

From a policy perspective, healthy food consumption involves eating less meat, consuming and growing more unprocessed food locally and participating in active lifestyles. Canadians are moving in the opposite direction, eating more red meat (13 kilograms per person in 2007), exercising less, spending more time in their cars and ballooning in size (Frumpkin, 2001; Ewing, Schmid et al., 2003; Lopez, 2004; Lawrence, Saelens et al., 2007; Poortinga, Gebel et al., 2011). While one out of three children in the United States are overweight, obesity rates of children in Canada have tripled in the past 20 years (Canadian Population Health Initiative, 2004). Some countries in the European Union, for example, are contemplating a “fat tax” on unhealthy food choices (ABC News International,

2010). Revenue Canada and Health Canada should investigate collecting “fat taxes” from fast-food outlets and vending machines that are used to supplement local and organic farmers.

Re-localizing food chains has emerged as a local economic initiative due to its apparent benefits (Graham, Healy et al., 2002; Gibson-Graham; 2003; Seyfang, 2006; Swenson, 2007; DeWeerd, 2009; Little, Maye et al., 2010). Some groups are initiating interventions to more conventional food products. A study in Portland, Oregon tested whether elementary children accustomed to mass-produced institutional lunches would tolerate local fare. Since cost was the major consideration driving school-food purchasing, local farmers missed out on Oregon’s \$70 million school-lunch market. When a grant provided seven cents per meal subsidy for local produce, it generated 84 cents of economic activity per dollar, compared to 50 to 60 cents per dollar on a typical product or service. Children also reported they liked the food better (Richardson, 2007). Provincial agriculture and education departments should target initiatives to highlight food programs and educate citizens about regional food specialities. Of the food British Columbians consume 48% is produced in the province (Balfour & McAdam, 2007), but tracking needs refinement (Wilson & Anielski, 2004).

5.5 Solid Waste and Recycling

The POA approach quantified waste by having respondents report the volume they disposed and recycled each week. Composting was more applicable if households did not have garburators or had access to composting facilities. For households that compost, if there is organic kitchen waste it is placed into another bin or outdoor compost pile (Sundberg, Franke-Whittle, et al., 2011). A

three-pronged approach had residents sort two paper materials, glass and plastic containers into three different bins. The findings identified co-mingling and source separation as the two collection strategies practiced, yet some residents reported a lack of collection space, fear of odours and rodent issues, and thus avoided collecting materials outside of glass, mixed paper, cardboard and #2, #4, and #5 plastics.

Advantages to co-mingled municipal recycling systems are no special recycling fleets are needed, residents are more likely to participate in programs due to simpler separation requirements, marginal cost of collection is lower, less truck traffic is observed and more flexible collection service is attainable (Goldstein, 2003; Ferrara & Missios, 2005). MURB occupants rely on private haulers to pick up their waste that are not arranged by a municipal authority. Source-separated systems can decrease quantities of garbage to be disposed, incur less maintenance of separation equipment and receive less contamination, which therefore incur less labour costs (Biddle, 1998; Cuyler, 2002; Emerson, 2004; Goldstein & Spencer, 2007). Co-mingling often uses automated recycling systems that lack inspection for contamination by labourers, which contribute to higher contamination rates. One study suggested that while collection costs go down significantly, a single stream-collection facility requires a capital investment approximately 20% higher than a source-separated facility. Labour costs may also be as much as 10% higher due to sorting at the recycling facility, even when overall participation rates increase (Goldstein, 2003).

In summary, evaluation of municipal waste-collection systems is complicated due to volatile market economics for recyclable materials, a range of diverse municipal infrastructure and disparate levels of public awareness

(Gamba & Oskamp, 1994; Barr, Gilg et al., 2005). A proliferation of residential mixed paper has created lower quality paper products that can also skew paper recovery quantities. Unit interiors require a flexible space for storing containers and paper products. Convenient and appropriately sized in-unit receptacles help reinforce behaviour change and pass recouped financial savings to occupants. Maximizing resource recovery requires a measure of adaptation and flexibility to accommodate regulatory changes like material bans. Establishing a culture of sorting materials into separate bins, rather than combining materials, meets resistance from occupants and property managers alike. Commodity price fluctuations and compliance with fire codes are institutional barriers that inhibit resource recovery. MURBs tend to be excluded from municipal programs and residents are left to fend for themselves in cramped recycling areas often inadequate to perform extensive source- separation (Ando & Gosselin, 2005).

The POA approach estimated disposal and recycling volumes generated by households and asked open-ended questions to evaluate progress towards minimizing waste. The POA method asked respondents to identify ways to mitigate external household-consumption patterns and identified stronger regulatory guidelines for planned obsolescence, packaging and extended product responsibility (Malcolm, 2005; Cooper, 2005).

Industry's use of planned obsolescence is a key contributor to waste and overconsumption (Cooper, 2010). It refers to a design strategy that assumes the product to be no longer usable or socially desirable after a given period of time. The practice is often referred to as innovation rather than associating it with inefficient and wasteful business practices. Businesses depend on introducing new models with additional features, but give little attention to the product then

left out-of-date or unserviceable. If durability were a prime business strategy, there would be less emphasis on planned obsolescence, by which the latest iPod is expected to last 18 months. The Office of Consumer Protection should work with industry associations to accelerate take-back programs and products that can be repaired. In British Columbia, "Return-It" centres have contracts with regional electronic recycling companies like Encorp that promote product stewardship through managing and improving systems to recover used packaging and provide a home for end-of-life products.

A design strategy to help curtail planned obsolescence uses "closed loop" design and extended product responsibility (EPR) (McDonough & Braungart, 2002). An initial step to "closing the loop" shifts responsibility onto the producer to collect and reuse old products and components. While Canada recently adopted a EPR and sustainable packaging strategy (The Council of Ministers for the Environment, 2009), it should follow strategies from Germany's "Green Dot" program where manufacturers and retailers have to pay for packaging.⁵⁴

5.6 Social Capital

The POA methodology quantified whether the household socialized more often, less often or the same amount with neighbours compared to where they previously lived. Other open-ended questions asked about how occupants socialized with neighbours, interacted in community and offered their feedback on security and safety issues. Because residential cohesion influenced

⁵⁴ Germany's "Green Dot" packaging ordinance started in 1990 and requires manufacturers and retailers to "take back" their packaging or ensure that 80% of contents are collected, reused or recycled. It recovers about 150 billion individual packages discarded each year, or 40% of the Germany's waste. See Emergo Europe, (2011). About Green Dot and Europe's Packaging Waste Recovery Efforts. Retrieved March 1, 2011, from <http://www.greendotcompliance.eu/en/about-green-dot.php>.

consumption levels and quality of life, it is useful to expand on social cohesion and resource sharing in the POA methodology in each indicator area (Thoyre, 2011).

The POA approach filtered aspects of socialization in the context of using collective social practices and conditions to shift consumption patterns. These activities influenced household-consumption levels through engaging neighbours in ways especially important to establish a culture that minimizes household impacts through place-making (Cowell & Greene, 1994; Thoyre, 2011). The concept of place-making is an important finding often over-looked in green and typical buildings (Kaatz, Root et al., 2005; Leaman & Bordass, 2007).

Respondents were asked to comment on perceived barriers to community living, and how safe occupants felt in relation to personal safety, crime issues and the likelihood to report suspicious activity. Police reports can determine criminal incidents within a neighbourhood or building, yet the POA approach attempted to assess the level of social cohesion in each case site and how strong residents relied upon each other opposed to security technology. A list of security features should be added to the survey that respondents can report on.

Adopting a renewed focus on the social cohesion of household actors can emphasize policies to enhance safety and resource-sharing. Gansky (2010), for example, coined an emerging ecosystem of people and businesses sharing and swapping without buying that contributes to the “Mesh” economy. Botsman and Rogers (2010) describe the rapid explosion in bartering, trading, renting, gifting and swapping through the rise of social media and the internet. Micro-applications of these initiatives are relevant to MURB residents that can take advantage of the close proximity households have to each other. Strata councils,

for example, can also adopt bylaws and rules that influence resource-sharing and foster low technological applications of household practices. While some strata corporations prohibit air-drying clothes, for example, other developments actively encourage it through supplying clotheslines and passing on economic savings to residents.

5.7 Sustainable Behaviours

The POA approach aimed to provide occupant insights about perspectives on climate change and environmentally friendly purchasing. It concluded that those residing in green buildings did not necessarily change their behaviour when living in their high performance units. While price was the key comparative certainty for a home purchase (x amount of dollars for x amount of space), green building certification prerequisites or credentials proved less convincing.

The sustainability of high performance buildings requires looking for ways to mitigate consumption of its users to credibly tout its sustainability claims. Shifting consumption patterns is not an issue that can be resolved by merely disposing of empty milk jugs into a curbside-recycling program. The behavioural dimension of buildings involves dissecting hypocrisy and self-denial, factors not usually informing discussions about retrofitting green roofs or converting to electric cars (Jensen, 2008). These dimensions skirt the hard questions about humanity's insatiable demand for dwindling resources, even when tempered (or augmented) by greater technological capacity and knowledge (Conca, Princen et al., 2001; Princen, 2005).

LEED or REAP certification systems entail the adoption of technological

solutions for improving housing efficiencies rather than exploring occupant-based approaches to build capacity, find ways to mobilize and expose consumption's root causes (Hoes, Loomas et al., 2009). Shifting consumption levels is problematic because without examining the market-based premise of our socially constructed economic mantra for continuous material growth, LEED and other green rating schemes fail to deliver (Jackson, 2009; UNEP, 2011). These sentiments are reiterated by Rees (2010, p. 1), "Few challenge the fundamental beliefs, values, and assumptions underpinning market-based consumer societies or examine the hidden motivators of human individual or group behaviour." Green purchasing of homes fails to reconcile how proponents of green certified building schemes promote messages that you can live in a green building and still consume conspicuously. Rather than seek ways to reduce absolute levels of resources, the appeal of "green" to the prospective homebuyer to consume is "all the more potent" (Bell 2009, p. 49).

Those committed to "buying green" often legitimately do so to ameliorate environmental problems. In real estate markets such as Vancouver, MURBs are often financed through pre-selling units before construction commences, but pre-selling limits a consumer's ability to choose more sustainable materials and products. Buyers often feel pressure to close the deal, rather than devote due diligence to building materials and technologies. Making informed decisions about housing often requires understanding lifecycle assessments for the most ordinary materials and commodities to determine their ecological and ethical implications (Nissinen, Grönroos, et al. 2007; Vachon & Klassen, 2008; Vachon & Mao, 2008). Lifecycle-cost assessments evaluate the impacts associated with each stage of the consumption/production process, but are rarely contemplated in

daily consumer decisions (Lutzendorf & Lorenz, 2006; Buzzelli, 2009).

Green certification systems, such as LEED and REAP, should incorporate lifecycle assessments into their rating systems to continue the education process in purchasing decisions. Promotional efforts might focus on how to reduce perceived initial costs through lifecycle assessments rather than encourage consumers to pay more for technological innovations (Kaenzig & Wustenhagen, 2010). Though this invention may not prove fully satisfactory, it moves toward further understanding the social and ecological consequences of purchases.

5.8 Livability

The POA approach assessed livability by determining occupants' satisfaction with their environment through home selection, interior space layout, neighbourhood characteristics, storage and noise levels. These characteristics were important to gain a sense of how users perceived their home, yet assume a process of incremental improvements to the existing system. Additional inquiry could examine how POA indicators contribute toward the framing of processes to create fundamental shifts in household routines rather than measure consumption per se (Meadows, 1999; Loorbach & Rotmans, 2010; Frantzeskaki & Loorbach, 2010; Sahakian & Steinberger, 2011). For example, livability indicators could explore how the role of advertising affects household consumption or how energy efficiency can be used for pecuniary emulation. Open-ended questions revealed storage capacity and preferences and noise levels inside and outside of the building to be issues. Storage capacity within MURBs leads to examining policies pertaining toward ways to increase storage options. How storage relates to recycling and organics collection is

another area that may affect underground-parking areas. One POE study, for example, noted some MURBs underutilized storage space, but residents were not likely to use parking stalls for storage, even if permitted, because of concerns relating to aesthetics, fire hazards and potential theft. The authors recommended the city administration revisit bylaws addressing residential storage in parking stalls to use storage more efficiently (Wenman, Hofer et al., 2008). Further investigation and market research should explore ways to maximize storage options without increasing a building's footprint.

The construction industry rates a material or an assembly's ability to resist airborne noise through classifying sound transmissions.⁵⁵ Generally, the higher the sound transmission, the more noise blocked out through construction segments. Since sound-transmission ratings are based on laboratory testing, construction techniques such as joints, penetrations or gaps within wall assemblies are not evaluated, which may contribute to undetected yet obtrusive noise levels. These factors implicate occupant feedback related to acoustics in buildings and can provide new learning on construction processes using social contexts.

Exterior noise impacts occupants by arterial street traffic transmitted through windows or doors. This compounds internal noise issues that rely on the latest construction materials fabricated out of lightweight materials. Sound transmission into a neighboring unit is also dependent upon proximity to elevators, HVAC systems, residents' living habits, background noise and wall

⁵⁵ The National Research Council of Canada administers Sound Transmission Tests (ASTM E90 / ISO 140-3) to assess airborne sound transmission through walls, floors and other elements of buildings. See the National Research Council of Canada, (2011, February 22). Sound Transmission Tests. Retrieved March 1, 2011, from <http://www.nrc-cnrc.gc.ca/eng/services/irc/standard-tests.html>.

partitions (MJM Acoustical Consultants Inc., 2003; Macintosh & Steemers, 2005). Ambient noise from plumbing fixtures can occur through air or building structures that are not usually covered by the BC Building Code (Government of BC, 2006) and illustrate the complexity of airborne and structural noise levels.⁵⁶ Airborne noise issues generated from voices or loud speakers are governed by the BC building code, but can differ from footstep and impact levels influenced by airborne noise (Whicker, 2010). Isolating noise by residents often exceeds construction capabilities due to compartmentalizing ambient noise incidents (Mahbub, Kua et al., 2010).

5.9 Stakeholders, Roles and Responsibilities

The POA approach links households to global consumption issues through monitoring consumptive processes in buildings and surrounding communities. The roles and responsibilities of stakeholders involved in a POA process was implemented to reveal drivers of household consumption. The vast decision-making process is composed of numerous actors including investors, builders, trades people, architects, equipment manufacturers, suppliers, lenders, insurers, codes and standards setters, realtors, property managers and occupants (Brown, Chandler et al., 2008). Each actor has distinct roles and responsibilities, but enters into the development process at different phases in the design, construction and occupancy of a MURB. The resultant process suffers from fragmentation that lags in identifying adequate research and development solutions. An outcome of this complex process is a building sector dependent on

⁵⁶ See the BC Building Code, Section 9.11. Sound Control (Government of BC, 2006).

models that often fail to accurately forecast which system is performing as expected (Brown, Chandler et al., 2008).

5.9.1 Post-Occupancy Assessment

There are various reasons why POE and POA are not routinely integrated into mainstream building design. Construction is typically developer-driven. A developer engages an architect to design a MURB on the basis of what the developer thinks will be most marketable, leaving buyers to choose between features offered compared to whatever else is available on the market at the time. Future occupants have little say in the building's design. As the process continues, the architect then asks engineers to provide the specifications necessary for the various structural, electrical and mechanical elements of the building. Engineers are rarely asked in advance to recommend the most sustainable alternatives, meaning that the opportunities for upgrading to newer materials, technologies and systems at a subsequent state are more limited and problematic. Typical fee structures for architects and engineers cause incentives to be distorted in ways that penalize efficiency. Additional costs are typically required to install superior heating, ventilation and air-conditioning systems to reduce operating costs, yet efficient system designers are often penalized due to under-valued lifecycle costs (Brown, Chandler et al., 2008).

Adapting design, construction and monitoring processes can result in more efficient buildings. Instead of following a linear trajectory with successive contributions from each team member, complementary design principles and decision-making protocols can be agreed upon to involve stakeholders sufficiently in monitoring the building (Kaatz, Root et al., 2005; Hoes, Loomas et

al., 2009). In this case POE/POA methodologies can be unwieldy, costly and hard to manage across more than one building (Leaman 1999a; 1999b; Bordass, 2005; Bordass & Leaman 2005a; 2005b). POEs are often created for single-building studies, or single project, multi-building studies with little forethought of future applications (Leaman, 1999a; 1999b; Bordass, 2005; Bordass & Leaman 2005a; 2005b). For POE/POA studies to be implemented routinely, a post-occupancy assessment should become part of the building-commissioning process post-occupancy that is carried out by a third-party auditor such as the Home Protection Office in British Columbia. Assessments should be abbreviated into web-based applications with re-certification reviews every five years. For example, the University of California-Berkeley's web-based occupant Indoor Environmental Quality survey mainstreams how a building performs from an occupant's perspective.

Energy-consumption data for MURBs should be maintained in an interactive provincial data base, hosted by the Lighthouse Sustainable Building Centre or another entity. The primary goal of the initiative would be to monitor resource consumption and provide technical assistance based on fees-per-service. The US Environmental Protection Agency, for instance, initiated the Energy Star's Portfolio Manager for MURBs to track weather-normalized energy-use intensity, energy costs, greenhouse-gas emissions and water consumption (US EPA n.d.).

To augment attention towards social practices in households, a modified POA checklist should address elements of occupant culture, socio-technical learning, consumer incentives, governance and decision-making guidance that households face on a daily basis (Gething & Bordass, 2006; Costanzo, 2006;

Goldsmith & Goldsmith, 2011). These initiatives help balance overly optimistic capabilities of computer modeling that recast physical boundaries to include how the urban form influences household routines. This data is not generally captured when interpreting occupant outcomes from POE studies (Bordass, Leaman et al., 2001). In focusing on residential applications, POA caters to the social practices of household organization toward collaborative action (Barr & Gilg, 2006).

Various protocols and checklists can complement POA (Gething & Bordass, 2006) to build capacity within MURBs to strengthen social practices, governance and capacity building (Seyfang, 2010).⁵⁷ Initiatives pertaining to energy efficiency, governance and decision-making capacity building should be delivered to strata councils and other homeowner groups governing the management of MURB operations such as the Condominium Home Owners Association of BC.

5.9.2 Sustainable Consumption

Roles and responsibilities toward reducing resource consumption requires a refocused orientation that operates within an integrated national framework for local communities and household priorities. Mechanisms include land-use and building policies, incentives and education.

⁵⁷ For some examples, see One Earth. (2009). Eco-strata Guide for Metro Vancouver, Retrieved November 20, 2010, from www.eco-strata.com, The David Suzuki Foundation. (2009). Sustainability at Home. Retrieved November 20, 2010, from <http://beta.davidsuzuki.org/media/news/making-sustainability-at-home-in-bc-a-toolkit>, and Natural Resources Canada. (2009). Energy Star® Purchasing Guide: Put Energy Star to Work for your Organization. Retrieved December 14, 2010, from <http://oee.nrcan.gc.ca/publications/equipment/m144-206-2009e.cfm?attr=20>.

Land-use controls can help curtail dispersed development and include zoning bylaws to encourage higher density; mixed-use land developments; street-grid plans and other compact and accessible local street systems; pedestrian and cycling infrastructure and green space (Brown & Southworth, 2008). Growth management strategies concentrate housing in urban regions.

A variety of financial incentives to promote compact development using principles of urbanism have increased energy and land-use efficiencies including use of DDCs, tax credits, bonds, locationally efficient mortgages (LEMs), utility-billing systems and incentives (Hendricks & Kaufman, 2010). Tax credits can encourage developers to invest in more compact residential and mixed-use construction projects that minimize land and water consumption, are pedestrian friendly and facilitate the use of public transit. The Smart Growth Tax Credit in New Jersey, for example, proposes a credit against income taxes equal to 4% of the developer's project costs (excluding the cost of the land), with additional credits up to 11% of the costs if a development meets smart growth requirements (Brown & Southworth, 2008). LEMs incentivize homeowners by allowing increases in the amount of money borrowed by calculating income saved from not purchasing an additional vehicle and by living close to public transit, employment and urban services. LEMs are available in Chicago, Seattle, San Francisco and Los Angeles, yet there are no known programs in Canada. Utility-based financial incentive programs can supply energy demand, reduce the base load and peak power demand. By reducing power distribution loads the system becomes more robust with less likelihood of failure or disruption. Other incentives can accelerate market penetration of energy-efficient building

products such as lighting, heating and cooling, low-flow toilets and showerheads and window glazing (Brown & Southworth, 2008).

Increasing building efficiencies is most practical during the construction phase of a building. The Canadian Mortgage and Housing Corporation should support the National Housing Act by providing provinces and territories with additional technical assistance to accelerate adoption of advanced building codes. Building codes should be made more stringent every five years and mandate minimum energy-efficiency levels. The uniform adoption of codes across regions increases predictability, reduces market risks and helps ensure early adopters are not penalized from incurring first-of-a-kind costs (Ehrhardt-Martinez & Laitner, 2010). This however, requires greater compatibility of building-trade standards that focus on efficiency upgrades and carbon reduction. The building industry compliance code of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), for example, does not currently enforce energy-intensity targets or carbon-emission reductions that create mixed messages for building compliance.

Technical and financial assistance should expand high performance training and certification that focus on third-party verification of building-code compliance. This is particularly relevant when the developer is not responsible for paying future energy costs and lacks financial incentives to reduce utility costs. Programs such as the federal government's successful ecoENERGY Retrofit program (formerly EnerGuide home retrofit) require a series of tools accompanied by third-party pre- and post-consumption audits, efficiency-rebate and financing options. More energy-efficiency programs from Natural Resources Canada are needed that model similar delivery for MURBs.

Industry influences building-consumption patterns from initial investment requirements to design applications, production, compliance and legal requirements. Industry can reduce waste (and therefore costs) by greening supply chains and travel distances (Vachon & Klassen, 2008; Vachon & Mao, 2008; Sustainability Purchasing Network, 2008). Further tracking and transparency of distributional impacts helps educate consumers and producers about costs and processes to generate commodities (Akintoye, McIntosh et al., 2000, Walker, Di Sisto et al., 2008; Ketchen Jr., Rebarick et al., 2008; Nagurney, 2010). The Sustainable Product and/or Service Development (SPSD) approach, for example, encompasses strategies aimed at maximizing environmental and social performance in Product Service Systems (PSS) (Mont, 2004; Maxwell, Sheate et al., 2006; Tukker, Charter, et al., 2008). PSS helps clean up production processes and redesign products by shifting from selling products to selling utility (for household applications, see Mont, 2004). Given an supportive policy environments, low-impact, green housing approaches focused on localized construction supply chains might be adopted by housing developers (Seyfang, 2010). Canada lags behind countries like Sweden and Japan in establishing lifecycle laws for products and extended product responsibility standards.

Current financing schemes fail to recognize the long-term value of renewable energy or energy-efficient investments. Investors require access to upfront capital for building expenditures that consume fewer resources, use renewable energy and generate lower operational costs (Lützkendorf & Lorenz, 2005). A revolving loan for green infrastructure investments can recoup future operational savings that are reinvested back into the fund. The Federation of Canadian Municipalities, or consortium of federal agencies and financial

institutions should develop a “sustainability fund” to loan capital for projects that reduce carbon emissions and facilitate resource-conservation projects. The fund should create economies of scale to increase the extent and magnitude of energy retrofits, renewable technologies, worker trainings and payback schedules to recoup savings. The Clinton Climate Initiative, for example, leveraged \$5 billion USD to retrofit public buildings in 16 of the world’s largest cities to reduce carbon emissions and increase energy efficiency by 120% (Clinton Foundation, 2011).

Civil society, including non-profit organizations and faith-based groups, influence political leadership by increasing public awareness, educate and conduct independent reviews that encourage cultural change. Civil society helps educate the public and key decision makers about carbon-reduction opportunities and provides technical assistance to enable implementation. Activities related to buildings and household consumption include greenhouse-gas reduction targets, energy labels and ratings of products and buildings; mandatory disclosure of energy-use information at time of sale of a building, energy audits and other decision tools (Intelligent Energy, 2006; Brown & Southworth, 2008; Cooperman, Dieckmann et al., 2010).

5.10 Principles of Practice Towards Sustainable Consumption

Several themes emerged from the POA process, including variations in temperature controls, driving habits, food preferences, household waste routines, socializing and interacting with neighbours, storage capacity and building governance and management. This synopsis offers a vantage point for policy makers using POA to analyze sustainable consumption through four principles

of practice (see Figure 9) that strives to reduce aggregate consumption levels rather than emphasize intensity levels.

1. Collectively maximize and leverage resource use when possible, rather than on an individual basis.
2. Shift consumer activities from commodities and materials to returnable products and services.
3. Integrate behavioural, distributional and ethical considerations into ecological technology adaptations (Hendrickson & Roseland, 2010).

Figure 9 Four Principles of Practice for Policy Makers to Examine Sustainable Consumption



Enhancing mechanisms for occupants to share resources marks a shift about how to mitigate impacts of the built environment, which currently emphasize technological modifications such as green roofs, cogeneration, solar panels, Energy Star appliances, etc. While these innovations are useful, the way households function within their immediate environment are equally critical to support sustainable lifestyles.

5.11 Policy Implications

I presented four general policy implications from the discussion paper to the public policy focus group to shift household-consumption patterns. The first is that full-cost accounting must infuse conventional economic decision making to represent the truer costs of unsustainable consumption. Until economic models are realigned, sustainable consumption has little chance of attaining the transformational shift needed to address the challenge of climate change and overconsumption. Full-cost accounting will assist converting taxation policies to target consumption, such as carbon taxes,⁵⁸ cap-and-trade systems⁵⁹ and lifecycle costing. Regulations must ensure that development pays the full costs of

⁵⁸ The carbon tax recently imposed in British Columbia, applied to carbon emissions generated by fossil fuels, is an example of a consumption tax incorporating externalities into the market economy. Carbon taxes convert into tax rates on fossil fuels (by 2012, the \$30-per-tonne tax will be equivalent to a 7.6¢ per litre tax on gasoline). Tax flows remain neutral, neither increasing nor decreasing government revenue. Rather than allow each province to initiate its own carbon tax, Ottawa should establish a federal carbon tax and provide cross-border adjustments for trade.

⁵⁹ The cap-and-trade system proposed by the Western Climate Initiative (WCI) will place a market price on carbon for a large and expanding portion of North America. Four provinces representing 25 million Canadians have already signed on as partners. The market-based auction system combines regulation with market-based mechanisms and could complement a carbon tax. Cap-and-trade requires a firm to have an emissions permit for every ton of carbon dioxide it releases into the atmosphere. Over time, the cap becomes stricter, allowing less pollution as permits become more expensive. Gains from emissions trading are largest when the inclusion of reduction opportunities is as wide as feasible to allow a range of abatement costs. Because some companies will reduce their emissions below their required limit more rapidly than others, they will sell their extra permits to companies not able to make reductions as easily (see Horne, 2008a, 2008b).

infrastructure and procurement, not only economically but also socially and ecologically.

Second, land-tenure mechanisms are required to promote access and secure rights to land and other natural resources. Land tenure affects how municipalities develop infrastructure, limit dispersed development and foster favourable conditions for households to invest in home improvements; this is reflected in development cost charges, impact fees, property rights, design guidelines, zoning ordinances and building codes.

The analysis of empirical data presented in Chapter 4 suggests, at least circumstantially, a pent-up demand for meaningful interaction within communities. While the co-housing model is not for everyone, nor a panacea to resolving isolated lifestyles, it holds promise for increasing occupant well-being and shifting consumption levels for a larger percentage of the populace. Co-housing is not without drawbacks, however. The co-housing model requires creative organizing, time and cooperation among households. Consensus decision-making can be long and tedious (Renz, 2006a; 2006b). Other potential challenges include the formation of socially exclusionary groups and other conflicts within groups living in close proximity, people must have financial resources to participate and land assembly takes time (Bader, 1999; Gold, 2005). It still may be viewed as a fool's quest in adverse financial and real estate markets, but as its experience in Denmark and other regions have shown, it has the potential of contributing significantly to more sustainable lifestyles (Choi, 2004; Cohen & Morris, 2005; Lietaert, 2010).

Nevertheless, there are applications from the co-housing findings that are applicable to green and typical buildings that implicate strata council

management and communication policies. Some examples include design considerations that focus on a 45 maximum number of units per MURB, minimal use of hallways, bulk food purchasing, using clotheslines and common laundry facilities, garden and power-tool sharing, ride-sharing, community meals, consensus decision-making, organic and recycling practices, security-prevention measures, common meeting room and guest-room sharing, aging in place and task forces for specific projects can be adapted to different MURB models. These areas can promote more livable environments, but as a full suite of features are rarely addressed in green buildings or by mainstream developers. They reflect possibilities that begin to rethink how the household environments is configured from a design and land-use perspective that involve various facets of social practices.

Third, governance and management structures and approaches require rethinking how households can be mobilized more effectively through training, resources, tool kits and checklists. In this regard, strata councils represent an untapped conduit in all types of MURBs. When consumption issues are viewed through the operational portal of energy use, mobility and food, there is significant potential to reduce waste. Flexible unit layouts, collective purchasing of some items and residential best management practices can enhance household awareness. Provincial transportation departments should set demand-management frameworks that can practise least-cost mobility planning and coordinate urban metropolitan hubs.

Fourth, developing social practice indicators for sustainable consumption requires conscious and concerted effort, particularly within the areas of housing, mobility and food. Feedback mechanisms are needed for locally significant

indicators, along with ambient signals to bring attention to greenhouse-gas emissions. Building certification systems should be consolidated and emphasize ongoing monitoring and audits to maintain high-performance operations and flag laggards for equipment repairs and retrofits. POA indicators help to create awareness of the need to measure progress for material consumption by instilling strategies to change behaviour and integrate households, buildings, municipal infrastructure and national networks. Demonstration projects, such as the West House at Simon Fraser University,⁶⁰ that profile low-carbon household developments locally can generate interest and knowledge transfer.

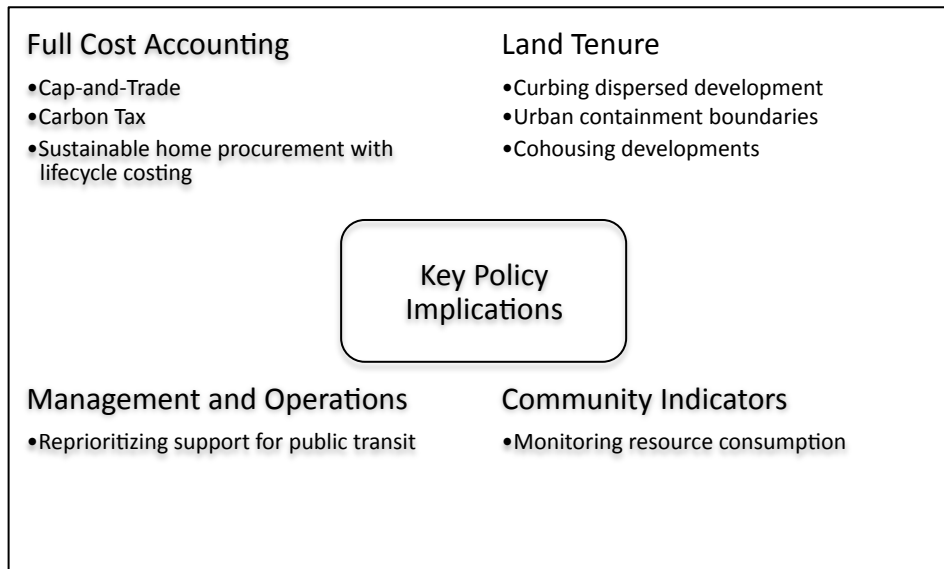
The focus group reviewed draft policy implications within the four general areas and prioritized items requiring immediate attention (see Figure 10). When combined and integrated with behavioural change strategies at the local, regional, provincial and federal levels, the high level policies have the potential to influence and shift consumption patterns on a wide scale. The policy implications that the focus group viewed as most important for shifting consumption patterns included:

- Putting a price on carbon through entering into a cap-and-trade system and establishing carbon taxes;
- Curbing dispersed development through the more efficient planning and design of communities;
- Re-prioritizing support for sufficient public transit;

⁶⁰ The West House is a partnership between the Canadian government, Simon Fraser University and industry. The house features a joint living, dining and kitchen area, bathroom, bedroom loft, balcony and a 226-sq.-ft. (21-sq.-m) garage. Residents can track and manage energy use from a web browser or smart phone that controls and monitors house information systems. See Simon Fraser University. (2010). Relocated West House Welcomes First Tenants. Simon Fraser University, Burnaby, BC. Retrieved April 10, 2011, from <http://www.sfu.ca/sfunews/news/relocated-west-house-welcomes-first-tenants.shtml>.

- Spearheading sustainable home procurement programs that publish building product performance measures and lifecycle costs;
- Establishing urban containment boundaries backed with affordable housing strategies;
- Scaling up co-housing developments; and
- Using indicators to monitor resource consumption, such as real-time smart meters for energy use.

Figure 10 Sustainable Consumption Policy Implications



5.12 Suggested Areas for Further Research

Green buildings are getting more “efficiently unsustainable” in their current iteration.⁶¹ Rather than become fixated on construction materials and building science to resolve ecological, social and economic issues, the social practices of household organization and user feedback requires greater

⁶¹ Rees, W. E. (2009, October 20). Presentation at the *Gaining Ground Summit*: Vancouver, BC.

emphasis. The way technology is organized and configured in households draws attention to the infrastructure more often than the user-occupants (Leaman & Bordass, 2001; Bordass, Leaman & et al., 2001; Bordass, Leaman et al., 2002; Bordass, 2005; Bordass & Leaman, 2005a; Guy & Shove, 2007; Leaman, Stevenson et al., 2010). Greater attention is therefore necessary in how building design implicates routines and behaviours to mitigate consumption levels established in daily routines. Connecting households to performance and actor-centred processes can link external socio-technical influences to new ways to monitor consumption levels. The POA attempts to merge these two disparate approaches into a more cohesive monitoring process. Additional research into how LEED or REAP can adopt POA categories into credits might help integrate behavioural considerations into engineering and design issues. For example, offering credits for clotheslines could reduce technological reliance on laundry dryers while encouraging low-cost, low-carbon solutions to climate change.

For green buildings to be affordable, they require additional social criteria integrated into point-allocation checklists. LEED-New Developments (ND) is a case in point, where only 4 out of 106 points are awarded for affordable housing. While the cost of building green is declining, green housing will only become sustainable when the majority of residents are able to purchase them. Further thought about using LEED or REAP to mobilize processes of engagement should be considered instead of defaulting to third-party certification systems (Cidell, 2009; Spinks, 2011). High performance building certifications should analyze building applications from social practice perspectives as evident in the lack of attention non-environmental issues receive thus far in building evaluation (Retzlaff, 2008).

Numerous green building standards complicate awareness and compliance issues, since more than ten different standards are used in Canada (One Earth, 2011). Nevertheless, to date, few market-based rating certifications include performance verification after buildings have been occupied, a shortfall implying “green” certification schemes act as an end in themselves rather than a means to an end.⁶² Ongoing performance verification is the next critical step in the evolution of high-performance “green” buildings to overcome inconsistent material and construction qualities and practices that do not meet certified standards (Newshaw, Mancini et al., 2009; Scofield, 2009). The Canada Green Building Council (CaGBC) has recently taken a preliminary step by initiating performance assessments in 400 buildings across Canada, yet requires additional research for quality control (Issa, Rankin et al., 2010).

Research on European government regulations should investigate the efficacy and challenges in reducing carbon emissions from buildings to be recertified for energy performance (e.g., every five years) and upgraded when undergoing renovations or upon resale (Cooperman, Dieckmann et al., 2010). Heating and cooling performance should be inspected regularly, and energy-efficient upgrades and products promoted to facilitate best management practices in keeping with standardized baseline comparisons (Janssen, 2004). Such initiatives could also stimulate the economy by offering new employment opportunities in building retrofits, energy-efficiency specialists and draft-

⁶² The LEED for Existing Buildings administered by the USGBC requires an evaluation during a specified performance period and re-certification every five years. In Canada, the CaGBC is currently creating a new certification-verification system commencing with existing buildings aimed at verifying and certifying actual performance and operational practices. At the regional level, the Cascadia Region Green Building Council launched the Living Building Challenge comprised of seven performance areas within site, water, energy, health, materials, equity, and beauty that is moving the built environment toward a more holistic approach.

proofing.⁶³ The costs incurred in upgrading and compliance can be recouped by lower operating costs (Katz, 2008).

Post-occupancy assessments of LEED-New Construction (LEED-NC) document a 25-30% improvement above national performance ratings, but residential buildings were omitted from the analysis (New Building Institute, 2008). New strategies are needed that incorporate lifecycle assessments into how suppliers and consumers evaluate products, materials and service options, rather than simply selecting bids based on lowest initial cost (Kneifel, 2010). Data availability and access are an ongoing impediment to assess lifecycle costing that require attention (Lutzendorf & Lorenz, 2006; Retzaff, 2008).

Over time typical buildings should become more energy efficient through regulatory changes, upgrades, retrofits and improvements in building design, technology adaptations and construction materials.⁶⁴ Nonetheless, the majority of MURBs built to provincial building code standards are not considered green. Additional research is needed into appropriate monitoring, scheduling and replacement plans for strata corporations, strata councils, unit owners and rental and management companies.

Much work in coming years is needed to maintain the quality of MURBs to maintain affordable housing stock. For instance, 80% of citizens living in

⁶³ Training programs are required for renewable energy professionals in areas such as solar, ocean, sewer, biomass, ground-source heat and district heating applications. The US-based Renewables Portfolio Standard (RPS) requires increased energy production from renewable sources, such as wind, solar, biomass, and geothermal. It is estimated the RPS will create 119,000 person-years of employment in California alone, over the lifetime of renewable energy plants built through 2017 (see Heavner & Del Chiaro, 2003).

⁶⁴ One estimate calculated that if the United States invested \$8 billion in MURB energy efficiency improvements over the next ten years, the US could achieve energy savings equal to the annual electrical output of 20 coal power plants and reduce greenhouse gas emissions by 50 million/tonnes, to over 100 million/t per year (The Benningfield Group, 2010).

apartment buildings in the United States encompass low-income households (The Benningfield Group, 2010).⁶⁵ Research into energy-efficiency mechanisms for rental housing is critical because many apartment buildings are occupied by renters unwilling or unable to make long-term upgrades to large appliances (Pitt, 2007). Since the owner has little economic motivation to upgrade, the renter pays a higher portion of income for utilities but is burdened with higher utility costs (Hendricks & Kaufman, 2010).

Co-housing is a model that offers new parameters for building more sustainable housing through establishing effective organizing practices that target aggregate consumption levels. Nevertheless, new terminology is required to instil greater acceptance of this emerging model to overcome the North American mindset and cultural stigma of “co-habiting.” Intentional communities serve as a response to the driving forces that increase resource consumption illustrated in Chapter 1. Tenure for intentional communities implicates a multi-unit residential focus, options to decrease automobile dependency and a diet promoting local and regional specialties.

Building on this research, the following actors, roles and responsibilities require additional investigation to expand and scale-up the intentional community model. Preliminary empirical data indicates there is a demand for intentional communities planned by future occupants in conjunction with private developers. Exposing a market niche involves identifying developers to facilitate land tenure in partnership with individuals and groups seeking to live within the same development. Since the primary challenge for intentional communities is

⁶⁵ In this case the author defines “low-income” individual as an individual whose family's taxable income for the preceding year did not exceed 200% below the federal poverty level.

land assembly, interested developers should expedite this niche by advancing a tenure model that secures an appropriate site (e.g., a land parcel, or designated floor space within a building). They then need to work with architects and individuals interested in forming an intentional community to develop appropriate governance models, draft conceptual designs, and select building materials in keeping with the group's ideals and budget. Future research requires further identification of institutional barriers and appropriate mechanisms to articulate a viable approach to wider forms of residential accommodation.

More occupant-centred POA approaches are needed to study the nature of consumption in households and clarify blurred assessment boundaries in relation to how dwelling type, location and how the urban form influences household-consumption behaviours. Sustainable consumption is a useful lens to frame these fields through examining consumer tendencies in the seven indicator areas to reveal social practices interacting with technology advances.

Further research is required to investigate effective interventions that can reduce household consumption levels while maintaining a high quality of life. Potential areas of inquiry include:

- Policy and management implications of occupant feedback and social practices as an integrated practice for addressing climate change.
- Defining absolute housing performance / consumption per capita and globally.
- Systematizing user feedback in housing.
- Identifying opportunities and barriers emerging in different communities that integrate user knowledge and feedback into housing developments.

- Establishing legislative milestones for feedback in the certification, contractual and commissioning processes for buildings.

5.13 The Belly of the Beast

In this dissertation I have argued that consumption represents the deepest quandary of sustainability and is metaphorically located in its belly. Households organized to instil high levels of trust with neighbours can actively engage in new forms of governance. Nevertheless, households require clear and consistent information from governmental jurisdictions that are lacking within the Canadian context. If Canadian society continues to develop along current trends, there will be little or no absolute carbon emissions reduction by 2050. The two co-housing sites examined here demonstrate practical applications of more sustainable consumption. Green building advocates and policy makers are missing key opportunities because efficiency gains in construction technology are being overrun by increase levels of consumption. A finding that has ramifications into the sustainability of green buildings if environments do not influence lifestyles and behaviours. Key responses toward sustainable livelihoods must focus not only on marketing green buildings but also on how households function within typical buildings. Some clues in the research findings look at principles of social practices that co-housing use and can be adapted to residential planning. These unique approaches precipitate financial implications for consumers and producers that have yet to be fully addressed through legislation.

To legislate policies that focus on material consumption, policy makers should incorporate POA approaches into building construction processes, codes

and feedback mechanisms from utility providers. Municipal building departments should be reoriented around interdisciplinary functions to address how housing, mobility and food interact at the local level. Reforming zoning bylaws, alternative development standards and associated permits are critical to reduce resource consumption levels associated with households, MURBs and dispersed land use patterns. Building assessments and certifications along with green building certification systems, such as LEED and REAP, should be consolidated and unified. Policy makers should establish stringent energy assessment requirements for buildings and demonstrate new forms of communication to highlight ecological features, boost public awareness and target the poorest performing buildings for upgrades. By designing appropriate incentives for developers, green design innovations and affordability measures can emerge through expedited development processes and recognition.

POA offers ways for occupants to monitor and provide feedback to building characteristics and technologies, lifecycle costing and occupant practices. Policy makers working on real estate valuation should focus on lifecycle costs of equipment and buildings to provide financial rationale for recovering redundant and obsolete materials that can lower ecological impacts and operating costs over the long term. However, is unlikely to occur without federal policy makers tackling fossil-fuel subsidies and compensating for indirect costs associated with health issues and climate change. Until society reflects a truer price for fossil fuel and all things that contain carbon, the use of POA to monitor building performance and household consumption will remain rudimentary. A federal carbon tax and cap-and-trade system that provides cross-border adjustments for trade would be the quickest way to expedite a transition

to renewable energy.

Academics can help demonstrate and test new concepts and strategies that garner feedback from inhabitants of residential buildings. Additional programs and courses should be offered at post-secondary institutions that investigate POA methods based on assorted building types (e.g., single dwelling, MURB and institutional residences) and building purposes (e.g., industrial, commercial and residential). Academic research and courses should not be confined to architecture programs, but should embrace trans-disciplinary approaches within planning, sociology, physiology, business, landscape architecture, building science and technology, engineering and computer science. Engineers and software developers, for instance, should be required to work with social scientists in interdisciplinary teams to monitor and tackle building conundrums and societal dilemmas.

Planners have generally devoted too little attention to consumption issues (Wacknagel & Rees, 1996), but as the magnitude of climate change increases, sustainable consumption programs targeting material throughput will grow in prominence. These programs are already developing for carbon offsets, pollution mitigation, transportation-demand management, transit-oriented developments, food security, sustainable purchasing policies and property-tax reform to name a few (Hendrickson, 2010). While most planners cannot track the gamut of interconnected issues included in a POA research program that influences location, neighbourhood connectivity and infrastructure development, a concerted approach requires combining technological building innovation with community development and household behaviours (Brown & Southworth, 2008; Retzlaff, 2008). Planners can lead the way in raising awareness about POA

strategies related to recommending land-use zoning and bylaw legislation and configurations of MURBs. Planners that link occupant feedback to residential buildings and household behaviours build capacity for residents and homeowner associations to reduce material consumption. Examples include protocols, toolkits, checklists and home-procurement programs that target housing, mobility, food-using technology, good practices and community building.

Architects and designers must also ingrain occupant feedback and POA approaches into the building-commissioning process. This is often neglected in the mainstream building process; viewed as an after-thought rather than an integral design component (Cooper, 1999; 2001; Leaman 2005; Bordass & Leaman, 2007). Teams of architects and designers need closer interaction with occupants, developers, engineers and contractors within building trades and related professions to identify what is working well and what is not (Andreu & Oreszczyn, 2004). Physical design examples (see section 5.10) can improve waste recycling areas and flexible unit layouts to foster greater behavioural change of occupants (Leafe, 2003; Mulder, Contanza et al., 2006; Barr & Gilg, 2006; Gray, Gleeson, et al., 2010; Little, Maye et al., 2010; Thoyre, 2010). These lessons from my research findings tentatively point toward design principles and guidelines that advance greater social cohesion with building occupants. The diverse actors of policy makers, planners, architects and designers must pay considerably more attention to the way we organize households within multi-family residential buildings to mitigate household consumption levels.

History reminds us that transformative change and human ingenuity can spread rapidly. Following the Industrial Revolution, cotton manufacturing

increased efficiencies ten-fold within two decades. It then tripled yet again by 1815, spinning from a single thread to as many as 80 threads simultaneously (Hawken, et al., 1999, p. 170). Fast-forward two centuries and technology once again leapfrogged at unfathomable speeds as Gordon Moore, founder of Intel, accurately predicted computer-processing speeds would double every 24 months. While we have indisputable evidence of recent technological advances, until we can shift our insatiable appetites for “more,” moving toward sustainability is tragically slow at the best of times. Until we can figure out ways to rein in consumption, it remains pivotal in this most perplexing and dire challenge of our age.

Sustainable development discourse has failed to deal adequately with the demand side of the ecological, political and cultural crisis. The social context must interact more aptly with efficiency measures to rethink labour and productivity while decreasing aggregate material-consumption levels. Ultimately, humanity and all living creatures are short-changed when consumption and technology are not integrated with behavioural considerations.

Possible solutions to changing the consumptive treadmill involve applying a trajectory of social inquiry to technical challenges. Until sustainable options become easier, cheaper and more convenient, behavioural change will remain lacking in efficacy and uptake. Appropriate solutions should adopt a suite of holistic and local approaches that involve financial implications on consumers’ and producers’ choices. This is perhaps a formidable task in light of a volatile and changing climate, unstable economic system and deteriorating sense of well-being, communities need to consider seriously whether we are not in fact consuming ourselves to death.

Nonetheless, not all hope is lost. A growing cadre of citizens and world leaders are actively challenging the single-minded pursuit of economic growth (Gertner, 2010; UNEP, 2011). Whether it be the ending of apartheid in South Africa, or the fall of the Berlin Wall, public perception and social change are not necessarily based on a simple proportional relationship between cause and effect; change can occur in abrupt, unexpected and ways that are difficult to predict. These research findings suggest a myriad of paths that households can follow to identify consumption drivers and proactively respond to their challenges. Gradually, we are increasing our knowledge about how households can monitor and assess their living environments.

Once we transfer attention from our biceps (production) and focus on our belly (consumption), we can begin to forge new paths. POA approaches to understanding occupants currently operate on the periphery of housing policies and constitute but a tiny sliver in the broad sector of residential housing possibilities. But the insights to be learned from the experience of the occupants is worthy of serious study and much wider application if we are to achieve the goal of more sustainable communities.

APPENDIX 1 – CASE SITES

Development: Silva, North Vancouver



Year Constructed: 2005

Units: 67 units, one guest rental unit.

Developer: 16th Street Development Ltd. (a joint venture between West Coast Projects and Marcon Construction), Designer - Perkins and Company.

Designation: Canada's first LEED certified residential building (Leadership in Energy and Environmental Design). ``Green`` elements amount to a 2 – 3% hard cost premium, which the developer thought was compensated for by news media exposure.

Features:

- An estimated 75 - 83% of construction and demolition waste was diverted from landfill including the reuse of asphalt and glue-lam beams.
- Locally sourced materials such as insulation, flooring and drywall
- Storm water output is reduced by 20% by incorporating a green roof and native drought resistant landscaping minimizes irrigation needs.
- Water conservation appliances and low flow plumbing fixtures (dual flush toilets and low flow fixtures) cut water consumption by 40 – 60% compared to Metro Vancouver's average of 320 litres / person / day.

- High-performance low E windows locally manufactured, BC Hydro PowerSmart efficient lighting, Energy Star appliances and natural ventilation reduced energy consumption 14 – 20% when compared to similar sized buildings.
- Low VOC paints, sealants and adhesives used.
- 40% of the units are designed with universal design to accommodate people in wheelchairs.
- Concrete/steel stud construction with fibreglass batt insulation.
- Occupancy sensors regulate lights in common areas.
- Heat rated gas fireplaces.
- A common exercise and a meeting room with a few small garden plots on the second floor.

Sources:

Mah, C. (2005). Residential Pioneer: Silva is set to become the first LEED Certified High-rise Residential Building in Canada. *Construction Business*, 12-14.

Saunders, C. (2006). Green Inside the Box: What Condo Developers are Learning from Environmentalists. *This Magazine*.

City of North Vancouver. (2006). Silva Building. Retrieved May 1, 2010, from <http://www.cnv.org/server.aspx?c=2&i=147>

Development: Quayside Village, North Vancouver

Quayside Village



Year Constructed: 1998

Developer: Developer - Artian Construction. Designer - The Courtyard Group, Community Dream Creators (co-housing consultants)

Designation: Co-housing Development, Silver Georgie Award: Best Low-Rise Development, 1999

Units: 19 units (with 1 guest bed-sitting room), 4 affordable units sold at 20% below market price, covenants ensure units will remain below market in perpetuity. One two-bedroom rental unit designated as affordable, wheelchair accessible. Commercial space accommodates a small convenience store.

Features:

- Common space features a Mediterranean-style courtyard surrounded on three sides and a 2,500-square-foot common house. Open fireplace and lounge, shared office, fully accessible bathroom, laundry area and craft room, and large country kitchen and dining area. Shared dinners scheduled each week for those interested.
- Third floor deck and octagon shaped reading room replicated from the old Dome Market building with water and mountain view.

- Landscaping features native shrubs, vines, berry bushes, fruit trees and flowers. Small garden plots, composting and recycling program, grey water treatment system, funded by CMHC.
- All units feature gas ranges, energy efficient gas fireplaces, soaker bathtubs and access to outside spaces.
- Many units use recycled hardwood flooring and most have views of the city, mountains or ocean.
- Units range in size from bachelor to three bedrooms in flats and townhome layouts featuring few hallways with rooms garnishing off central room.
- Most units share common laundry facilities.
- Development has obtained up to a 90% recycling rate.

Sources:

Bridge, T. (2007, April). All Together Now: 860 Square Feet; North Vancouver, Vancouver Magazine, Retrieved May 1, 2010, from <http://www.vanmag.com/articles/07apr/Densitygame5.shtml>

Quayside Village Co-housing. (n. d.). Quayside Village Co-housing, Retrieved May 1, 2010, from <http://quaysidevillage.googlepages.com/home>

Development: Cranberry Commons, NW Burnaby



Year Constructed: 2001

Developer: CDC Co-housing Development Consulting and not-for-profit corporation acting as the developer for financing, design and development.

Designation: 2002 City of Burnaby Environment Award for the development of an environmental and social housing model.

Units: 22-home in a 26,662 square foot, multi-family residential building.

Features:

- Units range in size from 500 to 1200 square feet.
- Each unit is privately owned in a complete, self-contained home with some shared common facilities.
- Located within a block of a busy commercial street with grocery stores, shops and restaurants, banks and other amenities, and close to public transportation.
- Commercial grade high efficiency boiler for domestic hot water and space heating combined with in-floor radiant heat distribution system. Additional costs for the in-floor system avoided dust and noise issues associated with forced air and electrical heating and saves \$3,500/year in energy costs.
- Compact fluorescent lighting in some locations such as porch lights saves \$1,000/year.

- Solar hot-water panels off-sets domestic hot water by 50% with support from the Renewable Energy Deployment Initiative (federal government) and the BC Government's Renewable Energy Technology Program.
- Low flow toilets and showerheads
- Landscaping employs native plantings, which require lower maintenance and water use and enhance the local natural ecosystem. Rain barrels located near planted areas reduce potable water demands.
- Use of high volume fly ash concrete in parking garage and building slab reduce GHG emissions associated with cement production by 50%.
- 10% reclaimed timber used for building wood. Challenges confronted a lack of supply and high costs for de-nailing wood on site.
- Construction site recycling mandated in construction contracts to maximize material diversion rates including cardboard, clean dimensional timber and palette wood, concrete, scrap metal, drywall, and paint.
- Shared composters and designated community recycling bins.
- A 2,400 sq. ft. common house included a spacious kitchen, dining area, and children's area, library, lounge, and meeting room. Other common areas include a laundry room, workroom, guest room and storage space. Extensive common facilities shared by the community facilitate sharing resources and bulk purchasing.
- The City of Burnaby worked with the community to provide development variances (setback and density) that contributed to the viability of the development's courtyard and helped make units reasonably priced. Metro Vancouver provided funding to support non-material costs of using high volume fly ash concrete.
- The up-front development of community plan paid off by fostering acceptance of appropriate neighbourhood change and NIMBY (Not in My Back Yard).
- CD zoning allowed flexibility in building design and setbacks.
- Extensive common facilities necessitated a special consideration of development density for the site, and an increase in allowable density.
- Required relaxation in parking requirements and alternative servicing methods.
- Homes are equipped with connections for private washers and dryers, but more than 50% share common laundry services.
- Some residents share cars, canoes and kayaks and about a third of the 38 parking stalls remain empty.
- Bicycle storage in parking garage.
- All units are equipped with two runs of CAT5 wiring, a local area network and a high-speed Internet connection.
- Air-drying line;
- Long life (40 year) roofing shingles;
- Natural and low VOC finishes;
- The use of salvaged lumber for 10% of the building;
- While each home comes equipped with its own full kitchen, residents have the option of eating in the common house each week.

Sources:

GVRD. (2003). Best Practices in Housing, GOMDH Series 2003. Retrieved November 1, 2010, from www.gvrd.bc.ca/growth/GOMDH/2003-BurnabyCranberryCoop.pdf

GVRD. (n. d.). Cranberry Commons Co-housing, Retrieved May 1, 2010, from www.gvrd.bc.ca/sustainability/casestudies/cranberry.htm

Development: Clements Green, UBC Endowment Lands



Year Constructed: 2006

Developer: - Vanmar Constructors Inc. Architect - Raymond Letkeman Architects Inc.

Designation: A *silver* certified Residential Environmental Assessment Program (REAP) building. UBC provides a framework to measure greener building practices for market-based and staff/faculty/student residential developments based on the LEED rating system. Clements Green is a co-development project initiated by UBC faculty and staff built with assistance from UBC Properties Trust. By using Co-Developers' equity (future residents) fund the required working capital, and avoid the developer's profit, sales and marketing commission, amounting to savings of 10 – 20% of the appraised value of a home. Upon completion of construction, each Co-Developer becomes a homeowner.

Units: 55

Features:

1. A four storey wood frame building with 55, two and three bedroom units.
2. 75-80% of construction waste was diverted from the landfill.
3. Water efficiency measures include dual flush toilets, water efficient fixtures and rainwater sensors on landscape irrigation.
4. Each suite will be allocated only one stall in the underground parking facility.
5. A 27 stall secure bike storage facility in the underground parking garage.
6. Water is metered and building occupants pay for the volume of water supplied (and the resulting volume of sewage disposed of) through strata fees. Reducing hot water reduces energy bills, likely to be in the region of 40-50% from the Metro Vancouver average rate of water consumption in a similar type of building.
7. Dual flush toilets and faucet restrictors used in all bathrooms (0.5 gallons per minute).
8. Clothes washers (offered to purchasers as options) are Energy Star compliant and front loading. Dishwashers are Energy Star compliant
9. Site landscape design includes water efficient landscape with drought tolerant plants, such as Otto Luyken, Laurel, Rugosa Rose and Spiraea and an Integrated Pest Management Plan to reduce pesticide use.

10. Rainwater sensors installed on the landscape irrigation sprinkler systems to reduce sprinkler use by up to 50%.
11. Energy cost recovery based on actual usage rather than on a square footage basis via occupant strata fees.
12. Hot water meters in each suite encourage accountability and lifestyle choices.
13. Low E glass throughout the building to decrease heat loss through in colder times and decreasing heat gain in warmer periods.
14. High recycled content free of urea formaldehyde such as Johns Manville or Ottawa Fibre insulation installed in walls, roof and the underside of the concrete slab in the ground floor parkade.
15. Light emitting diode (LED) lights use less than 3 watts as compared to 15 – 30 watts by incandescent lamps in exit signs.
16. Sensor-activated lighting in selected common areas and in the parkade. When these common areas are not in use the lights would be set to a low level that meets the safety requirements.
17. Compact fluorescent lamps used in all common areas, recessed down lights and wall sconces. Underground parkade, service and storage rooms are illuminated using high efficiency T8 or T5 fluorescent lamps.
18. All exterior lighting are specified as “full cut-off” that throw light down rather than up to reduces light pollution and preserve the night sky.
19. Geothermal System involves installation of a ground loop pipe drilled into the earth beneath the building to reduce the amount of gas needed to heat hot water. Fluid is circulated in a loop that draws heat from the Earth, which is slightly warmer than on the surface. A heat pump intensifies the warmer water before a boiler “polishes” hot water temperature to 140°.
20. The geothermal system provides approximately 30% of the hot water peak load demand (50-60% of total load) and the remainder is heated conventionally.
21. The plumbing and distribution system remains similar since gas and electricity is used. Individual hot water flow meters are installed in order to allocate gas and electricity usage among occupants.
22. Enerpro Systems provides an energy management system for hot water energy monitoring. It collects information and monitors, manages and controls the gas fired central hot water boiler system through a modem attached to the boiler. The system analyzes hot water demand on a daily basis and adjusts the boiler’s settings to respond to specific lifestyle patterns of occupants.
23. Direct air vents bring fresh air in from outside the building.
24. Flooring is carpet, hardwood or tile. All carpet is CRI Green Label approved to reduce off-gassing. All paint carries an EcoLogo label or is LEED approved as identified by the Master Painters Institute.
25. Adhesives and sealants used throughout the building do not exceed the VOC limits of the Canadian Environmental Choice/ EcoLogo program.
26. Garbage divider bins are installed in kitchen cabinetry to assist owners sort paper, metal and plastics.
27. The garbage room located in the underground parking facility for includes a recycling area.

Sources:

UBC Properties Trust. (n. d.). What is Co-Development? Retrieved November 1, 2010 from <http://www.ubcproperties.com/initiatives-co-development.html>

UBC Properties Trust. (n. d.). Clement Green, Retrieved November 1, 2010 from http://www.rethinkingbuilding.com/projects/design.php?c=2_4

Brown, R. (n. d.). Briefing to Clements Green Co-Developers, reSource rethinking Building Inc.

Development: Journey, UBC Endowment Lands



Year Constructed: 2004

Developer: Adera

Designation:

Units: 80 units

Features:

- Units range from 838 sq ft to 1560 sq ft. Most popular upgrade options were stainless steel GE appliances, granite countertops and hardwood floors.
- Several layout options include a three-bedroom convertible to a two bedroom with a separate suite mortgage helper.
- Common space includes a 1,500 sq ft sunset roof deck and garden.

- The UBC Community Card, given to all residents, provides discounted rates and benefits to UBC's athletic facilities and access to the UBC and Vancouver Public Library.

Source:

Adera. (n. d.). Adera Launches First UBC Project Journey, Retrieved November 1, 2010, from <http://www.adera.com/whatsnew/announce/pr2004-01-20>

Development: Reflections, UBC Endowment Lands



Year Constructed: 2005

Developer: Adera

Designation:

Units: 77

Features:

- 4 Located adjacent to Rhododendron woods and the Mid Campus Park in Hawthorn Place.
- 5 Water meter fund was provided by Adera to run for the first few years, but the strata has since decided that the program will not be continued once the original funds run out.
- 6 Meters are read once per year and a bonus is given to the more water-efficient occupants. Determined money would be better spent elsewhere than on individual water metering.
- 7 Water metering should be written into a Strata Act, to ensure implementation and entrench policy.

Source:

UBC Planning Department. (2006, August 9). Development Permit Board Minutes.

Development: Carleton Terrace, NW Burnaby



Year Constructed: 1992

Developer: Architect Michael D. Barley, Landscape Architect John G. Vincent, Consultant Building Science and Engineering Ltd.

Designation: 9 storey concrete high-rise.

Units: 74 units.

Features:

1. Two level underground parking garage
2. Mixed use – retail on ground floor, 2 – 9 features residential levels.
3. Concrete building with stucco
4. Penthouse on 9th floor with common roof deck
5. Units heated with electrical baseboard heating
6. Conventional landscaping
7. \$3 million renovation in 2001 due to water leakage. Included remediation of exterior walls, removal of existing claddings, installation of new rain screen wall system, replacement of windows and resurfacing of horizontal balcony and roof deck surfaces. Restoration Project in 2001, Architect – Michael D. Barley, Designer – Steven Moskalyk –Building Science and Eng., Developer – Preferred Restoration

Source:

City of Burnaby. (n. d.). Planning Department. Open File of Development Applications and Permits.

Development: Symphony, City of North Vancouver



Year Constructed: 2002

Developer: Developer Cragg Design Group, Architect Baker McGarva Hart.
Designation: 15 storey, concrete high-rise in Central Lonsdale.

Units: 67 units, consisting of one and two bedrooms.

Features:

- 4 Parking for 89 vehicles including 68 residential, 7 commercial, and 14 visitors
- 5 13 one-bedroom units, 52 – two bedroom and 3 penthouse units.
- 6 Density transfer features a Floor Space Ratio total of 88,140 sq ft
- 7 All windows utilize low E tinted glass
- 8 Water foundation feature beside front entrance
- 9 Ornamental landscape and courtyard
- 10 Uses 1998 Adaptable Design Guidelines levels 1, 2, and 3.
- 11

Sources:

City of North Vancouver. (1998, Dec. 21). Comprehensive Development Zone Bylaw 7024.

City of North Vancouver. (n. d.). Planning Department, Development Permit Files.

APPENDIX 2 – INFORMED CONSENT TO CONDUCT RESEARCH

Informed Consent By Participants In A Research Study

Green Dwellings, Green Consumption: Do "Green" Residential Developments Reduce Post-Occupancy Consumption Levels?

Co-Investigator

David Hendrickson is a PhD student at the Centre for Sustainable Community Development at Simon Fraser University.

Co-Investigator

Dr. Mark Roseland is Director of the Centre for Sustainable Community Development at Simon Fraser University.

Research Study

The purpose of the study examines the impact of households living in various types of residential developments in areas of housing, transportation, food, waste, community cohesion and behaviours. While environmental costs and human health benefits are receiving considerable attention, we are unaware of this type of research previously conducted in North America. The project will help inform urban policy and design in other developments and communities in BC and around the country. Aims of the study are:

- 1) Investigate appropriate indicators to measure and influence occupant satisfaction in living environments and household consumption;
- 2) Assess household consumption through six relevant indicators: housing, solid waste, mobility, food, community cohesion and ecological behaviour;
- 3) Determine appropriate public policy responses in which household consumption influences urban planning and building design characteristics.

Participants will be asked to participate in a mail-in survey and a follow-up interview. Those participants interested in being contacted for a follow-up interview should include their name and contact information on the survey. They will be contacted by email or telephone to participate in a 45 minute interview. There are no other expectations from participants in the study.

Ethics Review

This research is conducted under permission of the Simon Fraser Research Ethics Board. The chief concern of the Board is for the health, safety and psychological well-being of research participants. If you have any concerns about your treatment or rights as a participant in a study, you may contact Dr. Hal Weinberg, Director,

Office of Research Ethics, Office of Research Ethics, Simon Fraser University, 8888 University Drive, Burnaby, B.C. V5A 1S6 hal_weinberg@sfu.ca tel 778-782-6593.

The research project has received SFU ethics approval. Your identity will be kept confidential to the full extent provided by law. Your responses will be held in the strictest confidence by the research team. No participant names will appear in any reports or presentations from this study. Paper surveys will be shredded after completion of the study and names, addresses, and telephone numbers will not be transferred from the questionnaire into the database to guarantee anonymity. Recorded interview transcripts will be destroyed. Participants will not be harmed in any way by participating and may refuse to participate or withdraw from the study at any time without any consequences.

All participants have the right to ask questions related to the study, and to receive answers to your questions. David Hendrickson is available to answer any questions you have and may be reached at: (tel) 778-782-5188 (email) david_hendrickson@sfu.ca. We will provide a summary of the research findings to your strata council, which you may request from them.

Having been asked to participate in the research study named above, I certify that I understand the procedures outlined above describing the study. I understand that I may withdraw my participation at any time. I also understand that I may register any complaint with the Director of the Office of Research Ethics.

Participant indicates consent for interview without signature _____

Signature

The participant shall fill in this area. Please print legibly.

Participant Last Name:

Participant First Name:

Suite #

Street Address

City

Province

Postal Code

Participant Signature:
MM/DD/YYYY)

Date (use format

APPENDIX 3 - LETTER TO HOUSEHOLDS

c/o Household Study
2611 West Mall Complex
8888 University Drive
Burnaby, BC, V5A 1S6

January 15, 2008

Dear Sir/Madam:

We are conducting an important research study on household lifestyles and are particularly interested in your residence. Due to the challenge of locating diverse housing types of approximately similar size and vintage within the neighbourhood, we ask you to consider participating.

Participants filling in the questionnaire and including their name and address will be entered into a draw to win a new iPod!

We have enclosed a questionnaire asking about living space and daily household routines and ask the head of household to fill in and return the questionnaire in the enclosed self-addressed stamped envelope by Monday March 20, 2008. The head of household is an adult responsible for paying household bills.

The purpose of the study examines the impact of households living in various types of residential developments in areas of housing, transportation, food, and waste. While environmental costs and human health benefits are receiving considerable attention, we are unaware of this type of research previously conducted in North America. The project will help inform urban policy and design in other developments and communities in BC and around the country. The study, "Green Dwellings, Green Consumption" is conducted by PhD Candidate David Hendrickson and supervised by Dr. Mark Roseland from the Centre for Sustainable Community Development, Simon Fraser University, and is funded by the Real Estate Foundation of BC.

This research has received SFU ethics approval. Your identity will be kept confidential to the full extent provided by law. Your responses will be held in the strictest confidence by the research team. Paper surveys will be shredded after completion of the study and names, addresses, and telephone numbers will not be transferred from the questionnaire into the database to guarantee anonymity. Recorded interview transcripts will be destroyed. No participant names will appear in any reports or presentations from this study. Participants will not be harmed in any way by participating and may refuse to participate or withdraw from the study at any time

without any consequences. If you have any concerns about your treatment or rights as a participant in a study, you may contact Dr. Hal Weinberg, Director, Office of Research Ethics, Office of Research Ethics, Simon Fraser University, 8888 University Drive, Burnaby, B.C. V5A 1S6 hal_weinberg@sfu.ca tel 778-782-6593.

All residents have the right to ask questions related to the procedures of the study, and to receive answers to your questions. David Hendrickson is available to answer any questions you have and may be reached at (tel) 778-782-5188 or by email at david_hendrickson@sfu.ca. An identification code is placed in the top right corner of the questionnaire to assist us with following up with respondents who have not returned the questionnaire. We will provide a summary of research findings to your strata council, which you may request from them. Thank you for your assistance and don't forget to include your name and address to enter the iPod draw!

Sincerely,

David Hendrickson
PhD Candidate

APPENDIX 4 – SURVEY IN MANDARIN

(Translated by Karen Chin)

2008 年2 月25 2日

亲爱的户主

西门菲沙大学正进行一项研究计划，以帮助未来的住宅大楼的规划与设计。我们会要求户主填写问卷，然后请使用所附的回邮信封寄回。

如果你在调查问卷包括你的联络资料，您将有资格抽签一个新的iPod!

这研究项目已获得西门菲沙大学的伦理批准。你的身份将予依法保密。该研究小组将会把你的答案绝对保密。没有参与者的名字将会出现在这项研究的任何报告或简报。你的参与将不会对你造成任何损害，参与者可以在任何时候拒绝参加或退出研究，并没有任何的后果。

作为一个参与者, 如果您对在研究中的待遇或权利有任何关注, 你可以联络西门菲沙大学Dr. Hal Weinberg (博士), Director, Office of Research Ethics, Office of Research Ethics, Simon Fraser University, 8888 University Drive, Burnaby, B.C. V5A 1S6 或 hal_weinberg@sfu.ca (电话) 778-782-6593.

在问卷右上角有一个识别码, 以协助我们跟进没有返回问卷的受访者。我们会将研究成果提供给你的业主委员。

David Hendrickson
西门菲沙大学

请你回答你可以填写的问题。如果您有任何进一步的评论，请写在规定的空间中。或写在单独的
谢谢您的帮助。

疑问：

如果您有任何疑问，请联络：

David Hendrickson (电话) 778-782-5188

电子邮件: david_hendrickson@sfu.ca

谁来填这个调查问卷吗？

户主;这是一个成人，负责支付家庭开支。

请注意：我们问及年龄和性别，因为这些都是有关人在建筑物的需要。
我们要求户主填写名字，使我们可以跟进可能出现的任何事项。

1) 背景

你住在这里多久了... .. ? 请只选择一项

6 个月以上 少于6个月

你的年龄是什么... .. ? 请只选择一项

18-29岁 30-39岁 40-49岁 50-59岁 60+岁

你属于一个种族或族裔团?

2) 您家 (你目前住的地址)

你住在这里多久了... .. ?

少于6个月 6个月以上

有多少与你生活的人在18岁以上... .. ?
超过18 岁的人数

还有多少其他与你生活的人已年满18岁或在18岁以下的... .. ?
为18岁或下的人数

3) 住宅的整体

地点 你怎么评价整体位置... .. ?

欠佳 1-2-3-4-5-6-7 满意

1	2	3	4	5	6	7
---	---	---	---	---	---	---

空间 是否有足够的空间... .. ?

足够的空间 总体并不理想 1-2-3-4-5-6-7 满意

1	2	3	4	5	6	7
---	---	---	---	---	---	---

平面图 平面图是否适合你的... ..?

恶劣的平面图 1-2-3-4-5-6-7 空间布局很好

1	2	3	4	5	6	7
---	---	---	---	---	---	---

储存 有足够的储存... ..?

不够多 1-2-3-4-5-6-7 足够

1	2	3	4	5	6	7
---	---	---	---	---	---	---

外观 你怎么评价外观... ..?

恶劣 1-2-3-4-5-6-7 好

1	2	3	4	5	6	7
---	---	---	---	---	---	---

4) 您的家

你通常在家里... ..?

大部分的时间

晚上和周末

其他

你是住在一个... ..?

独立洋房

公寓/公寓大厦

合建房(co-housing)

这住宅是... ..? 出租

业主自用

5) 您的需要

设施提供是否能满足您的需要... ..? (如厨房, 浴室和厕所, 客厅, 室外绿地, 或其他)

很差 1-2-3-4-5-6-7 非常好

1	2	3	4	5	6	7
---	---	---	---	---	---	---

请举例说明好的设施?

和不太好的实例... ..?

6) **舒适性** 在冬季和夏季, 你的建筑物是否舒适

你会如何形容在冬季典型的生活环境? (如果你没有冬季在这里居住, 请留以下问题空白, 并跳到关于夏季温度的问题)

冬季温度

不舒服 1-2-3-4-5-6-7

舒服

1	2	3	4	5	6	7
---	---	---	---	---	---	---

太冷 1-2-3-4-5-6-7

太热

1	2	3	4	5	6	7
---	---	---	---	---	---	---

稳定 1-2-3-4-5-6-7

白天温度变化

1	2	3	4	5	6	7
---	---	---	---	---	---	---

冬季空调

风不动 1-2-3-4-5-6-7 凉风习习
1 2 3 4 5 6 7

干 1-2-3-4-5-6-7 湿润
1 2 3 4 5 6 7

混浊 1-2-3-4-5-6-7 新鲜
1 2 3 4 5 6 7

臭味 1-2-3-4-5-6-7 无味
1 2 3 4 5 6 7

冬季整体生活环境

欠佳 1-2-3-4-5-6-7 整体满意
1 2 3 4 5 6 7

你会如何形容在夏季典型的生活环境？（如果你没有夏季在这里居住，请留以下问题空白）

夏季气温

不舒服 1-2-3-4-5-6-7 舒服
1 2 3 4 5 6 7

太冷 1-2-3-4-5-6-7 太热
1 2 3 4 5 6 7

白天温度变化 1-2-3-4-5-6-7 稳定
1 2 3 4 5 6 7

夏季空调

凉风习习 1-2-3-4-5-6-7 无风
1 2 3 4 5 6 7

干 1-2-3-4-5-6-7 湿润
1 2 3 4 5 6 7

混浊 1-2-3-4-5-6-7 新鲜
1 2 3 4 5 6 7

臭味 1-2-3-4-5-6-7 无味
1 2 3 4 5 6 7

夏季整体生活环境

整体满意 1-2-3-4-5-6-7 整体欠佳
1 2 3 4 5 6 7

7) 噪音 你会如何形容噪音的影响… … ?

这个问题涉及到全年的环境, 请选择你对每一项的评价

噪音	整体满意	1-2-3-4-5-6-7	不理想							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				
声音从一个房间到另一个房间	太多	1-2-3-4-5-6-7	太少							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				
邻居的噪音	太少	1-2-3-4-5-6-7	太多							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				
其他从外面的噪音	太少	1-2-3-4-5-6-7	太多							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				

8) 照明 你会如何描述灯饰的质量… … ?

这个问题涉及到全年的环境, 请选择你对每一项的评价

照明	不理想	1-2-3-4-5-6-7	整体满意							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				
自然光	太少	1-2-3-4-5-6-7	太多							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				
人工光源	太少	1-2-3-4-5-6-7	太多							
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7				

9) 卫生 (请试着用你在其他建筑物的经验, 以对这建筑物评估)

你觉得建筑会影响你的健康, 使你觉得健康欠佳或更健康吗?

更健康	1-2-3-4-5-6-7	健康欠佳							
	<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	
1	2	3	4	5	6	7			

10) 个人控制 你对以下每一项有多大程度的自主控制… ?

自主控制重要性

如果对您很重要, 请于各项

勾一个勾

暖气	无法控制	<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	全面控制	<input type="checkbox"/>
1	2	3	4	5	6	7					
冷气	无法控制	<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	全面控制	<input type="checkbox"/>
1	2	3	4	5	6	7					
通风	无法控制	<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7	全面控制	<input type="checkbox"/>
1	2	3	4	5	6	7					
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7		
1	2	3	4	5	6	7					
		<table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr></table>	1	2	3	4	5	6	7		
1	2	3	4	5	6	7					

灯光 无法控制 全面控制
 噪音 无法控制 全面控制

11) **整体设计** 考虑各项的因素，你怎么评价整体的设计… … ?

不理想 1-2-3-4-5-6-7 理想

1	2	3	4	5	6	7
---	---	---	---	---	---	---

12) **环境设计的特点**

如果你对关于能源和环保设施有什么要补充? _____

13) **交通** 描述你的运输方法

(请选择你对每一项的评价)

自从我搬到这里生活:	更经常地	次数较少	没有改变
不适用			
我驾驶出/入工作	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以公共交通上/下班工作	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以自行车上/下班工作			<input type="checkbox"/>
我驾驶出/入购物			<input type="checkbox"/>
我以公共交通出/入购物			<input type="checkbox"/>
我以自行车出/入购物			<input type="checkbox"/>
我驾驶到/来自学校			<input type="checkbox"/>
我以公共交通到/来自学校	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以自行车到/来自学校			<input type="checkbox"/>
我驾驶出/入社会活动	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以公共交通出/入社会活动	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以自行车出/入社会活动			<input type="checkbox"/>
	更远距离	短距离	没有改变距离
不适用	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我驾驶出/入工作	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以公共交通上/下班工作	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我以自行车上/下班工作	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
我驾驶出/入购物	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

更远距离 短距离 没有改变距离

不适用

我以公共交通出/入购物

我以自行车出/入购物

我驾驶到/来自学校

我以公共交通到/来自学校

我以自行车到/来自学校

我驾驶出/入社会活动

我以公共交通出/入社会活动

我以自行车出/入社会活动

14) **食品** 自从我搬到这里生活，我的家人：

(请只选择一项)

比以前更经常地在家中准备食物。

比以前在家中准备食物的次数较少。

在家中准备食物的次数比以前没有改变。

自从我搬到这里生活，我的家人基于以下原因买杂货：

(以1 -4对以下每一项评价，1是最高的重要性；4是最低的重要性)

粮食种植在BC省

价格

品牌和外观

有机种植粮食

15) **垃圾** 不包括回收品，你每个星期丢多少垃圾出来？

(请只选择一项)

一垃圾袋

2-3垃圾袋

4-5垃圾袋

6

或更多的垃圾袋

回收品

(请只选择一项)

0 - 不要回收

1 袋的回收品

2-33袋回收品

你每个星期丢多少袋回收品

4 -5 5袋回收品

6 6或以上袋回收品

堆肥 是否你的家是否有使用废弃物为绿色堆肥？

(请只选择一项)

是

否

(如果是, 跳过这个问题) 若否, 什么是最主要的原因呢?

我的单位缺乏便捷的堆肥设施
我的建筑物缺乏便捷的堆肥设施

使用食物垃圾处理器
太忙
太复杂/发臭

16) 义工

您或您的家人是否有做义工的时间和/或捐钱给任何环境或社会正义组织/俱乐部/群体?
是 否

(若否, 则跳过了这个问题)

如果有的话, 有多少个环保团体与你的家庭是有联的。

如果有的话, 有多少个社会正义团体与你的家庭是有联的。

如果你做义工, 你每月做多少个小时?

0 -55小时 6 -10小时 11- 15小时 20小时以上

17) 空中旅行 你在过去的12个月是否有乘飞机旅行游玩呢?

(这个问题是问你, 而不是你的家人。计算从升空到降落的时间)

如果有的话, 只计算个人航班; 不包括与工作或部分个人/部分工作相关的空运航班。
。

在过去的12个月共有多少次个人的航班

在过去的12个月个人航班空中旅行时间

18) 应酬 自从我搬到这里生活, 我的家人:

(请只选择一项)

比以前更经常地与邻居饮/食应酬

比以前较少与邻居饮/食应酬

与邻居饮/食应酬的次数比以前没有变

请填写你的地址..... _____

邮政编码... _____

其他补充... .. ?

如果你有其他补充, 请把它提出在这里, 或写在这张纸后面。

谢谢您的帮助

请使用所附的回邮信封寄回:

Household Questionnaire

Centre for Sustainable Community Development
Simon Fraser University
2611 West Mall Complex, 8888 University Drive
Burnaby, BC V5A 1S6

APPENDIX 5 – QUANTITATIVE SURVEY: DEPENDENT VARIABLES

Dependent Variable Labels	
Space	Airsodourl
Spacelayout	Conditionsover
Storage	Nseover
Image	Nsepeople
Athome	Nseneighbours
Dwelling type	Nseoutside
Needs	Ltover
Twover	Ltnat
Twhot	Ltart
Twstable	Comfover
Airwstil	Health
Airwdry	Cntht
Airwfresh	Impcntht
Airwodourl	Cntco
Conditionwover	Impcntco
Tsover	Cntvt
Tshot	Impcntvt
Tsstable	Cntlt
Airsstill	Impcntlt
Airsdry	Cntnse
Airsfresh	Volsjgroups
Design	Impcntnse
Transfreqdrivework	Flightleisure
Transfreqpublicwork	Flighttotal
Transfreqwalkwork	Flighthours
Transfreqdriveshop	Socialneighbours

Transfreqpublicshop
Transfreqwalkshop
Transfreqdriveschool
Transfreqpublicschoo
Transfreqwalkschool
Transfreqdrivesoc
Transfreqpublicsoc
Transfreqwalksoc
Transdistdrivework
Transdistpublicwork
Transdistwalkwork
Transdistdriveshop
Transdistpublicshop
Transdistwalkshop
Transdistdriveschoo
Transdistpublicschoo
Transdistwalkschoo
Transdistdrivesoc
Transdistpublicsoc
Transdistwalksoc
Foodprepare
Foodtype
Garbagethrow
Recyclebags
Recyclefreq
Compost waste
Compostreason
Volunteer
Volenvirogroups

APPENDIX 6 – INTERVIEW PROTOCOL

Time	Site	Date
M/F _____	Ethnicity _____	Age (approx) _____
Interview Code # _____		

Intro

This interview should take about 45 minutes. The questions will build on questions you have already answered in the survey, but will provide me with more detail that will help in the interpretation and analysis of research results. At the end, you will have time to ask me any questions about the study or add any further information.

Sign Consent Form

Housing

- What is the size of your living space (sq ft or m2)?
- Within this space, how many bedrooms do you have?
- How many bathrooms?
- Do you have a living room and dining room?
- Do you have a home office?
- Do you have a balcony? Do you have access to common meeting space in the building?
- Which direction does your unit face?
- What floor level is your unit (first, second, third, etc.)?
- Is your water metered? That is, do you have a way of knowing how much water you use?
- Can I ask how much are your strata fees per month?
- What kind of dwelling did you previously live in, an apt/condo or house?

- Did you own or rent in your former home?
- Why did you move out of your previous home?
- What was the main reason why you moved into your current residence?
- Was your residence unoccupied in 2007 for any extended period(s) of time? If so, how long? Do you spend time at a cottage or second home?
- Was the total number of household members generally more or less than typical during the past year?
- Did you undertake any major renovations in 2007? If so, what were they?

Energy

- Do you have a washer and dryer inside your dwelling? Y/N
If no, where do you wash your clothes?
- (If you have a washing machine), is it front loading or top loading?
- (If you have a dryer) is it electric or gas?
- What is the approximate age of your washer and dryer?
- How many thermostats does your unit contain? Do you use them all? Do you have any programmable thermostats? Do you know how to program them?
- Do you have a gas stove or electric stove?
- How about a gas fireplace?
- How is your unit heated and what is the principal fuel for heating?
- Do you pay for heating? Y/N
- How is your water heated? Do you pay separately for hot water? Y/N
- How old is the heating equipment?
- How much do you pay for electricity per month? (i.e., BC Hydro)?
Is this amount constant or variable?
- How much do you pay for gas per month (i.e., Terasen Gas)?

Is this amount constant or variable?

- Are there any other fuel bills you pay for in your home? (e.g., oil, wood, etc)
- Do you feel that you have saved on energy costs compared to where living previously? Why? About how much per month do you feel you are saving (or spending additionally)?
- (If yes - saving) How do you use any financial savings you feel you have “saved” from living in your home compared to your previous home? For example, do you use any money “saved” from reduced fuel costs to invest in your retirement, or buy other things that you would not have been able to afford otherwise?

Social Capital [Now, I'd like to ask you about how well you know your neighbours]

- How many neighbours do you know on a first name basis?
- Have you ever done social activities together? (If yes, would you consider these activities formally and planned or more informal and spontaneous)?
- Have you borrowed or lent food or household items from or to your neighbours? What kinds of items?

Mobility

- How many cars does your household own?
- What kind and what year is it/are they?
- How many vehicle(s) did your household own before moving into this current dwelling?
- How do you commute to work? What about other members of your hh?
(LIST EACH MEMBER)
- How much does your household spend on fuel for your vehicle(s) per week?
- Approximately what distance and how much time do you spend commuting to work? (What about other hh members?)
- **IF DRIVE** - Do you rideshare or drive in a single occupancy vehicle to go to work? (___x week)? (What about other hh members?)

- What would you estimate is the **total distance** your household drives each week?
- How often do you use your vehicle each week (e.g., everyday, every other day)
- Does your hh take public transit? Why/why not? If YES, do hh members have a transit pass?
- Does your residence have parking for your vehicle(s) at your residence? (Other hh members?)
- Do you use it? Can you opt out?
- How much does your hh pay for parking at your residence?
- How much does your hh pay for parking at work or when away from your residence? (per week or month).
- Does your residence have bike storage? Is it in a private or public area? Is there a rideshare vehicle available to use?

Air Travel

- **(ONLY ASK IF AFFIRMATIVE ON SURVEY), You indicated on the survey** that you travelled for personal reasons in the past year, where did you fly? Did other hh members accompany you on this trip? How many?

Food

- Estimate your household food expenditures in total for groceries prepared in the home each week?
- How many people usually eat at home?
- How many times does your hh eat at a restaurant or order from a restaurant (and eat in) per week?
- How many times do you eat red meat per week, either at home or at a restaurant?
- What would you estimate is the number of frozen ready-made meals your hh eats per week?
- What grocery store do you frequent the most often? Why?
- Where is it, about how far away (distance)? How do you travel there?

- What % of groceries do you buy at this grocery store?
- **(Based on your survey response)**, why do you actively seek out “Made in BC” food products? **OR** Why don’t you actively seek out “Made in BC” food products?
- What percentage of your weekly food is local (Made in BC)?
- (Based on your survey response), why do you actively seek out organic food products? **OR** Why don’t you actively seek out organic food products?
- What percentage of your weekly food is organic?
- Does your hh garden? (If yes) Flowers, vegetables or both?
- Is there an adequate place to garden? Privately or within a public commons?

Garbage and Recycling

- Is there a limit to the amount of garbage that you can throw out every week? Do you use a dumpster?
- Is your home designed with adequate recycling receptacle areas? Why, why not?
- In which area or room(s) do you keep your recycling?
- You indicated on the survey that (YOU COMPOST - OR DO NOT COMPOST). Are there any factors or conditions that might encourage your hh to compost (or compost more)?
- Do you have any ideas about how to reduce garbage?

Sustainability Behaviours [Now I would like to ask you some questions about your behaviours and ideas for potential solutions]

- Does your hh actively seek out environmentally friendly products? (e.g., toilet paper) Why/why not?
- Does your hh actively seek out fair trade products? (e.g., fair trade coffee) Why/why not?
- Carbon dioxide is the major cause of climate change and global warming. Do you have any idea how much CO₂ is emitted by your hh in a year? Can you think of any ways this information might be useful to you?

- Are you familiar with the term “carbon offsets”? Y/N
(Carbon offsets can support projects that reduce CO₂ by a similar amount elsewhere (e.g., tree reforestation or renewable energy installations). Carbon offsets voluntarily compensate carbon impacts so people can reduce or neutralize their carbon impact.
- Would you be interested in voluntarily purchasing carbon offsets? Why/why not?
- How concerned are you about global warming and how it may affect future generations of people? Why?
- Are you taking any personal actions to reduce global warming?
- **You mentioned x (FROM 77 AND 78)** – Do you have any other ideas to help households to reduce their environmental impact?.
- Do you have any ideas how developers might create homes with a decreased environmental impact?
- Can you think of any urban land use policies/practices that might help reduce household consumption? (e.g., locating a bus stop within walking distance of where people live).
- That concludes the interview. Do you want to add anything else? Do you have any questions about the study? Thank you for your time.

APPENDIX 7 – QUALITATIVE DATA: EMERGENT CODES

Meta Codes and Sub-codes

Meta Code	Sub-codes
Behaviour	C02useinfo
Behaviour	Carbonoffsets
Behaviour	Conserve actions
Behaviour	Denial, despair, inaction
Behaviour	Enviro fairtrade products
Behaviour	Enviroskepticism
Energy	Appliance
Energy	BC hydro
Energy	Energy savings & rebound effect
Energy	Fireplace
Energy	Mainheating & problems
Energy	Teresengas
Energy	Thermostat
Food	#eatathome
Food	#frozenreadymeals
Food	Expense
Food	Grocerystore
Food	Local
Food	Organic
Food	Redmeat
Food	Restaurant
Garbage	Compost
Garbage	Recycling
Housing	#bathrooms & bedms
Housing	#hhmembers

Housing	Balcony
Housing	Direction & floor
Housing	Homeoffice
Housing	LEED influence
Housing	Lighting
Housing	Livingspace
Housing	Previoushomemove
Housing	Stratafee
Housing	Type (green, co-housing, typical)
Housing	Unoccupied & renos
Idea	Barrier to sustainability
Idea	Energy
Idea	Food
Idea	Garbage
Idea	Mobility
Idea	Social capital
Idea	Unit & urban form
Mobility	#,year, model of car
Mobility	#ofcarspreviously
Mobility	\$, distance, time
Mobility	Airtravel
Mobility	Bus
Mobility	Cycling, walking
Mobility	Parking
Mobility	Commute, vehicle use, rideshare
Site	Co-housing
Site	Green
Site	Typical
Social capital	Foodhouseholditems
Social capital	Neighbours
Social capital	Social activities

Water	Bill
-------	------

APPENDIX 8 – QUALITATIVE DATA: EMERGENT SUB-CODES

	Energy
1	Appliances
A	Choosing Gas Or Electric Range
B	Clotheslines
C	Washer – Dryer
D	Common Washer – Dryers
E	Carbon Tax
F	Venting Problems
G	Garburator Waste Energy
2	BC Hydro
A	Thermostats
B	Unsatisfactory Thermostats
C	Programmable Thermostat
D	Hard To Program
3	Energy Savings & Rebound Effect
A	Savings On Energy
B	Less
C	More On Heating Before
D	Spend On Other Things
E	Itemize Energy Costs
F	Smaller Home
4	Common Interior Walls
A	Cluster Buildings
B	Buy Instead Of Rent \$
C	Fireplace
D	Electronic Ignition
E	Principle Heat Source
5	Main Heating & Problems
A	Problems With Heating Vents
B	Air Flow
C	Baseboard Heating
D	Using Baseboard Heat
E	No Geothermal
6	Terasen Gas
A	Bulk Gas Rates
B	Thermostats
C	Program Or Manual Thermostats
7	Ideas About Energy

A	Energy Too Cheap
B	Venting Problems In Bldg
C	Alternatives To Dryers - No Clotheslines
D	Industry Plays Huge Part In GHGs
E	Turn Off Power When Not Using I
F	Tax Shift
G	Establishing Connection Between Behaviour And Cost
H	Visibility For Energy Use By Community Rather Than BC Hydro
I	Visible Meters Over Thermostat Design
	Food
1	Eating At Home
2	Frozen ready-made meals
A	Convenience
3	Price
4	Preferred Grocery Store
A	Independent
B	Price Most Important
C	Variety
5	Organic Food
A	Farmer To Consumer - Connecting To Farmers
B	ALR
C	Food Miles - Local And Organic Preference
D	Food Miles And Quality
E	Local Food Social Events
F	Seasonal Food
G	Price
H	Urban Delivery
I	Better Taste
6	Community Economic Development
A	Local Economy
B	No Support For Community Garden
C	Benefits – Knowledge Of Community Gardens
D	City To Facilitate Community Gardens
E	City Support
7	Organic Food – Seek out
A	Group Shopping
B	Flavour And Quality
C	Intentional Buying Organic
D	Healthier – Food Miles
E	Food Miles - Quality
F	Health
G	Certification Concerns
H	Cost Differences

8	Red Meat
9	Eating Prepared Food Outside Of The Home
10	Enviro Fair Trade Products
A	Coffee
B	Skeptical Of Certification
C	Certification
D	Enviro Friendly - Relative To What?
E	Price Considerations And Certification
F	Small Acts Are Important
G	Paper
H	Green Procurement
I	Cleaning Products
J	Lawn Mowers
K	Health
L	Toxicity
M	Availability
N	Access
O	Coops And 10 Thousand Village Types
P	Crafts And Thrift Stores
Q	Vancouver – Strong Ethic
11	Ideas About Food
A	ALR
B	Sprawl
C	Community Gardens
D	Bulk Buying
E	Small Grocers
	Garbage
A	Garburator Convenience And Lack Of Facilities
B	Lack Of Facilities
C	No Facilities
D	Lacks Physical Facility And Social Behaviour
E	Compost Facilities For Every hh
F	Now Has Composting Facilities
G	Design Composting Bucket/Recycling Areas
1	Unaware Of Amount Of Garbage
A	Amount Of Garbage And Communication
B	Does Not Make Enough Compost To Use
2	Communication
A	Compost Facilities Unknown
B	Communication From Electronic Newsletter
3	Garburator Dependency
A	Garburator Is Bad For Sewage System
B	Garburator – Lack Of Waste Visibility
C	Need Composting Facilities And Price Signals
D	Garburator Diverts Waste To Sewage

E	Energy Use In Garburators Is Wasteful
F	Lifecycle Costing For Sewage To Energy Vs Secondary Treatment With Garburator
4	Recycling
A	Separation Under Sink
B	Recycle Under Sink
C	Kitchen Recycling Facilities
D	Design Recycling Containers That Fit Or Don't Design Them
E	On Deck
F	Remove Recycling Daily Due To Lack Of Space In Unit
G	Flexible Sorting System
H	Holistic Recycling Systems By Occupant
I	No Limits To Discarding
J	Sorting
K	Poor Design For Recycling
5	Recycling In Bldg
A	Facilities In Building Are Needed For People To Recycle
B	Common Recycling Bins
C	Recycling Facilities
D	Personal Champion
E	Design Bins Dependent On # Of People In Unit
6	Ways To Reduce Waste
A	Conspicuous Consumption
B	Packaging
C	Grocers Nearby So Can Buy More Frequently
7	Industry And Regs
A	Industry Redesign Without Waste
B	Factor 10
C	Industry Design Waste Out Of System
D	Return It Centres
E	Excessive Packaging
F	Speed Up Regulation Process And Increase Materials To Recycle
8	Ideas About Garbage
A	Visibility Of Garbage
B	Lack Of Awareness How Much Is Thrown Out
C	Changing Behaviour
D	Addiction - Blue Box Is Just A Star
E	Using Fish Concept And Take To Adults?
F	Human Nature
G	Consume Less
H	Industries Role

I	Education
J	Signage – Communication - Lack Of Awareness About How Much Garbage Produced
K	Awareness
L	Learning From Past Generations
9	Industry
A	Packaging
B	Industry’s Role – Regulation – Education - Introducing New Materials
C	Infrastructure
D	Changing Muni/Regs - Changing Industry / Environment
10	Developers
A	Profit Generation
B	Integrated Design - Using Kitchens And Closets
C	Integrated Design - Methane From Food Waste - Viewing Waste As A Resource
D	Lack Of Facilities
E	On Site Diversion
F	Separating And Storing Recyclables
G	Lack Of Facilities
11	Policy
A	Construction Recycling
B	Infrastructure - Separating Recyclables - Pricing
C	Reducing Saves Money
D	Personal Champion
E	Fire Codes Compatibility
F	Financial Incentives
G	Economy Of Scale
12	Return And Reuse Centres
A	Reuse Stores - Centres
B	Return It Centres
C	Craig’s List For Free
D	Electronic Reuse
E	Bags
	Sustainable Mobility
A	Alternative Fuel Vehicles - Less SUVs
B	Bus Frequency Lacks
C	Bike Parking
D	Subsidize Public Transit
E	Inconvenient Transit
1	Urban Form And Policy Impacting Mobility
A	Public Institutional Hypocrisy
B	Car Sharing – No Regs - Liability Issues - Lack Of Leasing Arrangements

C	Insurance Regs
D	Aging In Place And Being Close To Services
E	TOD
F	Transit Too Expensive And Too Slow
G	Infrequent Transit
H	Sprawl
L	Urban Form Around Building
M	Short Driveways Or No Driveways
2	Noise
A	Noise - Traffic Calming
B	Developers
C	Lack Of Bike Parking
D	No Bike Racks At Front Of Building
E	Separate Parking Stall From Unit
F	Common Property Parking Means Flexible Space
G	Behaviour Change
H	Quality Of Life Equates To How Much You Drive
I	Max Rather Than Min Muni Parking Regs
J	Education
	Social Capital
1	Sharing Household Items
A	Sharing Things, Space, Skills Knowledge
B	Sharing hh Items
C	Car Sharing
2	Food Sharing
A	Food Items
B	Bulk Buying
C	Bulk Buying
D	Local Food From Social Activities
E	Embedding Local Food Through Socializing
3	Advantages Of Community Living
A	Multi Generational Living
B	Seniors In The Building Doing Activities
C	Mixed Generations Or Senior Housing
D	Meet Through Dog Walking
4	Challenges And Barriers
A	Strata Council Is Extent Of Socializing
B	Disadvantages of Sharing
C	Challenges Of Intergenerational Living – Senior Co-housing?
D	Forming Community Requires Ongoing Commitment
E	Consensus Decision Making - Privacy
F	Challenges With Community

G	Multi-Cultural Challenges – Surrounding Community Facilities
H	Multicultural Barriers
5	Bldg And Urban Design
A	How Does Placemaking Form?
B	Walkable Neighbourhood
C	Common Facilities And Loaning Items
D	Economy Of Scale – Sharing Homes
E	Community Making In Surrounding Areas
F	Design For Connecting With People
G	Design For Community
H	Community Needs Time To Form – Different Entrances
I	Designing For Interactions – New Community
6	Designing For Gardeners
A	Sharing Benefits Of Gardening
B	Gardening Builds Community
7	Security Issues
A	Safety Over Community - Design
8	Who Are The Occupants?
A	Investor Residents Not Living In Units
B	Students And Out Of Towners
9	Co-housing Model
A	Co-housing Best Model For Community Bldg
B	Intentional Community
C	Involvement Is Up To You
D	Consensus Decision Making
10	Legal Liability
A	Developing A Building Forms Community
B	Legal Liability
11	Knowing Your Neighbours
A	Interview Potential Neighbours
B	Informal Policy Of Introducing New People
C	Security In Knowing Neighbours
12	Planned And Spontaneous Activities
A	Planned Social Activities
B	Meals And Meetings
C	Spontaneous Events
13	Ideas About Social Capital
A	Community Building
14	Sustainable Practices
A	Common Parking
B	TOD
C	Reduce Barriers To Share
D	Update Muni Bylaws For Sustainability

15	Design Strategies For Social Capital
A	Communities Of Scale – Max 45 For Livability
B	45 Unit Max
C	Senior Only Co-housing - Multi-Generational – Advantages Aging In Place
D	Design – No Hallways Builds Community
E	Guestroom Facility
F	Livable Residential Towers – How To Do It? - Aging In Place – Multigenerational - Options For Privacy - Consensus Model Of Decision Making - Critical Mass To Do Sustainability Projects
G	Design For Community
16	Co-housing
A	Stronger Sales For Co-housing
B	Role For Owner Developer
C	Space To Use Owner Talents/Interests To Develop More Sustainably – I.E., Landscape
D	Co-housing Occupants – Politically Active
E	Role Of Ownership For Sustainability – Community To Develop
F	Co-housing - Free Guest Room And Common Facilities
G	Co-housing - Bartering Talents
H	Co-housing - Install Internet
I	Collective Contract - Co-housing
J	Co-housing – Anticipate Problems
K	Co-housing – Sj And Environmentalism
L	Challenges Of Consensus Decision-Making
M	High Level Of Trust
N	Private Development Model For Co-housing
	Unit & Urban Form
1	Bathrooms & Bedrms
2	Number Of hh Members
3	Balcony
4	Direction & Floor
5	Home Office
A	Live- Work
6	Lighting
7	Living space
8	Strata Fee
9	Site Type (Green, Co-housing, Typical)
10	Unoccupied & Renos
A	What Are Sustainable Products/Materials?
B	Storage
C	Cosmetic Over Efficiency

11	Green Credential Influence
A	Water Flow Issues
B	Toxic Smells From Off-Gassing
12	Why Move From Previous Home
A	Moving For Community
B	Co-housing
C	Location
D	Layout
E	Location, Safe, Green Space, Good Investment
F	Price
G	Price And Ground Level
H	Price And Avoid Traffic
I	Aging In Place
13	Amenities
A	Location And Amenities, Community
B	Amenities
C	Quiet, Nature
14	Non-Toxic – Green Design
A	Multiple Entrances – Non-Toxic
B	Rezoning Process - Location
15	Green Site
A	Greener Design
B	Well Kept And Maintained
C	Guest Suite Added Bonus
D	LEED Influence
E	Good For Marketing
F	Location And Employee Benefits
G	Quality
H	Bonus To Be Green
16	Typical Site
A	Finances Before Sustainability
17	Developers
A	Alternative Energy
B	Noise Reduction
C	How To Reduce Noise
D	Noise - Visual Pollution
E	Siren And Traffic Noise Issues
F	Small Living Area - Green Credentials
G	Communicate/Market Environ Features
H	Storage
18	Co-housing
A	Demo Project - Co-housing
B	Co-housing As A Pilot
C	Uncertainty Of Co-housing

D	Co-housing As A Real Estate Model
E	Co-housing Zoning - Market Co-housing As Sustainable
F	Co-housing Expertise
G	Connect Buyers And Sellers Of Co-housing
H	Connect Developers With Co-housing - Affordable Land
I	Co-housing -Don't Go To Public Tender
J	Not Only Developing Co-housing But Take Ideas From Co-housing To Transplant In Conventional Developments
19	Design Innovations
A	Introduce Sustainable Living Products In The Home
B	Need Outreach Indifferent Languages
C	Landscaping -Personal Champion
D	Green Roofs
E	Pedestrian Lanes Instead Of Streets
F	Good Kitchen Layout
G	Passive Solar Heating
H	Concrete Over Wood MURBs
I	Ventilation - Washer Drain - Outside Drains – Protect From Frost
J	Landscaping - Water Reducing - Space For Bikes
K	Guest Room
L	Toxicity
M	Awnings
N	Kitchen Layout
O	Loud Elevators
P	Low Toxic Paint
Q	Vertical Gardens
R	Maintenance Of Building
S	Low Flush Toilets
T	45 Unit Max
U	Bulk Buying
V	Green Roof - Growing Food - Reduce Lawns
W	Bike Locks Outside Front Door
X	Own Your Own Energy Utility
Y	Density
Z	Facility For Meeting/Organizing
Aa	Natural Lighting
Ab	Building Materials
Ac	Strata Council Is Critical For Making Change
Ad	Upass
Ae	Carbon Neutral Bldg

20	Land Use Considerations
A	Far - Density Bonus
B	Shared Common Space
C	Zoning
D	Regulate Developers
E	Density
F	Sprawl - Carbon Neutral Retrofits
G	TOD
H	Utility Poles Obstructing Views
I	Construction Recycling
J	Driving Inconvenience
K	Economic Over Other Considerations
L	Net Metering -Market Driven LEED - Incentives
M	Sustainable Communities
21	Green Space
A	Safety
B	Exercise Within Daily Activities
C	Brownfield Vs Greenfield
D	Surrounding Urban Form Is Important
E	Consider Bioregion
F	Trees – Green Space
G	Tree Cutting Restrictions
H	Community Gardens
I	Using Parks As A Playground
J	Landscaping
K	Green Space
L	Pedestrian Mall
M	Selecting Residential Areas Based On Bioregionalism
22	Integrated Design
A	Design For Common Areas
B	Passive Design – ALR - Sprawl
C	Height Of Buildings
D	Community Consultation
E	POA
F	Aesthetics Of Building And Urban Form
G	Planning For Future Public Access Amenities
H	Design With Nature
I	Pigeons
23	Aging In Place
A	Aging
24	Environ Features, Promotional Material, Website
A	Multi-Generational
25	Behaviour
A	Density Fears

B	Ascetics Over Energy Efficiency
C	Privacy Is Unhealthy
D	Cleanliness Comfort
E	Education
F	Farm Opportunities For Learning
G	Skeptic In Award Winning
H	Active Users Builds Enviro Concern
I	Stake In Community By Owning Something
J	Keeping Things Longer
K	Change Mentality Of Large Homes
L	Smaller Houses
26	Barriers Inhibiting Sustainability
A	Cultural Barriers
B	Racism And Stereotypes Towards New Immigrants
C	Strata Council Pivotal Towards Action
D	Signage Promoting Sustainability
E	Communication With Signs
F	LEED Credentials Build Awareness
G	Less Maintenance Fees – But Not Advertised
27	Mobility
A	Public Transit
B	Public Transit (Convenience)
C	Public Transit (Inconvenience)
D	Inconvenient Public Transit - Efficient Vehicles
E	Public Transit Too Slow
F	Urban Form Can Deter/Encourage Driving
G	Aesthetics Over Sustainability
H	Schools Are A Major Part Towards Complete Communities
I	Communities Are Autocentric
28	Business Case
A	Business Case For Sustainability
B	Higher Return For Units With Community
C	How Sustainable Is It? - Rebound Effect - Lifecycle Costs
D	Industry Not Shouldering Enviro Burden
E	Payback Periods -
F	Require hh To Create Economies Of Scale
G	Economic System
29	Developers
A	No Clothes Lines
B	No Space
C	Environ Features Must Work Or Useless
30	Co-housing
A	Role Of Co-housing As A Residential Model Is

	Unknown
B	Finding Land For Co-housing
C	Strata And Condo Bylaws
D	Co-housing Done By Amateurs
E	Temporary Financing During Construction
F	Development Political Lobby Not Supportive Of Co-housing
G	Lack Of Developer Awareness About Co-housing
H	Awareness And Value In Density
I	Lack Of Integrated Design -
J	Ability To Organize In Co-housing
31	Community Development And Mobilization
A	Small Actions Help
B	Cycle Of Development
C	Population Explosion - Drops In Food Production
D	Consensus Decision Making
E	Local Solutions And Context
F	Consumptions Interconnected Vicious Circle
G	Consensus Model Of Decision Making
32	Behavioural Influences
A	Societal Change With Smoking
B	Learning To Live Like Past Generations
C	Cleanliness And Comfort
33	Lack Of Respect For Nature
A	Redefine Quality Of Life
B	Lack Of Environ Awareness
34	Lack Of Education
A	Lack Of Awareness
35	Consumer Driven Society
A	Role Of Advertising
B	Inherent Addiction
C	Self-Restraint
D	Disposable Mentality
E	Me First Generation
F	Privacy Concerns Over Common Space
G	Has Privacy Led To Social Isolation
H	Role Of Ownership
I	Canadian Dream
36	Safety
A	Perceived Security Issues And Individuality
B	Nimbyism
C	Perceived Safety Over Access
D	Personal Responsibility
37	Waste

A	Amount Of Waste - Garburate – Waste Is Invisible
B	Compost
C	Separating Vs Comingling
D	Industry Is Greater Contributor - Amount Of Waste Disposal
E	Too Difficult To Separate
38	Governance And Policy
A	Public Office Leading By Example
B	Lack Of Leadership
C	Lack Of Leadership – Taking Personal Responsibility
D	Disjointed Regulations
E	Density
F	Municipal Regs - Mentality We Are Doing Enough - Tax Shift- Lack Of Education
G	Politically Active Citizens
H	Transparent Public Development Process
39	Muni Finance
A	Regulation - Pricing Failures - Tax Shifting - Full Cost Accounting - Externalities
B	Tax Shift
C	Measuring Resource Consumption - Tax Shifting
D	Save On Property Tax
E	Owner Developed- Zoning- Density Bonus-Lack Of Incentives
F	Rationing Measures
G	Co-housing Zoning
H	Financing - Finding Land
I	Long Term Outlook For Building Code Planning - Public Access To Green Roofs
J	Tax Shifting From Assessed Value To Resource Consumption - Subsidizing The Rich
K	Showcase Environ Products
L	Financial Models - Lifecycle Costing Muni Fees

APPENDIX 9 – FIELD SITE OBSERVATION PROTOCOL

- Description of trees and natural vegetation surrounding development
- Access to building/unit
- Security and lighting
- Accessibility for physically disabled
- Location of stairways
- Signage
- Internal appearance of building
- External appearance of building
- Quality of building materials (floors, walls, ceilings)
- Cleanliness and configuration of common areas of building
- Distance to bus stop
- Distance to services
- Garbage removal
- Green space on property and proximity to green space
- Parking and bike facilities
- Unencumbered views

APPENDIX 10 – PUBLIC POLICY FOCUS GROUP AGENDA

Green Buildings, Green Consumption
Focus Group Session
Thursday, November 19, 2009
#101 Boardroom
Simon Fraser University – Harbour Centre
Time: 9am – 12noon

A light breakfast will be served

Invited Participants

- Colleen Sparks, Director, Carbon Neutral Ops & Climate Outreach, Climate Action Secretariat (by video conference)
- Magdalena Szpala, Sustainability Analyst, BC Housing
- Tony Gioventu, Executive Director, Condominium Home Owners' Association
- Emmanuel Prinet, Executive Director, One Earth
- Juvarya Warsi, Economic Development Strategist, Light House Sustainable Building Centre
- Celina Owen, Manager of Communications & Administration, REFBC
- Bev Grieve, Manager of Planning, City of New Westminster
- Mark Roseland, SFU
- David Hendrickson, SFU
- Michelle Murvai, SFU (notetaker)

Proposed Agenda

9:00 – Introductions

9:10 – Brief Presentation – David Hendrickson

9:30 – Discussion on policy implications of the report

10:30 - Break

10:45 – Discussion on potential next steps

12:00 noon – Adjournment

Questions:

9:00 – Introductions

Opening: Welcome. I'm glad everyone could make it this morning. We need to get everyone's best insights into this conversation in order to make the policy implications relevant for the report.

9:00 – Brief Presentation – David Hendrickson

Rational Objective – Are the policy implications from the report on target, practical and realistic?

Experiential Aim – Establish communication about SCP for households with policy makers

9:30 – Discussion

In this focused conversation, I want us to specifically discuss the policy implications for SCP for hh. I have a handout of the policy implications outlined in the report to help us examine the categories and specific policies in greater detail. Based on the presentation and your own experiences with MURBS and households, I hope our discussion will shed light on how consumption can be framed into policy for various jurisdictions from households, buildings, municipal, provincial, and federal jurisdictions. I know everyone is busy and it takes a lot to be pulled into these types of discussions, so let us get started.

1. What caught your eye in this report?
2. What did you bump up against in this report?
3. What part of the report left you skeptical or frustrated?
4. What are the main points the report is making?
5. What are the implications (if any) for how we do our work?
6. What work needs to be done before we make a final decision about the changes we are recommending?

Within the context of your own organization, which policy implications are most likely to move forward a sustainable consumption and production (SCP) agenda?

7. Which policy implications move toward SCP for households?
8. Which policy implications move away from SCP for households?
9. What intrigues you about these policies?
10. What worries you?
11. How are contradictions and dilemmas addressed in this report?
12. Think about this report in terms of implications for your organization. What three main headings would you make to describe implications?
13. Which of these draft policy implications would encourage interdepartmental cooperation?

14. Which of these draft policy implications would most likely detract from interdepartmental cooperation?
15. Which draft policy implication would resonate most at the municipal level?
 - a. At the household level?
 - b. Which of these policies do we need to implement (pick three).
 - c. What do we need to clarify?
 - d. Which ones are low priority? (mark them)

10:45 – Break

16. Where do you see disconnects or gaps with any of these draft policy implications?
17. What has to happen with citizens to create synergy around sustainable consumption and production?
18. If you had to look five years down the road, which of these policies do you envision could be realized?
19. Do you feel these draft policy implications yield the test of time?
20. What did you hear that you don't already know?
21. What did you hear that you need to hear again
22. What central themes can we pull out from this?
23. What concerns does this raise for you?
24. What questions/barriers do these policies raise?
25. Which ones get the most long lasting results or provide the most significant long-term benefits?
26. What gaps do you notice?
27. How does the policy implications fit with what you already know about this issue in your organization?
28. How realistic are the policy implications, given available resources?
29. What additional questions does this presentation raise for you as a senior manager in your organization?
30. What potential consequences does this approach have for your organization?
31. What are the implications within our work?
32. What immediate next steps do we need to take?

Closing: Thank you for your time today. I guess we all noticed that this conversation did not just deal with households, but household consumption has ramifications beyond the home. These are important matters that we have noted down and will think more about. Thank you for your insights and your time. Your input will be incorporated into the final report, which should be available sometime in December.

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