District energy and sustainable neighbourhood planning:

A study of the Burnaby Mountain District Energy System

by

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The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

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Abstract

In this thesis I answer the research question: *what barriers were faced in the implementation of the Burnaby Mountain District Energy System, and what was the role of the SFU Community Trust in overcoming these barriers?* I base this analysis on the typology of barriers to district energy implementation in Canada as suggested by the Canadian District Energy Association. I bring in ideas from community energy planning and governance of sustainable development in understanding the role of the SFU Community Trust in realizing this neighbourhood-scale and capital-intensive effort to reduce greenhouse gas emissions from the urban built environment of the UniverCity community in Burnaby, British Columbia. While I find that the SFU Community Trust was not responsible for reducing all barriers faced in the implementation of this district energy system, their significant leadership role in shaping the normative, cognitive, imaginary and regulative aspects of the institutional framework surrounding UniverCity's development enabled the implementation of the Burnaby Mountain District Energy System in 2012.

Keywords: low-carbon district energy; sustainable neighbourhood development; governance networks; barriers

Dedication

To my parents, for teaching me the value of hard work and instilling in me a deep love of learning, but most importantly you taught me to persevere.

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Chapter 1.

Introduction

1.1. Cities and energy, and climate change

Cities are an important scale for policy action to reduce human-generated greenhouse gas (GHG) emissions contributing to global climate change. While cities are a major source of GHG emissions, they are also the scale at which significant climate action policies can be carried out (Bulkeley, 2005; Burch, 2010). My research looks at one particular form of action that cities are engaging in to reduce energy use and GHG emissions from the urban built environment: policies supporting the implementation of low-carbon shared thermal energy systems between buildings in the same neighbourhood or district, known as low-carbon district energy systems (UNEP, 2015). This research is a study of a district energy system that was implemented in a newly developed neighbourhood named UniverCity located on Burnaby Mountain in British Columbia. This project is unique in that it was led largely by a university-affiliated land developer, the Simon Fraser University (SFU) Community Trust. The research question asks: *what barriers were faced in the implementation of the Burnaby Mountain District Energy System, and what was the role of the SFU Community Trust in overcoming these barriers?*

Cities comprise only 4% of the world's land, yet they account for 75% of the world's GHG emissions (UNEP, 2014). The built environment in cities alone account for 40% of the world's global energy consumption which, in turn, is associated with 30% of all energy-related GHG emissions worldwide (UNEP, 2014). Urban centres are currently home to 54% of the world's population and this share is expected to increase to 66% by 2050 (UN-DESA, 2014). With the population of the globe expected to rise to 9.5 billion by 2050 (UN-DESA, 2014), there is pressure to shape our cities' built environment and

infrastructure systems to accommodate this population but to do so in a more ecologically responsible and sustainable manner. These population and urbanization trends point to the city as the crucial level of social organization where much action for climate change mitigation can and must be taken (Bulkeley & Betsill, 2005; Dusyk et al., 2009; Rees & Wackernagel, 1996).

In the last four decades the connection between human activity and global environmental impacts has been made clear, beginning with the Intergovernmental Panel on Climate Change (IPCC) in 1988 (IPCC, n.d.). The first IPCC assessment report in 1990 provided scientific evidence linking human activity to increased GHG concentrations in the atmosphere and trends in global temperature increases. Subsequent assessment reports strengthened the connection between human activity and the negative impacts of higher GHG concentrations in the atmosphere, and made increasingly dire warnings about the need to act to stabilize the climate to mitigate the negative impacts associated with a warming world. However, a lack of coordination and action at the international level means that much of the impetus for action has focused on local governments (Ostrom, 2010).

Cities, as major centres of consumption and production, are concentrated sources of negative environmental impacts but that also means that they are a key location for reducing these impacts stemming from human activity (Rees & Wackernagel, 1996; Coelho & Ruth, 2006). From a governance perspective, it is often local governments that are best situated to act since they often have jurisdiction over local energy supply and management, transport, planning and waste management (Bulkeley & Betsill, 2005), and these development factors all have interrelated negative environmental consequences. Furthermore, although climate change is a global concern, its effects are felt in different ways in different geographical areas around the world; thus, effective policy responses to climate change challenges require deep understanding of the local context (Murakami et al., 2011). It is also at the local governance level where political responsiveness is highest as there are strong social connections between those with conviction to act on sustainability goals and those who are involved with policymaking (Jepson, 2001). This close connection allows local authorities to coordinate various actors and to facilitate community involvement through

urban governance networks to create climate change mitigation programs (Bulkeley & Betsill, 2005).

Looking at the spatial dimensions of a city, we can intuitively see an association between the city's physical form and its overall energy use and environmental impact. From the life-cycle and embedded energy of a building's material construction, to the density and diversity of building use and the accompanying transportation energy use, to the energy associated with provision of municipal services such as waste, water and storm water treatment, we can see that cities are concentrated sites of energy consumption which produce significant environmental harms (Troy, 2012). At the same time, this urban concentration means there is great opportunity for large-scale improvements to be made in targeting these energy uses. My research examines one neighbourhood-scale project for GHG reductions – the Burnaby Mountain District Energy System (BMDES). This research will contribute to the knowledge of how barriers to the implementation of large-scale infrastructure aimed at reducing the negative impacts associated with our built environment, such as district energy systems, are overcome through actions within governance networks.

1.2. Research question

My research question asks: *what barriers were faced in the implementation of the Burnaby Mountain District Energy System, and what was the role of the SFU Community Trust in overcoming these barriers?* This question seeks to gain a deep understanding of the governance network and institutional context surrounding the Burnaby Mountain District Energy System at the UniverCity neighbourhood, as an investigation into the urban response to climate mitigation in the Metro Vancouver region.

The SFU Community Trust (the Trust) acts on the behalf of Simon Fraser University who is the land owner of the UniverCity community. The Trust has a sustainability agenda and as such can be considered an unusual actor in the neighbourhood development process. Typically, development in the Canadian context is a process negotiated between three main groups: developers, citizens and municipalities (Grant, 2008). Developers are usually for-profit companies responsible for carrying out

the processes of constructing the built environment and are driven by a market approach to development, whereas municipalities have the statutory right to enforce land-use decisions of what can be built and where within their jurisdiction. However, citizens provide input to the planning process through public consultations for neighbourhood or area plans with municipal officials, in order to determine what types of land-use would be acceptable for the area. The presence of the Trust adds a layer of complexity in the negotiations that are typically held between private developers and local governments in urban neighbourhood development. The Trust is recognized as the driving force behind the district energy system and other sustainable neighbourhood achievements at UniverCity (FCM, 2011; CMHC, 2015). By focusing my research around the development of one specific district energy project and the role of one significant organization in shaping that development process, I trace the history of the project along its spatial, temporal, and governance contexts.

The research presented in this M.URB thesis will be useful to planners, policy makers and developers in the Metro Vancouver region, as well as a general public that is interested in understanding the connection between energy and the built urban form, and the governance of sustainable neighbourhood development. This research will contribute to a dialogue on how different institutional and governance arrangements surrounding district energy may contribute to reducing harmful environmental outcomes associated with the built environment, all within the context of today's social, economic and governance frameworks in the Metro Vancouver region and in North America.

1.3. Case study context

1.3.1. Provincial context – British Columbia, Canada

British Columbia (BC) is home to 4.6 million people (BCStat, 2014) and is a prosperous Canadian province with abundant natural resources for energy, including significant hydroelectricity potential and two large shale gas deposits in the northern part of the province (Horne, 2011). British Columbia has recently become known as a leader for climate action in Canada (Dusyk et al., 2009). In 2007 the Province made a commitment to reduce GHG emissions by 33% below 2007 levels by 2020, and this was

touted as the most aggressive legally-binding GHG reduction target in North America (BC Ministry of Environment, 2008). In 2008, the province introduced the first carbon tax within North America in an attempt to set a price signal for consumers and industry to reduce fossil fuels use (BC Ministry of Finance, n.d.; Sustainable Prosperity, 2014).

The two main sources of energy powering BC's built environment are electricity and natural gas; they account for 38% and 54% of all household energy use, respectively (Statistics Canada, 2011). Both of these energy networks within the province are stable and highly developed, and are operated by large-scale utilities. BC Hydro, a crown corporation, provides the majority of electricity while FortisBC, a private utility, is the largest natural gas supplier in the province (BC Hydro, 2014; FortisBC, 2013). BC Hydro is the largest electricity provider for British Columbia serving 95% of BC's population (Horne, 2011) with over 93% of production from hydroelectric generation which is considered renewable and low carbon (BC Hydro, 2014). British Columbians also enjoy some of the lowest electricity prices in the world – a recent study by Hydro Québec ranks Vancouver's residential electricity rates as the 3rd lowest of North American major cities (Hydro Québec, 2014).

On the natural gas supply side, BC is home to significant natural gas reserves. The discovery of shale gas in northeastern BC in 2005 brought down natural gas prices (Horne, 2011) from a high of $9.78/GJ in 2005 to $3.71/GJ as of October 2014 (FortisBC, 2014). While natural gas is sometimes touted as 'clean-burning' fuel (Ministry of Energy, Mines and Petroleum Resources BC, 2012), it is nevertheless a fossil fuel that releases significant amounts of GHGs during combustion, as well as during the extraction and processing stages (Horne, 2011). Furthermore, the extraction and processing of natural gas has additional environmental impacts such as habitat destruction and ecosystem disruption and there are significant risks to water quality associated with the common extraction method of hydraulic fracturing (Horne, 2011; Whiticar, 2012). Overall, the low prices of both natural gas and electricity in BC generally does not tend to encourage a culture of energy conservation from a consumer perspective.

In British Columbia, community sources of GHG emissions are typically considered as those from buildings, vehicle transportation, and solid wastes. Depending on the community, however, other sources of GHG may need to be accounted for, such as land-use changes (deforestation), wastewater treatment, agriculture, marine and rail transportation (CEA, 2008). Generally speaking, however, the building sector in BC is responsible for 35% of greenhouse gas emissions from community sources (Province of BC, 2010). Such emissions come from building level energy uses such as heating and cooling, which are fueled by natural gas and electricity (Statistics Canada, 2011; Snider, 2006). Space heating in British Columbian households is chiefly provided by natural gas and electricity, at 55% and 39% of households, respectively. In British Columbia, especially in the metropolitan areas, development tends to favour denser housing which are more likely to be built with electric heat than single family dwellings. As a result, BC Hydro expects that the market share for electric heated housing will still be on the rise over the next 20 years (BC Hydro, 2012).

Given the recent controversy over the economic, environmental and social costs of the construction of a new hydroelectric dam on Site C of the Peace River in northern BC, a continued dependence on electricity to meet building heating needs is not a sustainable decision. The Pembina Institute, a nonpartisan Canadian energy think tank, called the Site C project “irresponsible” and “not in the public interest of British Columbians”, citing that it is at odds with BC’s Clean Energy Act (Pembina Institute, 2010). This 2010 Act encouraged the switching of fuels to sources that decrease GHG emissions, although no specific technologies were identified (Horne, 2010). Others critics say that the proposed area to be flooded by the Site C dam is “too precious to destroy” (Peacock, 2009) as it is an area of significant wildlife habitat, prime agricultural soil, and is situated on culturally-important First Nations traditional lands (Peacock, 2009; Dusyk, 2010). All the above reasons contribute to the justification for implementing low-carbon district energy systems that reduce reliance on large-scale hydroelectric dams.

1.3.2. Regional context – Metro Vancouver

The Metro Vancouver region, in which this research is located, is a regional governance area in British Columbia's Lower Mainland comprising 21 municipalities, one electoral area, and one Treaty First Nation (Metro Vancouver, 2015). This region, like many other urban centers around the world, is experiencing population growth pressures, with an additional 1 million new residents forecasted between 2011 and 2041 (Metro Vancouver, 2009). With a current population of 2.4 million as of 2013 (BC Stats, 2014), this is an increase of 41% in less than 30 years. In Metro Vancouver, heating, cooling and other energy uses from buildings account for 42% of total GHG emissions from community sources (Metro Vancouver, 2014). This figure is higher than the 35% provincial average from the same emission source but may be attributed to the higher percentage of built environment in the region as compared to the rest of the province. There is clearly a need to grow Metro Vancouver's communities and infrastructure to accommodate the expected population increase, but to do so in a more environmentally sustainable manner. Moreover, as part of BC's 2007 commitment to reduce greenhouse gases, the *Local Government (Green Communities) Act* (Bill 27) was amended in 2008, adding a requirement for local governments to deliver GHG reductions from community energy sources such as transportation, buildings and waste (BC Climate Action Toolkit, n.d.).

Low-carbon district energy systems are now being considered by municipalities throughout the Metro Vancouver area for large-scale development projects. District energy systems in operation at Southeast False Creek and River Districts in Vancouver, the City Centre in Surrey, the Alexandra district in Richmond, Lonsdale in the City of North Vancouver, along with the Burnaby Mountain system serve as examples for the region. Several similar systems are at various stages of proposal or planning in areas such as the Cambie corridor and Northeast False Creek in Vancouver, the Sapperton area in New Westminster's waterfront, and the North Vancouver Lonsdale expansion.

It is important to note that within the Metro Vancouver region, district energy at the neighbourhood scale only refers to district heating, in which only heat is being shared within an area. Most municipalities in Metro Vancouver, however, use these terms interchangeably, so for simplicity's sake I will do the same.

1.3.3. Municipal context – the City of Burnaby

While the City of Burnaby is located within the Metro Vancouver region, Burnaby maintains its legal status as a municipality from the provincial *Local Governments Statutes Amendment Act* of 1998. Local governments in British Columbia are considered an "administrative extension of the provincial government" (Bish & Clemens, 2008, p. 15). As of 2008's *Local Government (Green Communities) Act* amendment, local governments are now obligated to carry out the community energy planning process, starting with an inventory of all community sources of GHG emissions, followed by incorporating targets, policies and actions for GHG reductions in their Official Community Plans (BC Climate Action Toolkit, n.d.). One strategy that is commonly tied to community energy planning is the district energy (DE) system, which takes advantage of economies of scale in neighbourhoods to potentially achieve more GHG reductions from buildings (refer to Section 2.1 for more detail on this strategy).

The City of Burnaby is a self-proclaimed leader in environmental stewardship for the protection of environmentally sensitive areas of water and wildlife habitat (City of Burnaby, n.d.). On the issue of climate mitigation such as reducing energy consumption and thus GHGs emissions from the built environment, however, they do not appear to demonstrate significant leadership. In response to the 2008 *Green Communities Act*, which required BC municipalities to include GHG reductions targets within their Official Community Plans, the City of Burnaby Council in 2011 adopted an interim community GHG reductions target of 5% below 2007 levels with no target date by which to achieve these levels. This was meant to be an interim goal set while the City works on an environmental sustainability strategy and updated emissions reduction target; both are expected to be complete by early 2016 (Clutton, 2015). Compared to the higher targets that have already been set by surrounding municipalities in Metro Vancouver (see Table 1), as well as the specified timelines for action prior to 2020, the City of Burnaby may even be considered a laggard in responding to climate action.

Table 1: Medium- and long-term greenhouse gas reductions targets for selected Metro Vancouver municipalities (in alphabetical order)

City (Source[1])	Medium-term target	Long-term target
City of Burnaby (2011a)	5% below 2007 levels	None stated
City of Coquitlam (2012)	15% below 2007 levels by 2031, and 30% below 2007 levels by 2021 (per capita)	None stated
Township of Langley (n.d.)	10% below 2007 levels by 2021 (per capita)	None stated
City of New Westminster (2015)	15% below 2007 levels by 2030	None stated
City of North Vancouver (2014).	15% below 2007 levels by 2020	50% below 2007 levels by 2050
District of North Vancouver (2014).	8% below 2007 levels by 2020, 13% below 2007 levels by 2030	21% below 2007 levels by 2050
City of Richmond (2014a)	33% below 2007 levels by 2020	80% below 2007 levels by 2050
City of Surrey (2015)	33% below 2007 levels by 2020 (per capita)	80% below 2007 levels by 2050 (per capita)
City of Vancouver (2012a)	33% below 2007 levels by 2020	None stated

What is compelling about my research focus on the BMDES, then, is how unusual it might seem that such a capital-intensive carbon reduction policy like the BMDES came into existence in a city with such low targets of carbon reduction and a slow response to climate action even in the face of provincial mandates. This is one reason why a study of the SFU Community Trust is useful in understanding low-carbon district energy implementation in instances where there is no apparent motivation demonstrated by the municipality.

1.3.4. The UniverCity community

The district energy system in question is located in the UniverCity neighbourhood development at the top of Burnaby Mountain in the City of Burnaby, on land owned by Simon Fraser University (SFU). The residential neighbourhood started becoming a

[1] GHG reductions targets for these municipalities were compiled from either the municipality's website, council report, official community plans, or official community energy and emissions plans. Refer to Works Cited.

reality in 1995 after negotiations between the City of Burnaby and SFU led to an agreement to open up 65 hectares of land to the development of a residential community. An official community plan (OCP) was created and subsequently approved by the City of Burnaby's council in 1996. In it, the Trust envisioned a complete, walkable neighbourhood for up to 10,000 residents (SFU Community Trust, n.d.). The UniverCity neighbourhood is widely marketed as a "model sustainability community" (SFU Community Trust, 2014a).

As of 2015, the Phase 1 and approximately half of Phase 2 of the neighbourhood's development is complete, and UniverCity is home to 3,500 residents (SFU Community Trust, 2014b). Phases 3 and 4 are currently in development and are expected to be complete within the next 25 years, when the neighbourhood is expected to be home to 5,500 additional residents. The BMDES began operations in 2012 and currently provides heating and hot water to 7 buildings of a potential 41 buildings in phases 3 and 4; all future development in Phases 3 and 4 are mandated by the SFU Community Trust to connect to this system as they are built (SFU Community Trust, 2014b). Future plans for the district energy system include a potential connection to SFU Burnaby main campus, along with a fuel switch from natural gas to biomass from local wood waste as a means to further reduce the carbon footprint of both the UniverCity neighbourhood and the SFU Burnaby campus (SFU, 2011). Both systems currently use natural gas as a fuel source. Biomass fuel is being considered for the future joint plant as it is a carbon neutral and renewable source of energy and is widely available in BC through beetle-killed timber, wood wastes from the forestry industry and agricultural wastes (BIOCAP Canada Foundation, 2010). Wood waste fuel for the future Burnaby Mountain District Energy System is anticipated to come from local construction sites and municipal landscaping sources (CMUS, 2010).

1.3.5. The SFU Community Trust

The SFU Community Trust was created in 1999 as a separate corporate entity from Simon Fraser University in order oversee the planning and development of the UniverCity neighbourhood on SFU-owned lands. The Trust has two officially stated goals: 1) to create a complete community on Burnaby Mountain, with a diverse selection

of housing and a full range of shops, services and amenities; and 2) to build an endowment fund to support teaching and research at SFU (SFU Community Trust, n.d.). As the trustee to the SFU-owned lands, the Trust works with the City of Burnaby and developers to build out the neighbourhood through pre-paid 99-year land leases. With this arrangement, land ownership remains with the Trust in perpetuity. The Trust is governed by an independent board of directors consisting of representatives from SFU as well as finance, real estate and property development experts within the region (SFU Community Trust, n.d.).

The SFU Community Trust has a stated sustainability agenda encompassed by the four 'sustainability cornerstones' of Environment, Equity, Education and Economy (SFU Community Trust, n.d.). In Section 4.1.2, I discuss the origins of this sustainability agenda in 2000, and in Section 5.1 I trace the evolution of how energy conservation is considered within this framework and its impact on the eventual district energy implementation.

Chapter 2.

Conceptual framework

The conceptual framework presented in this chapter lays out the analytical basis for understanding how barriers common to district energy were overcome, as well as the role of the Trust in shaping the implementation of the Burnaby Mountain District Energy System. This conceptual framework guides the understanding of what choices were made by the Trust regarding energy use from the built environment of UniverCity, and the outcomes of these choices and their ultimate influence on DE implementation. The first literature explains how DE systems fit within with community energy planning concepts through the energy-choice hierarchy; this guides the understanding of 'why' a DE system was pursued. The second part of my conceptual framework describes the barriers to DE implementation in Canada, and provides a way to categorize the barriers faced and eventually overcome. The last component of my conceptual framework explains how this sustainable urban development initiative is realized within this governance network and highlights why a governance perspective is needed to augment the understanding of barriers to DE such as 'leadership'.

2.1. Energy management in the urban context

2.1.1. Community energy planning

Community energy planning is a merging of the traditional planning ideas around urban design, 'complete communities', and 'green cities' with energy management concepts typically used by energy utilities, such as energy cascading, demand-side energy management, and integrated resource management (Jaccard et al., 1997). In traditional resource planning, integrated resource management calls for the consideration of both the supply and demand-side options. On the supply side, energy

cascading principles are applied in arranging energy-using processes to optimize the use of waste energy, while demand-side management strategies are applied to reduce energy demand through a variety of incentives or consumer education. Community energy planning (CEP) is an integrative planning principle that encourages communities to define energy priorities that have the potential to reduce GHG emissions from the built environment. This practice was introduced to North American planning circles as local policy responses to global climate changed in the early 1990s through the California Energy Commission's *Energy-Aware Planning Guide* (Failing, 1995). As early as 1997, community energy planning was being promoted to British Columbia local governments through the non-profit, non-government advisory organization BC Energy Aware Committee (CEA, 2006). However, it was not until the 2007 amendment to the *Local Governments (Green Communities) Act* (Bill 27) of British Columbia that local governments were required to actively carry out community energy planning activities and to account for their communities' GHG emissions. This *Act* introduced the requirement for local governments in BC to complete an inventory of local sources of GHGs from transportation, buildings and solid wastes (Climate Action Secretariat, n.d.) and to incorporate GHG reduction policies and actions within their local community plans and regional growth strategies, essentially incorporating community energy planning concepts into local policy documents.[2]

2.1.1.1 Energy-related choice hierarchy and community energy planning

Looking at energy in the urban setting, according to Jaccard et al. (1997), decisions regarding energy use can be made at different levels within an energy-choice hierarchy, as conceptualized in Table 2. This hierarchy is based on the differences in time horizons and physical scale of each level; as one moves up the hierarchy, decisions made at each level have longer term consequences and are of greater physical size and scope. Categorized at the bottom level are options for energy-using equipment, for example, transit vehicles, motors, appliances, and building heating, ventilation and air conditioning (HVAC) systems. Situated at the middle level are the processes that use this equipment, such as production processes, transportation modes, and building and

[2] A list of the GHG reduction policy targets that some municipalities in Metro Vancouver have committed to can be seen in Table 1 in Section 1.3.3.

site design. Finally, at the highest level are decisions about the urban systems or conditions that shape or prescribe the energy-using processes and equipment, such as urban density, mix of land uses, energy supply infrastructure, and transportation network (Jaccard et al., 1997). For example, while the serviceable life of a building's HVAC system can be 5 to 20 years and buildings can last for 20-80 years, the urban form, shaped by land-use, energy infrastructure and transportation networks, may last for centuries. Vancouver's overall grid-like urban form and street layout, for example, is a remnant of the decisions made in the late 19th and early 20th century to build the city around the electric streetcar (Berelowitz, 2005) and remains in place today.

In addition to the time and physical scale implicit to the energy-choice hierarchy, there are also differences in the level of authority for decision-making at each level. At the equipment level, decisions tend to be made by private individuals responding to market forces in relative isolation, whereas at the systems level decisions tend to be made by public entities in the example of land-use planning by local or regional governments. This scale of decision needs to be made with the intention of safeguarding the greater public good, which requires coordination and consultation between different stakeholder groups through governance processes. In Section 2.3 I define governance processes and how they differ from traditional models of government in directing and implementing public policies.

Table 2: Hierarchy of energy-related choices (Source: Jaccard et al., 1997, p. 1066)

Infrastructure and land-use patterns • Density • Mix of land uses • Energy supply infrastructure • Transportation networks
Major production processes, transportation modes and buildings • Choice of industrial process • Choice of transportation mode • Building and site design
Energy using equipment • Transit vehicles • Motors • Appliances • HVAC systems

The hierarchy shown in Table 2 is the conceptual foundation for community energy planning; it encourages local authorities to consider the policy opportunities available at each level of the hierarchy. Available policy tools include regional growth strategies, development planning and approvals, official community plans, site planning and building design, zoning and rezoning bylaws, transportation and infrastructure plans, and neighbourhood concept plans (CEA, 2006). While community energy planning as a tool is generally targeted towards local and regional authorities, it would appear that the SFU Community Trust took the lead on several of the policy tools that are typically within the purview of the local government. For example, the Trust created the UniverCity community plan as well as their own design guidelines and requirements, the latter of which are functionally similar to municipal zoning and rezoning bylaws. The energy hierarchy and community energy planning framework helps to conceptualize why the Trust pursued the implementation of a district energy system in addition to other energy-related policy decisions that were made about land-use and development density, despite commonly known barriers and risks to district energy systems which are discussed in Section 2.2.

2.1.2. District energy and the urban form

District energy (DE) systems are a type of energy supply infrastructure that supplies heating, cooling or electricity, or any combination of the three, to any number of buildings connected to a network within a specified service area. DE systems as a strategy for reducing community sources of GHGs is commonly cited in community energy planning guidance (CEA, 2006 and 2008; NRCann 2011) because it addresses a number of the choices within the energy choice hierarchy. In order to justify the capital costs of a DE system, a balanced energy load of a sufficient scale is needed. This balanced load occurs when energy is being produced and consumed at an even rate, which lengthens the life of the energy-production equipment and reduces operating costs. Such loads are more easily achieved in systems serving neighbourhoods with high building densities and a mix of building uses. In such neighbourhoods, the need for energy is balanced between residential uses, which typically demand more energy the evening and nighttime, and commercial uses, which require more energy in the daytime. This type of urban form of high density and mixed-uses complements common urban

development goals of livability, walkability and 'complete communities' with compact forms[3].

Another advantage of district energy systems is that they can provide their service area communities with greater long-term flexibility in fuel source; this can translate to an ability to lower GHG emissions in the future. Once the energy network infrastructure is in place within a neighbourhood, it is possible to switch to low carbon or renewable energy supplies such as geothermal, biomass or waste heat recovery from other processes should the economic or political case for doing so becomes compelling. This fuel switch is more easily done at a large scale by making changes to the central plant of a district system rather than making changes to each individual building; thus the potential to reduce GHG emissions for a neighbourhood in one step is higher (Ghafghazi et al., 2010; CDEA, 2011). This flexibility to switch fuel sources in order to reduce GHG emissions from neighbourhoods, sometimes called 'future-proofing' (UNEP, 2015), is a commonly cited reason that municipalities within Metro Vancouver are pursuing various DE strategies. (City of Vancouver, 2012; City of Richmond, 2014; City of Surrey, 2014). District energy is also being promoted worldwide "as a best practice approach for providing a local, affordable and sustainable energy supply, improve energy efficiency and support energy access efforts", according to the United Nations Environment Programme (2015).

District energy is not a new technology; the first system in Canada was installed in 1880 in London, Ontario for a hospital campus (CIEEDAC, 2014). These systems are already commonly used by large-scale industrial or institutional building owners, such as heavy industrial manufacturers, and university or hospital campuses that consist of multiple buildings (IDEA, n.d.). The application of DE technology outside of the industrial or institutional context, for example, in systems that serve mixed-use neighbourhoods containing residential users, is much less common (CIEEDAC, 2014). While Metro

[3] In current planning literature, livability, walkability and complete communities are interconnected ideals of places that have the following characteristics: opportunities for citizen engagement in planning; an active public realm which allows for the creation of a common identity; urban form consisting of mixed-use and affordable housing that are pedestrian-friendly and enhances public transportation networks; and green spaces that provide for biodiversity and recreation (Timmer & Seymoar, 2006).

Vancouver municipalities refer to DE systems, they only refer to systems providing heating. In other parts of Canada, however, the supply of cooling and/or electricity at the district level is also pursued depending on the local context.

Within the Metro Vancouver region there has been a history of district heating in large-scale institutions. Simon Fraser University's Burnaby campus, like many universities in North America, has its own DE system which was built in the 60s and expanded as the campus developed (Gavel, 2011). The University of British Columbia's Vancouver campus also has its own long-established DE system, as do the major hospitals in the area such as Vancouver General Hospital and the Children and Women's Health Center of BC.

An example of DE outside of the institutional sector is found in Vancouver, where a significant portion of the downtown peninsula is connected to a district heating system through Central Heat Distribution Limited, a privately-owned utility that has recently rebranded as Creative Energy. Creative Energy has been providing heating to downtown Vancouver since 1968 and currently serves 210 customers including condominium buildings, hotels, office buildings, social housing, small manufacturing, and a hospital (Creative Energy, 2013). This system grew with the densification of downtown Vancouver and was originally launched based on the business opportunity its founders saw in providing a growing downtown with a heating system that reduced local air pollution associated with oil-fired boiler technology of the time (Berry, 2015; Renger, 2015). While this system was not planned with our current perspective on community energy planning and a need to reduce GHG emissions, it is a good example of the scalar benefits of DE. Currently, Creative Energy is responsible for 6.5% of the GHG emissions from community sources in Vancouver (COV, 2012b), and since 2014 they have been in talks with the City of Vancouver concerning a fuel-switch to a low-carbon source such as wood chips (Lee, 2015a). If successful, the fuel-switch would lead to significant GHG reductions from the built environment in Vancouver and be a testament to the 'future-proofing' advantage of DE systems.

With its various touted advantages to the urban environment, it may be puzzling that these systems are not more widely used in Canada. Despite the examples listed

above, thermal energy supplied by district system in Canada only accounts for 1% of total thermal energy (CIEEDAC, 2014; Compass Resource Management, 2010), while GHG emissions related to the building sector accounts for 35% of total emissions (BC Ministry of Environment, 2008). In several Northern European countries, district energy is the predominant means of supplying heating to buildings. For example, Denmark and Sweden began to undergo an energy transition to district heating after the 1970s oil crisis. Today, the city of Copenhagen, Denmark is connected to a district heating grid that supplies 98% of heat consumed within the city. Denmark, as a nation, boasts of 60% heat supplied by DE systems (Copenhagen Cleantech Cluster, n.d.). Its neighbour, Sweden, lags slightly behind with 50% of heat supplied by district networks (Ericsson, 2009). Both of these nations attribute their lower per capita GHG emissions from building-related energy consumption to the use of these systems.

In the North American context, while the same oil crisis led to immediate policy responses in the way of price controls on energy, increased regulation of energy production, and even some energy rationing, many of these policies did not survive beyond the mid-1980s (Rosenbaum, 2015). While there was a rise in interest in district energy in Canada after the 1970s oil crisis (CIEEDAC, 2015), the degree of growth in the market share of district energy has been extremely low compared to countries like Denmark and Sweden (IEA, 2004). It was not until the late-1990 to early-2000s with the introduction of community energy planning that energy and land use began to be discussed in combination as a planning issue. Now that there is a rise in interest in DE again, in the next section I discuss the known barriers to implementing this technology in Canada.

2.2. Barriers to implementation

According to a 2011 research study conducted by the Canadian District Energy Association (CDEA) with funding from Natural Resources Canada (NRCan), there are five main challenge areas opposing the widespread implementation of district energy in Canada. These factors are broadly categorized as knowledge, leadership, economic, human resources, and sustainability challenges (CDEA, 2011). **Knowledge** challenges relate to the lack of education and awareness of district energy as a viable option to the

provision of thermal energy to the urban built environment. Such barriers are blamed for DE being overlooked as an energy policy option by policymakers and sustainability advocates. **Leadership** challenges relate to a shortage of thought-leaders and project champions of DE at various levels, as well as the lack of strong political leadership and will to create a regulatory and legislative environment that is more supportive of district energy investments, and thus reducing the economic challenges associated with such projects. The **economic** challenges identified by the CDEA relate to the generally difficult business case for district energy, due to the low cost of energy and a lack of carbon pricing in Canada (outside of the province of BC) as well as the capital-intensive cost of physical infrastructure, the lack of access to capital and supportive financing support mechanisms, risks to market penetration and uncertainty of access to customer base associated with DE systems. The **human resources** challenge is identified as the lack of overall technical knowledge in the proposal, design and operation of district energy systems. Finally, the **sustainability** challenge associated with DE is that it is not well-promoted as a tool to achieve urban sustainability goals and thus is not part of "the public's 'green' agenda…that could contribute to communities moving away from fossil fuel dependency and reducing GHG emissions" (CDEA, 2011, p. 24). Such challenges vary across Canada and across different projects, however, I use this framework of barriers as a starting point to trace out the path to the implementation of DE at UniverCity.

The CDEA report proposes a rather simple causal relationship between the five noted challenges to DE implementation as rooted in a lack of knowledge about district energy, which is the most significant barrier in their view.[4] It claims that because there is low awareness of DE as a sustainability policy option, there is a lack of political leaders who are willing to create a supportive policy environment for this type of infrastructure. Without the support of policy, a lack of leaders in the development or engineering realm also contributes to the economic and human resource challenges seen by DE projects. This culminates in a sustainability barrier which leads to "the lack of ability for DE to sell and position itself as a green energy option" (CDEA, 2011, p. 25). The CDEA report

[4] My findings and discussions in Chapter 4 show that the root of the barrier faced in the path to the Burnaby Mountain District Energy system was not the knowledge barrier, but a barrier more related to how sustainability is prioritized as a development goal.

suggests that if more people in leadership positions knew about the benefits of this type of technology, they would be motivated to realize these projects, lamenting that "if DE is unable to develop a message that is capable of inspiring leaders, it will be unable to gain the momentum it needs to experience significant growth into the future" (CDEA, 2011, p. 25). One of its proposed actions to reduce the leadership barrier is to recruit and cultivate more 'project champions, visionaries, thought leaders and stronger political advocates' (CDEA, 2011, p. 40). Such recommendations may be understood within the context of the report as they are written by CDEA, an industry association representing owners, operators, suppliers and municipalities in support of the growth of the district energy industry in Canada. The report was likely intended to justify the work of the organization and to set its course of action in promoting the growth of the industry.[5]

There are two main limitations to the use of this framework for my case study of district energy implementation. First, the scale of the CDEA framework differs from my research scope which centres on the implementation of one specific DE system. The CDEA barriers are the result of an industry-wide study and may be too generic and thus insensitive to the context of an individual project, however, they are still a useful basis for understanding the events leading up to the implementation of the Burnaby Mountain District Energy System, which I detail in Chapter 4. I also elaborate on these barriers as they arise and interact, and I discuss the relative impact of each barrier to the Burnaby Mountain DES in Section 4.4.

The second limitation of the CDEA barriers is in what they label the 'sustainability' barrier, in describing the phenomenon of DE not being well-promoted as a tool to achieve urban sustainability goals as DE is not inspiring to those in leadership positions. The CDEA assumes that DE is the correct or appropriate sustainability policy option, without delving into any higher level discussion of how DE can contribute to or

[5] Currently, the use of this report's specific recommendations for growing the DE industry in Canada is unclear, as the CDEA was integrated into the International District Energy Association (IDEA) in July 2012. The IDEA is a non-profit trade association based in the United States with members from over 200 countries. It was formed in 1909 and has similar goals to CDEA in promoting the uptake of district energy technologies (IDEA, 2012). The IDEA continues to work with Canadian members to promote the industry but future research may reveal the outcomes directly relating to this Action Plan.

even detract from the larger policy concerns or issues within urban sustainability. The CDEA's understanding of the 'sustainability' barrier is about the ability to promote, or brand, DE as a viable urban sustainability option and thus in Section 4.2.2 I demonstrate how this barrier should instead be labelled more appropriately as a 'sustainability image' barrier.

To my knowledge, this CDEA framework has not been used in social science research context on DE. Although the climate change phenomenon is typically considered a scientific issue, sustainable development as a response to the problems caused by climate change is an inherently social issue (Hoffman & Jennings, 2012). Even the CDEA report acknowledges this by suggesting that "DE challenges relate to people not technology" (CDEA, 2011, p. 24), but it lacks an examination of the 'people'-related factors behind the challenges to DE, especially the knowledge and leadership barriers. I delve into these barriers by considering the governance and institutional contexts in which DE leaders work which leads to the removal of other barriers to DE implementation. In the next section I explain the governance and institutional lens through which I examine the role of the SFU Community Trust.

2.3. Governance concepts

2.3.1. Governance and sustainable urban developments

In recent years, scholars have come to consider governance and sustainable urban development as closely interrelated issues (Joss, 2011; Bulkeley & Betsill, 2005; Griffin, 2010). Because sustainability-related development issues must be considered at the intersection of the economic, social and environmental aspects of policymaking and have long-lasting and global implications that are often complex and uncertain, the traditional forms of government, with their emphasis on short-term political and economic cycles, are ill-adapted to handle them (Joss, 2011). Governance is defined as "broader than government, covering non-state actors", and governing is done "with and through networks…to exchange resources and negotiate shared purposes" (Rhodes, 2007, p. 1246). Governance is understood to be a responsibility shared between the state, the market and civil society in dealing with societal problems (van Zeijl-Rozema et al., 2008),

and differs from the traditional hierarchical state model of ‘government’ by a single governing body (Rhodes, 2007). This traditional form of governing has been blamed for many failures such as political inefficiencies, poor policy implementation, reduced transparency and accountability, as well as our current environmental problems (Griffin, 2010). In the face of these sustainability challenges, "neither top-down government policies nor bottom-up market forces can alone support directed long-term sector- wide changes; they can only occur through combinations of government policies, market forces, and bottom-up initiatives from civil society" (Loorbach, 2007, p. 1). Griffin (2010) goes on to state that “not only [do] the causes of many sustainability problems lie within governance arrangements, but…their solutions are likely to result from institutional, i.e. governance reform” (Griffin, 2010, p. 366).

At the urban scale, governance is the process through which local authorities, private business and civil society achieve collective goals within the urban realm (Monstadt, 2009), such as the development of the built environment and infrastructure systems for housing, energy, waste, water, etc. Scholars agree that urban governance forms have been changing in the last several decades in response to higher level forces such as the dynamics of global capitalist accumulation, new technological development, and the privatization of public services (Harvey, 1989; Hodson & Marvin, 2009; Monstadt, 2009; van Zeijl-Rozema et al., 2008). This implies a current movement away from governing as in a previous era of comprehensive and top-down town-planning, to more reflexive forms of governance where there is "negotiation and bargaining between interested state and non-state actors with interdependent resources” (Smith et al., 2005, p. 1498). These various actors differ in their viewpoints, positions and interests when it comes to the development and functioning of urban infrastructure systems (Hodson & Marvin, 2010), and these differences must be negotiated within governance networks. In the current context of the agenda for sustainable urban development, the role of various governance actors in implementing community energy plans and DE projects may be better understood using a governance network perspective.

This framework is appropriate for my research because the implementation of the DE system is a ‘sustainability’ attempt within the urban development realm. The BMDES was realized not through top-down planning efforts from any formal government level but

through the participation of governance actors like the SFU Community Trust negotiating with both the public sector (municipal and provincial government representatives) and with the private sector developers through a governance framework.

2.3.2. Characteristics of governance networks

Governance networks as a basis for understanding governance relationships builds on analysis of how public policies problems and solutions are shaped through the negotiations between actors who have different resources and levels of authority (Smith et al., 2005; Marcussen & Torfing, 2003). Marcussen and Torfing (2003) further define governance networks using the following five characteristics: 1) governance networks are a non-hierarchical collection of interdependent but autonomous actors; 2) interactions between actors are negotiations that are facilitated by deliberation, understanding, social learning and joint action; 3) negotiations take place within existing institutional frameworks that have regulative, normative, cognitive and imaginary aspects; 4) these networks are self-regulating, or self-governing, and not completely subject to hierarchical chains of command or to market rules; and 5) these networks help produce a public purpose.

Of the five listed characteristics of governance networks, it is the third characteristic regarding the different aspects of institutional frameworks that is most helpful to understanding the role of the Trust in the implementation of the BMDES. The other characteristics of the governance networks surrounding this project will not be the focus of my analysis but are apparent. For example, the non-hierarchical nature of this network is evident and comprises the SFU Community Trust, Simon Fraser University, the SFU student body, the City of Burnaby, market developers, utility providers, the BC Utilities Commission, and other professionals involved in the development of the district energy system. In the network surrounding the development of the UniverCity and the BMDES, there is no clear hierarchy of decision-making authority and the implementation of the DE system was the result of extended periods of negotiations between various network actors and not from the direct authority of any level of government. The public purpose produced by this governance network was the DE system with its goals of reducing GHG emissions from the buildings in the UniverCity neighbourhood as an

urban initiative for climate mitigation. It is the third characteristic of institutional frameworks, comprising the regulative, normative, cognitive and imaginary aspects that will provide more insight into the role of the Trust in this research.

2.3.2.1. Elements of institutional frameworks

I propose to understand the Trust's role by focusing on the institutional frameworks that are shaped by the Trust that were critical to the implementation of the DE system. I will consider these frameworks, or the rules of the negotiations taking place within this particular governance network, that are shaped by the Trust using the lens of the cognitive, normative, regulative and imaginary aspects. This is a more process-oriented approach to understand the 'leadership' role of the Trust as I examine the specific actions taken by the Trust and the related outcomes on the governance network. In Section 2.2 I referred to the CDEA's view of the leadership challenge as the need for more "project champions, visionaries, thought leaders and stronger political advocates to promote the application of DE….and the creation of a more supportive regulatory and legislative environment for DE in order to mitigate investment risk associated with DE projects" (CDEA, 2011, p. 40). Beyond the CDEA's simple call for more DE leaders, my research looks at the elements of the governance network surrounding the development of UniverCity and the BMDES that was shaped by the Trust, in order to understand how 'leadership' led to a supportive environment for DE.

The regulatory, normative and cognitive aspects as dimensions of institutional frameworks are rooted in institutional theory which seeks to understand how stability and meaning is created in institutions (Scott, 2014). It is a foundational sociological theory which focuses on how participants within institutions (as a level of social organization) deliver purposive actions. Applied to governance networks, Marcussen and Torfing use these elements to explain the boundaries of the negotiations taking place between governance actors, or what might colloquially be known as the 'rules of the game' of a governance network (2003).

According to Marcussen and Torfing (2003), the regulative element of governance networks establish the formal rules that allow and prohibit certain kinds of actions, whereas norms dictate what actions are appropriate and socially legitimate

within network negotiations. The normative framework is concerned with how and what actions can be taken to pursue the outcomes that are valued by the governance network. The cognitive element describes the shared mental maps or what shapes the "patterns of thinking, feeling and acting: mental programs, or the software of the mind" (Hofstede, 1991, in Scott, 2014). In the sense of governance networks, it represents the causal beliefs and knowledge shared by and between its actors. The imaginary aspect of governance networks is about the identity-formation potential of shared worldviews, as well as a belief in the obligation to actors to promote this worldview. Through the imaginary element of governance networks, actors "produce identities, ideologies, common hopes and visions" (Marcussen & Torfing, 2003, p. 3) that guide their actions towards their public purpose.

The negotiations for the development of the BMDES and the UniverCity community took place through an institutional framework which was actively shaped by the Trust. In Chapter 5, I discuss the normative, cognitive, regulative and imaginary elements of the institutional framework shaped by the Trust and how these elements interacted and changed over time. I propose that examining what elements were shaped by the Trust will provide greater understanding of the leadership that can be attributed to the Trust in implementing the BMDES. My research did not reveal a clear hierarchy of which element was more significant, only that their interaction and evolution over time all contributed to a more supportive environment for DE implementation.

Chapter 3.

Research design

3.1. Case study research method

The case study of the Burnaby Mountain District Energy System (BMDES) was selected as it is an example of a recent implementation of a neighbourhood-scale climate action initiative and would provide insight into the meaning and outcome of leadership on DE implementation in the Metro Vancouver region. The case study research method was selected as best suited to answering this research question: *what barriers were faced in the implementation of the Burnaby Mountain District Energy System, and what was the role of the SFU Community Trust in overcoming these barriers?*

One common criticism of the case study methodology is "how can you generalize from a single case study?" (Yin, 2003, p. 10). The intent of my research, however, is not to create a blueprint for how other communities can implement DE systems. In this research, I provide an in-depth understanding of the specific contextual conditions surrounding the BMDES with a focus on the institutional framework and governance network that enabled the project. This case study does not seek to make broad generalizations about how to implement DE systems, however, it highlights specific institutional and governance arrangements that enabled this particular project, and will facilitate our understanding of urban climate mitigation initiatives in the Metro Vancouver region and in North America.

The unit of analysis is the governance network surrounding the development of the UniverCity community and the BMDES. I begin my analysis at the beginning of the UniverCity development in 1996 and conclude it in late 2015, at the time this thesis was

written. My research findings are an outcome of the iterative process between document analysis and qualitative interviews.

3.2. Document Analysis

3.2.1. Project information

At the project level, I reviewed planning and policy documents surrounding the BMDES and the UniverCity neighbourhood development. This included development concept plans, official community plans, vision statements, design charrette briefs, planning and development guidelines and requirements for UniverCity, zoning or rezoning applications and council reports and minutes from the City of Burnaby on UniverCity. For the development guidelines and requirements, I analyzed five versions (2000, 2005, 2007, 2010, and 2014) focusing on the descriptions of the sustainability cornerstones and the 'Green Building Guidelines' section, to determine changes over time. I analyzed the meeting minutes of the following three committees of the SFU Community Trust, where available: the Board of Directors (1999-2015), the Planning Committee (2004-2015), and the Community Advisory Committee (1999-2004). I reviewed the output of the three undergraduate SFU Geography-449 courses in which the UniverCity neighbourhood was studied through a sustainable community development lens. I reviewed the early coverage of UniverCity's development by the SFU student newspaper, *The Peak*, from 1999 to 2002, to gain a sense of the student population's reaction to the development during the public consultation period of the development. I focused on UniverCity neighbourhood development guidelines and requirements to understand the policy framework around the DE project and related building-energy policies throughout the various phases of the community development, in order to understand how the DE system was implemented.

I also accessed the web archived versions of the UniverCity website, where I compiled and analyzed the President's Messages which Michael Geller published on a monthly or bi-monthly basis during his term as President of the SFU Community Trust from 1999 to 2006. Through the web archives, I also reviewed the mandate and

‘sustainability cornerstones’ of the Trust as they were made publicly available on the web from 1999 to 2015.

3.2.2. Limitations of the documents analysis at the project scale

As a significant portion of my document analysis involved the meeting minutes of the SFU Community Trust from 1999 to 2015, some of its limitations must be discussed. These minutes were used extensively to create the development timeline of the UniverCity neighbourhood as well as the BMDES, as well as to gain a sense of the internal discussions of the Trust regarding various sustainability initiatives at UniverCity. A limitation with these minutes is that they were written by various administrative staff and may not include the finer details of the discussions in the meetings. Also, the format and the level of detail provided in the minutes varied over the time period reviewed and across the three separate committees. Finally, meeting minutes may not have been thoroughly reviewed by committee members for accuracy or thoroughness. In any case, while they are a valuable insight into the discussions that took place, they do represent a source of uncertainty.

In accessing the web archived versions of the UniverCity website between 1999 and 2015, some uncertainties were inherent and key pieces of information may have been missed. However, in general the web archives were captured at fairly consistent intervals (several times a year) and a large amount of information was captured each time. Also, I browsed through these archives extensively to capture all documents and public messages, especially in the attempt to capture the evolution of the Trust’s mandate and ‘sustainability cornerstones’ through time. The President’s Messages written by Geller between 1999 and 2006 were largely used to corroborate the sequence of events in the development of University against the meeting minutes of the various committees.

3.2.3. Background or contextual documents

For background information, I examined documents from the province of British Columbia relating to reducing greenhouse gases at the community level, such as Bill 27-

2008 *Local Governments (Green Communities) Statutes Amendment Act* and its related implementation aides and toolkits, as well as assessment reports on its effect on GHG reductions province-wide. Specifically on the district energy topic, I reviewed the application documents made to the British Columbia Utilities Commission (BCUC) by Corix Multi-Utility Services, the owner and operator of the BMDES to gain an understanding of the provincial utility regulative process. I reviewed all documents relating to the application made to the BCUC through the Certificate of Public Convenience and Necessity (CPCN) process for the operation of the BMDES. Furthermore, various organizations in BC have produced reports on district energy, such as Carbon Talks from the SFU Centre for Dialogue, the Pacific Institute for Climate Solutions, Community Energy Association, the Canadian Center for Policy Alternatives, and QUEST (Quality Energy Systems of Tomorrow). I reviewed such information to gain a contextual understanding of DE and community energy planning in Canada.

From a national perspective, there are no coherent guidelines on reducing community sources of greenhouse gas emissions. Natural Resources Canada, a national government department, also has delivered or funded various guidance and education on community energy planning and implementation, including an 'Action Plan for Growing District Energy Systems Across Canada' on research conducted for the Canadian District Energy Association, which was discussed in Section 2.2 as a frame for the barriers faced in the implementation of the BMDES. I reviewed these documents methodically for themes around community energy, enablers and barriers at various levels of governance, with a focus on the institutional arrangements that support or detract from community energy planning and DE implementation.

3.3. Qualitative interviews

Through the in-depth qualitative interview process, I developed an understanding of the key processes and dynamics that drove the implementation of the BMDES. This type of information is not apparent through the published documents and can only be obtained through personal accounts of the project itself. Qualitative interviews revealed the role of the SFU Community Trust in facilitating this particular sustainable development project, which is discussed in Chapter 4 and Chapter 5.

From January to June 2015, I interviewed eight key professionals who were involved with various aspects of the development of the BMDES. These research participants have varying levels of involvement with UniverCity and with the BMDES, from temporary to ongoing involvement; they are listed in Table 3 below. Interviews lasted between 30 and 70 minutes and averaged 55 minutes. All eight interviews were recorded, transcribed and augmented with additional notes within 48 hours.

Table 3: Research participants in qualitative interviews (in alphabetical order)

Name of participant	Current Title/Organization	Role on project, term of involvement (approximate)
Curt Hepting	President, Enersys Analytics Inc.	Consultant providing engineering advice to SFU Community Trust on building energy codes, energy efficiency and district energy implementation, 2014
Dale Mikkelsen	Director of Development, SFU Community Trust	Oversees the development of the UniverCity neighbourhood and district energy system, 2006 to present
Developer	President, Unnamed Development Corporation	Developer of residential project connected to the Burnaby Mountain District Energy System, 2009 to 2014
Elizabeth Yip	Municipal Lawyer, Terra Law Corporation	Lawyer representing the SFU Community Trust, 1999 to present
Mark Roseland	Professor, Simon Fraser University	BMCC/SFU Community Trust Board of Directors, 1998 to present; and Chair of the BMCC/SFU Community Trust Community Advisory Committee, 1999 to 2004; Member, Board of Directors Planning Committee, 2004 to current
Michael Geller	President, The Geller Group	Former President & CEO, BMCC/SFU Community Trust, 1999-2006
Robert Renger	Senior Current Planner, City of Burnaby	Municipal planner involved in the neighbourhood and district energy system development, 1998 to 2015
Trent Berry	Principal, Reshape Infrastructure Strategies Ltd.	Consultant to the SFU Community Trust in the procurement of the Burnaby Mountain district energy system, 2008-2012; Consultant to SFU on potential district energy system connection to Burnaby Mountain campus, 2012 to current

Research participants were asked whether they wished to be identified in this research, and 7 out of 8 participants provided their written permission to be identified. This provision was approved by the Simon Fraser University's Office of Research Ethics. My research was categorized as 'Minimal Risk', where participants can reasonably expect that the probability and magnitude of possible harms from taking part in this research to be no greater than those they may encounter in his or her everyday life.

Interviews were semi-structured to encourage the research participants to provide additional information or thoughts on district energy implementation. A copy of my interview guide is presented in Appendix A. I began each interview by establishing the participant's connection to DE implementation at UniverCity, and asked general questions clarifying their professional roles. Subsequently I asked for their personal narrative of the development of the UniverCity development and/or Burnaby Mountain project and their perceptions of challenges faced in the implementation of energy-related sustainability initiatives at UniverCity. I asked for opinions on what the interviewees considered key achievements or successes they have encountered, or key lessons taken away from what they identified as failures. Finally, I asked interviewees for their thoughts on DE as a policy option for sustainable urban development.

During the qualitative interview process, I employed snowball sampling by asking research participants to identify others who had direct involvement with the Burnaby Mountain project who may be able to shed light onto my research question. Three of the eight research participants were reached by recommendation of Dale Mikkelsen: Elizabeth Yip, Robert Renger and the unnamed Developer. In considering the potential for bias due to this sampling method, I believe this to be insignificant except in the case of the Developer. Interviewees Yip and Renger were interviewed as they were the only people currently fulfilling the roles of municipal lawyer and planner for the UniverCity project, respectively. In the case of the Developer, as the BMDES is still quite new, there are only a handful of developers who have been involved in developments connected to the DES, the available sample size was very small. However, as I was only asking the Developer of his or her personal experience with the DE project, and not seeking a representative view of other developers who have been connected to the Burnaby Mountain DE system, the potential for bias is small.

Other participants were selected based on my document analysis which indicated they had key information to the development of UniverCity and/or the Burnaby Mountain DE system. All research participants were contacted by email and all who were asked to participate in my research agreed to do so.

Overall, since my research topic is not controversial or negative, the interviews were positive and constructive discussions. Research participants were given the opportunity to remain anonymous and only one interviewee (Developer) requested to be unnamed. Since the key stakeholders within the specific project being studied are selected due to their involvement with the Burnaby Mountain project, it was vital that my research be able to identify these individuals to understand their specific views and potential biases. The developer who chose to be unnamed wished to remain anonymous as s/he did not wish for his or her views to be taken as representative of the development community.

3.4. Analytical procedure

I analyzed the qualitative interview data and the documents using the conceptual frameworks identified in Chapter 2. I looked for details relating to the energy-choice hierarchy actions taken by the Trust, along with the barriers or enablers that were faced. Finally, I applied concepts from the governance and institutional perspective to understand the role of the Trust in driving the implementation of the DE system. In conducting this research and analysis, I gained a full understanding of how the Trust's actions through the governance network contributed to the implementation of the Burnaby Mountain DE system. I used NViVo, a qualitative analysis software in order to manage, code and analyze all interview data. A coding scheme based on the conceptual framework of this research was created to highlight where participants discussed ideas and events that were related to barriers to the DE project, as well as of the governance network and institutional framework encountered in the implementation of the BMDES.

Chapter 4.

The development of Burnaby Mountain District Energy System

In order to understand the development of the Burnaby Mountain District Energy System and the barriers that the Trust faced in its implementation, I looked to the development history of the UniverCity neighbourhood. This history is laid out in this chapter and I also point to where my findings connect to the conceptual framework presented in Chapter 2. The DE system constructed in 2012 was not the first step that the Trust had taken towards reducing energy use from the built environment; its roots appeared in various forms and may be traced to the beginning of the development in the late 1990s. The implementation of the DE system followed a path set forth by earlier decisions and policies for the neighbourhood's development in terms of building energy efficiency initiatives. For this reason, I present my findings in chronological order, beginning in 1996, when Simon Fraser University requested and the City of Burnaby allowed the development of a residential neighbourhood on SFU-owned lands, and continue on to the present day (mid-2015) when this research and analysis was conducted. This timeline was constructed through extensive document review and analysis, as well as qualitative data gathered through in-person interviews as detailed in Chapter 3.

As this chapter discusses the various phases of development within UniverCity's East Neighbourhood, readers should refer to Figure 1 which shows the phasing and provides a general idea of the level of development that has taken place up to January 2015. The phasing of the project is not entirely indicative of the development timeline; land parcels were allocated to different phases in the two master comprehensive development rezoning processes with the City of Burnaby. As of January 2015, all of Phase 1 and approximately half of Phase 2 is complete, while several of the land parcels

in Phase 3 development are complete and inhabited. The reader should also note that as the Trust had two organizational precursors, and I use the name of the organization that is appropriate to the timeline. The Burnaby Mountain Development Corporation was founded in 1996, renamed the Burnaby Mountain Community Corporation in 1997, and finally again in 2000 as the SFU Community Trust. The reader should also note that this neighbourhood development was not given the name 'UniverCity' until 2002, but for simplicity's sake I refer to 'UniverCity' regardless of the timing.

Figure 1: UniverCity - East Neighbourhood - development phasing plan as of January 2015 (Source: SFU Community Trust, 2015)

4.1. Early days of UniverCity – 1995 to 2000

In 1995, representatives of SFU and the City of Burnaby reached an agreement for the development of a residential neighbourhood adjacent to the SFU campus on top

of Burnaby Mountain. SFU agreed to transfer ownership of 800 acres of university lands to Burnaby to be dedicated as the Burnaby Mountain Conservation Area, and in exchange Burnaby would allow SFU to create a market housing neighborhood on 10 acres of SFU-owned land. The primary goal of the neighbourhood development from SFU's perspective was to create an endowment fund, according to the 1995 memorandum of understanding (MOU) signed by Burnaby and SFU that launched the residential development. This MOU detailed the anticipated benefits of this decision:

> New options will be available for the University to support its primary mission of teaching, research and public service through the creation of the Burnaby Mountain Endowment Fund, and through the responsible development of campus lands – including opportunities to establish an integrated and balanced community with a complementary mix of land uses, continuing the University's record or combining environmental integrity with internationally recognized design excellence. (Stubbs & Copeland, 1995).

Following that agreement, SFU staff, with the approval of the Board of Governors, prepared a development plan concept in February 1996 which subsequently shaped the official community plan (OCP) for this neighbourhood (SFU, 1995). This OCP was officially adopted by the City of Burnaby Council in July 1996 and outlined the plans for land use and zoning, circulation and transportation, residential density, allowed commercial services, and other community characteristics within the neighbourhood. Both the development concept plan and the OCP highlighted a desire for a pedestrian orientation to the neighbourhood, and specified high development densities of up to 60 units/acre (City of Burnaby, 1996). By circumscribing the density and mix of land uses within the neighbourhood under a concern for pedestrian orientation of the built form, the OCP addressed the highest level of the energy hierarchy of density, mix of land uses, and transportation networks. Although the OCP mentioned these high-level elements of the community energy hierarchy, it did not speak to the energy outcomes relating to the density, mix of land uses and transportation networks. The SFU Development Concept Plan and the OCP did not specifically mention the lower levels of the energy hierarchy, such as building energy-efficiency or alternative energy supply within the neighbourhood, nor did it have an explicit energy-reduction mandate.

After the adoption of the OCP in 1996, the Burnaby Mountain Community Corporation (BMCC) led an extensive community visioning process in July 1998 to develop a vision for the neighbourhood (Geller, 2005). The resulting 1998 Vision Statement provided the aspirational goals for the neighbourhood and mentioned energy in the context of 'alternative energy use', but only in the context of transportation with alternative energy vehicles. The Vision Statement imagined the East neighbourhood development in the year 2025 with high-density mixed-use housing (BMCC, 1998), echoing a similar energy-hierarchy decision as in the OCP, but like the OCP it does not delve into detail of the lower levels of energy choices.

At the time, community energy planning was a new concept in the region and the City of Surrey had put it into practice through their 1995 community energy plan for the Surrey City Centre area. However, in my analysis of documents associated with UniverCity up to 1998, no explicit reference to the energy choice-hierarchy was found, nor was any specific focus on reducing energy consumption from buildings in the neighbourhood. This implies that the reduction of energy use from the built environment was not a priority in the neighbourhood's development prior to 1998, despite community energy planning being a known concept in the region and there being an example of a non-institutional DES in downtown Vancouver.[6] So what really drove the density and land-use decisions at the highest level of energy-choice hierarchy that later made the neighbourhood suitable to DE?

4.1.1. The influence of transportation concerns

One of the key influencing factors for the dense built form of the development was evident from the interviews and document analysis; a focus on transportation issues. According to Mark Roseland (2015), a member of the BMCC Board of Directors from the 1999 to present-day, transportation and the associated air pollution was of the highest priority in the early days of the UniverCity development. Roseland pointed to the legacy left by the 1960s decision to locate SFU on top of Burnaby Mountain:

[6] Refer to Section 2.1.2.

> Frankly, in the early days, transportation was more important…nobody in their right mind would put a university on top of a mountain now, it was an insane thing to do then, but you could kind of get away with it 50 years ago…ever since then, a big part of what we do is compensating for that...so we're about transportation problems… (Roseland, 2015).

Furthermore, Robert C. Brown, the president-designate of the Burnaby Mountain Development Corporation from 1996 to 1999, was quoted in the SFU student newspaper *The Peak* stating that SFU was "a shopping center for education – people drive up here, they consume education, and they leave" (Fletcher, 1998). In 1996, approximately 11,000 students, faculty and staff were commuting to Burnaby Mountain daily (Moodie Consultants, 1996), with a night-time population of approximately 1,400 students who lived in the student residences (BMCC, 1998). There were already concerns for the levels of air pollution from traffic exhaust from the existing population, according to *The Peak* (Letts, 1998). The added pressure from the transportation needs of 10,000 new residents, the anticipated doubling of the student population, plus the fact that the residential development would replace existing surface parking lots on Burnaby Mountain meant that transportation was a high priority in the early days of the development. Much emphasis was placed on transportation-related issues, as evidenced by the number of reports and studies sponsored by the BMCC in the early days of the development. Three of the nine studies from this time period were related to transportation: a 1996 transportation study, a 1999 student-mover feasibility study, a 2000 sustainable transportation study.[7] The Community Advisory Committee of the Trust also sponsored two community workshops throughout 2000, one of which was held to discuss transportation strategies around carpooling, parking constraints, universal transit passes and bicycle infrastructure. By contrast, none of these studies or reports was explicitly about energy use from buildings.

In response to the perceived priority of the transportation challenge, the 1998 Vision Statement envisioned the neighbourhood in the year 2025 as "physically compact…whose component parts are linked by pedestrian walkways, paths and trails" instead of a more dispersed and automobile-centred built form (BMCC, 1998). While the

[7] Other studies from this time pertained to environmental impact and wildlife impact assessments, and site servicing.

form of the neighbourhood was later found to be suitable for the implementation of a DE system, the original land-use pattern and density decisions were a reaction to transportation concerns, and not an explicit mandate to reduce energy use in the neighbourhood to reduce GHG emissions from buildings. The urban form of the neighbourhood was determined through negotiations within the governance network which were aimed at solving a separate problem perceived at the time. However, this attests to the complementary nature of community energy planning at the infrastructure level of the energy-choice hierarchy (refer to Table 2 and Section 2.1.1). Decisions at this level are interrelated: for example, decisions about density cannot be separated from land-use planning which also determines energy supply infrastructure and transportation networks. Decisions at the lower levels, however, do not reflect this same level of interdependence: building design does not necessarily constrain transportation choices. In order to plan for sustainability then, it is necessary to begin at the infrastructure level where such complementary decisions about land-use and energy systems can be made. The Trust, in planning for transportation, found themselves making decisions that would later affect energy use from buildings, which had a positive effect on DE implementation.

Next, I address the question of how building-related energy consumption issues eventually factored into the planning priorities for the neighbourhood development.

4.1.2. District energy and sustainable neighbourhood development

4.1.2.1. Student input to community energy planning

In the Spring of 1999, Mark Roseland, who is also a prominent professor at SFU in addition to being a member of the Board of Directors for BMCC since its inception in 1999, led the first of three undergraduate Geography courses, GEOG-449, with cooperation from the BMCC. According to Roseland (2015), a representative from the BMCC would introduce the development project and its status and current challenges in an overview at the beginning of each semester, and students would go on to research and propose sustainable development concepts that can be applied to this community and presented these to the BMCC, Burnaby representatives and the general public at the end of the semester.

From the analysis of the Spring 1999 class project write-up, principles from community energy planning appeared as students described the economic and environmental benefits of energy-efficient building design and energy-oriented land use planning. The student responsible for the 'Energy' section of the class project highlighted the connection between land use and energy, and advocated for more integrated planning:

> Land planning is of the utmost importance to building energy efficient structures. Land planning can influence access to sun and wind energy for heating and cooling by use of the building's design characteristics…the most feasible [energy] alternative will not be so much in the energy sources themselves, but in the more efficient design of structures, use of land and existing utilities. Designing neighbourhoods of higher density can help to accomplish this. Distribution of utilities, and loss of heat and energy, is easier to support and will generate more savings when structures are located close together. (Harrison, 1999).

This student pointed to a brief case study of the community energy plan conducted by the City of Surrey in 1995 that included a recommendation for "district heating and cooling for multiple buildings in densely populated areas" (Harrison, 1999). Students from subsequent classes picked up on these community energy planning themes. One student from the Fall 2000 class even recommended that the Trust "institute an energy efficiency and GHG abatement mandate for Burnaby Mountain to ensure that at each phase of planning and development these issues are taken seriously" (Connolly, 2000), although the student did not identify specific targets.

This project work by students appeared to have had at least some influence on the direction of the development project as the reports were later referenced within the Call for Expression of Interest for master planning consulting work put forth by the BMCC in January 2000. This Call for Expression of Interest pointed to the students' project work, with a caveat that "although the study [conducted by the students] is limited by the authors' time and experience, the document contains a number of important ideas which can be considered a viable contribution to the planning process" (BMCC, 2000). Michael Geller, President of the SFU Community Trust from 1999-2006 later stated that "[w]hile not all of the ideas put forward by the Geography students have been incorporated in the plan, I do believe that the general spirit of the recommendations has

been incorporated both into the planning process…[including] a commitment to sustainable planning principles" (Geller, n.d.).

Dale Mikkelsen, current Director of Development at SFU Community Trust, provided his narrative of the introduction of sustainable development concepts to the UniverCity neighbourhood, attributing it to feedback from the student body:

> …when UniverCity became a development reality… it was determined through pro forma work that there was a good economic model to develop, to create endowment wealth at the University, that was the goal from the start…that was the first goal, so sustainable [development] had nothing to do with it. And then it went to public open house, and the public process, and the main open houses were done up here on campus...And that was what was mostly heard from the students…and the sustainability question came up through that public process, and the need to define [sustainability], and that this community...given that it is in an academic environment and a place of research, that it should also demonstrate sustainability….so a piece that spawned out through '99 and 2000 was the development of the 'cornerstones', which are the 4 E's. Environment, Equity, Economy and Education. (Mikkelsen, 2015).

In his quote, Mikkelsen explained that the *pro forma*, or the economic cost-benefit analysis, determined that development would be worthwhile to pursue for the sake of growing SFU's endowment, and emphasized that sustainable development was not a priority at the time. It appears that community energy planning concepts and the mention of GHG reduction were at least in part introduced by the Geography students as neither of these topics had been mentioned in any of the reviewed documents prior to this point in time. A key process that was not mentioned by Mikkelsen but helped to bring community energy concepts into the development context for the neighbourhood was the 2000 Design Charrette. This process contributed significantly to the creation of the Trust's four 'cornerstones' of sustainability, the origins of which are discussed next.

4.1.2.2. Energy, Economy and the four 'cornerstones' of sustainability

In late 1999, the Trust hired Dr. Patrick Condon, a professor of Urban Design and Livable Communities at the University of British Columbia, and his associates to produce a Design Charrette Brief to guide the participants of an extensive 5-day design charrette held in February 2000. The goal of this charrette was to provide SFU and the larger community with design ideas to serve as the basis of planning, as well as to select the

professional team to lead the neighbourhood's masterplan. In this brief, energy is mentioned under the goal of 'Economy', to "provide attractive, compelling and profitable approaches to building design, energy conservation, infrastructure and servicing while ensuring that development responds to market conditions", and to "demonstrate the relationship between livability, affordability and ecological compatibility in community form" (Condon et al., 2000). This document made an economic argument for energy conservation and also mentioned the practicality of district heating systems in dense development sites, and advised charrette participants to "assume that, in the future, buildings on the site could be connected to a district heat system" (Condon et al., 2000). The recommendations from the Design Charrette Brief implied to charrette participants the increasing importance of looking at energy choices within the neighbourhood and alignment with community energy planning principles, by specifying energy end-use targets of the lowest level of the energy-choice hierarchy. While the Design Brief suggested specific actions on energy and even specified a target metric of on energy consumption for buildings of 285 kWh/m^2 (Condon et al., 2000)[8], the brief made no explicit connection between the impacts of energy use from buildings to the atmosphere in terms of GHG or carbon emissions. The Trust, to date, does not have an explicit energy consumption target for UniverCity, although they do require specific levels of building energy performance as compared to current energy codes through their design guidelines (as described in Section 4.2.1).

One significant and direct outcome of the Design Charrette Brief is the introduction of four thematic areas for sustainable community development which were later used by the Trust as the guiding principles of the development of UniverCity. In this brief, four sections, Equity & Vibrancy, Ecological Function, Economy, and Education, were named in order to structure the discussion of the goals of the UniverCity development. In 2001, a reformulated version of these four themes appeared in the community plan and as the four "Sustainability Cornerstones" of the SFU Community Trust: Equity, Environment, Economy and Education. According to then-president Michael Geller, these four themes "guide[d] the overall planning and design" of the

[8] This is roughly half the average energy consumption for buildings in the region (Condon et al., 2000)

neighbourhood and “set the stage for many of our innovations” (Geller, 2002; 2003). In Section 5.1, I explore the significance of these four ‘cornerstones’ to the later implementation of the DE system.

4.1.2.3. The knowledge barrier is reduced but not overcome

It appears that by the year 2000 that the knowledge barrier to district energy, according to the CDEA definition, had at least been reduced through input from the Geography students led by Roseland from 1999-2000, and through the involvement of Condon et al. in producing the Design Charrette Brief. Both sets of documents included concepts of community energy planning, but although the Trust was aware of district energy as an option, knowledge alone did not directly lead to the implementation of district energy; other challenges still existed.

From document analysis and interview evidence, it is clear that while there was knowledge of community energy planning and the benefits of district energy, energy-use from the built environment was not the determining factor for land-use planning of the neighbourhood. Transportation concerns, as discussed in 4.1.1, were the main reason for the choices made regarding density and mix of land uses in the early days of the development. These early decisions, however, did set in motion a number of initiatives which later facilitated the implementation of the district energy, such as the four sustainability cornerstones as well as the development approvals process and new guidelines and requirements, which I discuss in Chapter 5.

4.2. Phase 1 and 2 developments: 2000 to 2006

4.2.1. Starting with an institutional innovation in development

Within the City of Burnaby, all commercial, industrial, institution and multi-family residential developments must gain a Preliminary Permit Approval (PPA), from the Director of Planning and Building prior to being issued a Building Permit (BP) (City of Burnaby, 2015). This is the typical regulatory process for urban development within Burnaby. In the UniverCity neighbourhood, however, an additional layer of approvals was introduced in that the SFU Community Trust first vetted all development proposals

using their own set of publicly available Development Guidelines before a proposal may be submitted to Burnaby for a PPA and BP (BMCC, 2005). These guidelines aimed to ensure that the proposed individual developments are compatible with the overall design of the neighbourhood, and cover a range of topics such as planning and design principles, signage, residential livability, landscape design, as well as the green building guidelines on water conservation, energy efficiency, waste reduction, and indoor air quality.

At the time of Phase 1 and 2 development in 2002, the energy efficiency guidelines for UniverCity were still only 'guidelines' in the sense they were not written explicitly into the zoning bylaw for the neighbourhood and were not legal requirements for development. However, through governance network negotiations, the Trust gained the support of Burnaby on these Development Guidelines. The City referenced these Guidelines in the zoning ordinance for Phases 1 and 2, requiring the "demonstration of consistency with applicable design guidelines and development guide plan" in order to proceed with the PPA process (City of Burnaby, 1996). This special administrative provision to the zoning bylaw for Phase 1 and 2 upheld the Development Guidelines which form a part of the regulatory framework that helped promote the advancement of energy-efficiency in buildings and other sustainable development practices at UniverCity. This is essentially a new governance framework created for the development of UniverCity and in Section 5.3 I explore its significance to the implementation of the DE system.

4.2.1.1. Laying the groundwork for higher building energy performance

The neighbourhood Development Guidelines are a policy instrument put in place by the Trust to include elements of community energy planning from the early days of the development, although no explicit energy goals had been adopted by the Trust. The 2002 version of the guidelines for Phase 1 targeted building level energy-using systems through specifying energy performance standards for equipment such as lighting, building heating and cooling systems, and appliances. The guidelines also encouraged building design practices that promoted energy reduction through building and site considerations, such as building orientation and its effect on solar heat gain or loss. Buildings within Phases 1 and 2 were to comply with either the Model National Energy

Code for Buildings 1997 (MNECB) or the energy efficient design requirements of ASHRAE 90.1-1989 'Energy Standard for Buildings Except Low-Rise Residential Buildings'. These two standards are now widely used in Canada and in the US, respectively, for designing buildings with reduced energy consumption (Frappé-Seneclauze & MacNab, 2015). At the time, the Trust had technical support from the Canada Mortgage and Housing Corporation (SFUCT, 2002b) and local sustainability consultants Resource Rethinking Building in creating these guidelines (Geller, 2015). In addition to meeting minimum building energy performance standards, the Trust encouraged UniverCity developments to meet or exceed the MNECB's energy performance thresholds by 25% by including this within the Development Guidelines (BMCC, 2002). From the document analysis conducted for this research, it is unclear whether the encouraged levels of energy performance were taken up by the developers, and future research should be done to verify the outcomes of this early policy.[9]

In 2002, energy performance requirements in buildings were new for Burnaby, since the applicable provincial Building Code (1998 version) made no mention of building energy performance standards (Frappé-Seneclauze & MacNab, 2015). The BC Building Code did not actually include energy performance standards or other green building requirements until its 2008 revision (BC Office of Housing Standards, n.d.). In the realm of energy use, the Trust was setting higher standards for their Phase 1 and 2 development than what Burnaby could formally require through the BC Building Code at the time. Within the Metro Vancouver region, however, higher building energy standards were not unheard of; the City of Vancouver had already set an example of leadership by including energy performance standards via their adoption of ASHRAE 90.1-1989 in the 1991 Vancouver Building By-law (Frappé-Seneclauze & MacNab, 2015). Vancouver, however, does have special administrative powers granted to it by the Vancouver Charter, which Burnaby does not.

[9]For developments in Phase 3 and 4, this encouragement for higher levels of energy performance was backed by a density bonus. Under this scheme, the Trust would grant developers an additional 5% of developable floor area if they meet an additional level of energy performance than required (SFUCT, 2007c). Presumably, this increases developers' willingness to construct higher energy performance buildings.

This ability to impose and encourage additional design parameters by specifying building energy use performance was key to the Trust having influence over the lower levels of the energy-choice hierarchy. The Trust, however, had actively negotiated themselves into a position where they could do so by shaping the regulative framework, as I discuss further in Section 5.3. Burnaby, as a municipality operating under the BC *Local Government Act* and the *Canadian Municipalities Act*, may only enforce the BC Building Code and cannot require additional technical building standards, such as energy performance, as a legal condition of development (Mikkelsen, 2015). Municipal governments, however, may still influence building energy performance in the re-zoning process for comprehensive developments. According to Robert Renger, Burnaby's senior current planner, 'voluntary' building energy efficiency standards and other environmental aspects of development can still be negotiated in comprehensive development zoning applications even if there are no explicit municipal policy or guidelines to do so:

> [Environmental aspects are] negotiated. It's part of a package you're approving and we very typically say we want an environmental package, and [for example] sometimes we lower the parking requirements and put in co-op car facilities, it's all really typical. So I think that comprehensive development zoning, which is site-specific zoning, gives us a lot of power to work out something. And it is 'voluntary' in the sense that it's mutually agreeable [to the City and the development proponent]. (Renger, 2015).

Burnaby, as of 2015, does not have any publicly stated energy performance policies connected to urban development, other than an interim GHG reductions goal set in 2011.[10] Even today, it is unclear what energy performance levels are actually being negotiated in the rezoning process by the City of Burnaby as no stated policies were found during this research. The lack of a municipal energy policy in development echoes research conducted by Burch (2010) on barriers to climate action faced in three municipalities BC's Lower Mainland. Burch pointed out a regulatory barrier to climate action where "without a policy basis upon which to force developers to adopt 'green'

[10] Burnaby's GHG reductions goal is for a 5% decrease in GHG emission from community sources compared to 2007 levels, without a specified date for achievement of this target. This goal was set as required by the Province's 2008 *Green Communities Act*. Refer to Section 1.3.3 and Table 1 for how the City of Burnaby's interim GHG reduction target compares to other municipalities within the Metro Vancouver region.

standards, the outcome depends heavily on the ability of individual staff members to negotiate" (Burch, 2010, p. 7580).

Another significant impact of the Development Guidelines is that building energy-efficiency parameters were transparent to the development community from the start, and these guidelines are analogous to a municipal development policy. Instead of being negotiated as 'voluntary' conditions and prerequisites for development through a separate time-consuming rezoning process with Burnaby, building energy-efficiency guidelines were provided to the developers at the start of the development process. These guidelines clearly set out the Trust's expectations in terms of energy and other sustainability-related initiatives. According to the UniverCity developer interviewed for this research, these guidelines are the Trust's way of saying clearly from the start that "if you want to develop here you have to play by our rules" (Developer, 2015). This developer demonstrated appreciation for the clarity the Trust provided through the guidelines for UniverCity, and spoke of the frustrations he felt in development process which he metaphorically called the 'game' typically 'played' between developers and municipalities:

> There was a lot of information available that [the Trust] made available, in terms of guidelines and requirements, and they were very open and communicative as to what those were….they were very clear in what their needs and wants were, and how they had to be fulfilled and where you were able to do so….[Developers want authorities to] tell us what the deal is, we'll make sense of it, or not, and we'll happily carry on. It's when you have uncertainty or changing goal posts, and you think you're playing one game and it turns out not only are you on the wrong field but you're not even there playing the game you thought you were in. That gets a little frustrating. (Developer, 2015).

In the Metro Vancouver development community, developers are concerned that additional time spent in the municipal approvals process leads to lowered profit margins (Holden & Sidhu, 2014). This is a commonly-held concern about the opportunity cost associated with time spent in the municipal approvals process, because processing time reduces the overall speed at which developers can finish a development, profit from it, and move onto the next profit-making project (Developer, 2015; Roseland, 2015). The UniverCity developer expressed the general desire of the development community for reducing time spent on approvals in the early part of a project, and the preference for

moving onto the next project when it comes to the development of market residential units:

> If a developer's objective is to acquire land, build condominiums, and sell them to homeowners, our time horizons is 5 to 10 years from the time that we start...and it's really those first couple of years where you're in, you're out and onto your next project. (Developer, 2015).

By negotiating a comprehensive development zoning for Phases 1 and 2 and providing a clear set of neighbourhood Development Guidelines, the Trust essentially shielded developers from the lengthy municipal rezoning process and made development at UniverCity easier and thus more valuable to developers. This also had the effect of making the Trust's energy-efficiency and other sustainability initiatives more acceptable to developers. By the Trust's own estimates, development projects at UniverCity save approximately 6 months when compared to going through the rezoning process with the City of Burnaby (CMUS, 2011) because the Trust had arranged a comprehensive development rezoning incorporating their own set of development parameters prior to developers becoming involved. In Section 5.3, I further explain the implications of this governance process to the eventual success of the DE implementation.

4.2.1.2. Some leadership in building-energy efficiency

The Trust can certainly be seen as taking a leadership role within the origins of the building energy-related guidelines for UniverCity. In general, the Trust had taken on some of the roles traditionally within the purview of the municipality, such as the development of official community plans and design standards, which are granted to municipalities through BC's *Local Government Act* (Bish & Clemens, 2008). The City of Burnaby, at the beginning of Phase 1 and 2 development, was concerned about the impacts of development on the surrounding natural environment on Burnaby Mountain. The UniverCity site is considered an Environmentally Sensitive Area (ESA) in Burnaby, where an additional set of planning and design principles are to be followed, and in this case the principle of "achiev[ing] a net zero increase in runoff and avoid degradation of water flowing into the three watersheds" (Stubbs, Copeland, 1995) was of more importance than energy. According to Renger:

> …the energy savings elements…came from UniverCity, the things that we [the City of Burnaby] laid stress on a lot is from day one, was the environmental considerations especially related to stormwater management because this [development] is up on the hill…[and] flows into very important streams in Burnaby. So stormwater management, keeping the water clean and, not creating great peaks as they may happen down[stream] there, was very important from our point of view. That was the big challenge that we worked through, and as I said the energy savings elements and criteria were developed primarily by SFU [Community Trust] with our support… (Renger, 2015).

In this sense, the Trust provided leadership on reducing energy consumption of buildings in lieu of leadership from the municipality and the provincial government, whose building code did not include energy performance standards until 2008.

4.2.2. An accumulation of barriers

4.2.2.1. Knowledge and sustainability image barriers to district energy

Although DE was known and likely discussed in the 2000 design charrette process, a DE system was not pursued for Phase 1 developments. There was no mention of a DE system in the 2002 design guidelines, and residential buildings of Phase 1 proceeded to be built without compatibility with future district heating systems. These buildings were constructed with electric baseboard heating, a typical practice for multi-family residential buildings in BC because of its low construction costs (Snider, 2006). District heating systems provide heating through hydronic systems, where a warmed liquid circulates throughout the building via pipes and provides heat through in-floor or wall-mounted radiators. For a typical new residential unit, the cost of a hydronic system can range from $2000 to $8000, compared to several hundred dollars for electric baseboards (Hepting, 2015; Fisher, 2014). Buildings with electric heating systems can be converted to hydronic systems after construction, but the conversion is rarely undertaken as it is a costly and disruptive renovation process (Berry, 2015; Hepting, 2015). In the absence of policy mandates for DE compatibility, it is difficult to persuade developers to voluntarily provide the more expensive hydronic system in new buildings

as they are not likely to recuperate the added cost in the final sale price (Developer, 2015).[11]

The desire to not interfere with private developers' ability to profit through development at UniverCity was one of the reasons cited by several interviewees for why the Trust did not pursue DE in Phase 1 (Mikkelsen, 2015; Geller, 2015; Roseland, 2015). According to Michael Geller, president of the Trust from 1999 to 2006, concern for the economic viability of the UniverCity development was a significant reason for not pursuing a DE system in the early phases, although there was awareness of the potential for a DE system connecting to the SFU campus heating systems in the future:

> When we started of course everybody wanted us to incorporate every environmental feature being contemplated in the project, from composting toilets to district energy to green roofs to LEED Gold or Platinum, etc. I was concerned that, while I wanted to create a sustainable community…I didn't want to incorporate so many avant-garde or untested features that might compromise the success of the project… we did do a few things that I think were significant in the field of energy… but on the question of district energy, I specifically did not try to put in a district energy system…. that was around 2000, 2001, 2002…there was some conversation that perhaps in the future there would be the potential to tie something to the University's plant, which could give you the benefit of taking unused heat from the university to heat the homes in the winter and so forth... but I very deliberately stayed away from district energy because I wasn't convinced, at that time, that it was going to be beneficial. (Geller, 2015).

[11] Today, the concept of developer-led 'green loans' is beginning to arise as an option for implementing higher energy-efficiency systems, and UniverCity became home to such a project in 2006. In green loans, developers borrow money on behalf of future residents to finance the construction of high energy-efficiency systems beyond what the Building Code requires. Verdant at UniverCity is a multi-unit residential development heated by a geothermal heating system. Responsibility for the repayment of the green loan was transferred to the building's strata corporation after the completion of the project. Residents of Verdant repay this loan through their strata management fees, based on the premise that the additional loan payments would be equivalent or less than the energy costs they would have had to pay if the building used conventional heating systems (CMHC, 2015). Verdant, however, is a unique project developed in a partnership between the SFU Community Trust and a socially-motivated developer (VanCity Enterprise) and an environmentally progressive consultant (ReSource Rethinking Building), with some funding from the Canadian Mortgage and Housing Corporation to be an exemplar in social and environmental sustainability.

The statement above demonstrated that Geller was evaluating the benefits of a DE system only against the Trust's mandate for UniverCity's development to contribute to SFU's endowment fund, and not necessarily against a community energy planning perspective driven by reducing energy consumption or GHG emissions. The concern of not being able to attract market developers to Phase 1, and therefore the spectre of financial failure of the community, was foremost at the time. This is explained by board member Mark Roseland:

> In the early days the issue that was of primary concern to the Board was "Would anybody buy [a home] on Burnaby Mountain?" So the first few buildings, were really quite terrifying in a sense, because there was definitely a possibility that people would go "I'm not going to buy [a home] up there, there's nothing up there". And certainly there was almost nothing up there for a very long time…So getting those first buildings up and making them market successes, having them actually sell and having the developers say "Yes, I'm willing to do another [development] because I didn't completely lose my shirt on that [first] one" was really a big deal. (Roseland, 2015).

Geller corroborated on this concern, and explained the development context changed over time as market developers experienced financial success in selling units at UniverCity:

> …we had an extremely difficult time attracting our first developers. It became easier in the second phase, but in the first phase we really did not have very many legitimate bids…Developers often don't want to be pioneers, so once the first projects were built and they sold reasonably successfully, then it was easier to attract future developers (Geller, 2015).

The above quotes reveal a combination of the knowledge and 'sustainability image'[12] barriers, which manifested as an issue of the relevance of energy in the built environment as a development priority. The CDEA defines the knowledge barrier as 'policy and political decision makers [are] not aware of DE, or its relevance, because they did not have access to the information which would make its relevance clear' (CDEA, 2011, p. 7). The sustainability image barrier describes DE as being "overlooked as an option that can contribute to the 'green' agenda" of communities (CDEA, 2011, p.

[12] Refer to Section 2.2 for the discussion for why the CDEA's 'sustainability' barrier is more appropriately named as the 'sustainability image' barrier.

59). Indeed, Geller did not appear to have considered DE a relevant option for the community, despite having known about the benefits of DE[13], and the Trust having a professed sustainable development, or 'green', agenda. At that point in time, what made DE irrelevant in the face of competing priorities in sustainable urban development was that the Trust's sustainability agenda did not have a strong connection between energy use and GHG reduction, as I discuss in 4.2.2.2. What was relevant at the time was the imperative for the Trust to contribute to the SFU endowment fund through the market success of UniverCity, which has always been part of the Trust's mandate.

4.2.2.2. Contextualizing the lack of relevance of energy issues

The competing interest in the financial success of the neighbourhood development can be understood within the context of the time, because there was also no significant public or policy interest on energy in the built environment. The CDEA's knowledge barrier pointed to a lack of knowledge as a reason for leaders not considering district energy relevant – but not only was district energy not relevant at the beginning of Phase 1 and 2 development, neither was the concern for energy use and its associated GHG emissions. Prior to 2007, there was no significant position on energy or climate change leadership from the province of BC (Dusyk et al., 2009). The City of Vancouver, often considered a leader in urban environmental policymaking, had commissioned a task force to produce the *Clouds of Change* report in 1990. In this report, a number of policy recommendations relating to atmospheric change were made and adopted by Council, including a target for CO2 emissions reductions (City of Vancouver, 1990), but its implementation met with a number of difficulties (Jones, 2012; Moore, 1994). There was also no climate leadership from the City of Burnaby at the time. Finally, despite the connection between energy and GHG emissions pointed out by the Geography-449 students in 1999 and 2000 as well as the recommendation for building-level energy-use targets by Condon et al. (2000), the Trust had no started targets for energy reduction in the community, other than through the general language of sustainable development and 'resource efficiency'. In an analysis of the Trust's 2002 Development Guidelines, an explicit connection between reducing energy consumption and impacts to climate

[13] As I've shown in Section 4.1.2.3, the benefits of DE was known by the Trust at least by the year 2000.

change could be found within the Green Building section. Here, the justification for lowering energy consumption in buildings is framed as reducing the "potential impacts of the climate of greenhouse gas emissions (global warming) from fossil fuel consumption" (BMCC, 2001, p. 65). While the connection between energy use and climate impact was at least being referenced here, it was just one issue being identified amongst a number of green building topics such as environmentally-sensitive site strategies, water conservation, resource efficiency, waste reduction, healthy buildings and indoor air quality. However, the focus on energy consumption does sharpen over time, as I discuss in Sections 4.3.1 and 4.3.2, and its implications on the Trust's normative framework are further explored in Section 5.1.

4.2.3. The success of Phases 1 and 2 and other energy initiatives

District energy, at the time of Phases 1 and 2 development, was not considered a relevant 'sustainability' option, because energy and GHG emissions were not important sustainability topics to the Trust until at least 2006, as I show in Section 4.3. The mandate of the Trust to contribute to SFU's endowment through the financial success of the neighbourhood prevailed, and a DE system was not considered for Phase 1 and 2 developments. As a result, a significant portion of UniverCity, or approximately 1000 units out of a total of 3000 units allowed by the 1996 OCP (City of Burnaby, 2007), were built without compatibility to future DE systems.

Despite this apparent setback for DE, the Phase 1 and 2 developments did proceed with other sustainable development initiatives in addition to building energy performance requirements such as stormwater management, landscape design, water efficiency, 'eco-friendly' building materials. The Trust addressed building-related greenhouse gas emissions from building energy-use through a number of other initiatives targeting the lower two levels of the energy-choice hierarchy – energy-using equipment and building systems. The Cornerstone, a mixed-used commercial and residential rental project built in 1995, is heated by a combination of renewable geothermal heat and heat recovered from refrigerators in the residential units (UniverCity, 2005; Geller, 2015). This alternative energy system was developed at the initiative of the Trust who acted in the role of the developer. The Verdant project,

completed in 2007, is a residential condominium development that is also known for its unique approach to housing affordability through a restrictive covenant on title limiting resale values. The Verdant building is heated by geothermal exchange system which claims to achieve 65% reductions in greenhouse gases as compared to similar buildings (Verdant, n.d.). (See also Footnote 11). These two projects demonstrate the implementation of community energy planning concepts at the building-systems level through alternative energy systems like geothermal. Although such systems were not explicitly required by Building Code or by the Trust's own Development Guidelines, they were realized in part due to additional influence of the Trust. The Cornerstone building was developed by the Trust, as opposed to a private developer (Geller, 2015), and the Trust was a partner in the development of Verdant (CMHC 2015). From this research, it is unclear how buildings in Phase 1 and 2 that were not developed by the Trust met or exceeded the Trust's development guidelines for energy performance standards.[14]

The financial successes of Phases 1 and 2 development in part paved the way for the implementation of a DE system, as I discuss in Section 4.3.3. UniverCity went on to win a number of awards and international recognition for excellence in community planning[15]. Phase 1 became home to approximately 2,000 residents in 1,000 housing units (City of Burnaby, 2007), and as other neighbourhood amenities such as shops and businesses, parks, an elementary school and a childcare centre were added by 2012, UniverCity became increasingly attractive to development. According to the developer interviewed for this research:

> You have a complete community [at UniverCity] today. When we were first there, the Nester's Market [grocery store] hadn't opened. The daycare hadn't opened. Hadn't even been built. The [elementary] school was just about to start construction…So all of those things have been added since we did our first project. It's a more attractive community today than it was 5 years ago. More people, more critical mass. (Developer, 2015).

[14] In Section 6.2.3 I discuss the issue of an overall lack of accountability in community energy planning.

[15] Refer to Appendix B for a complete listing of awards won by UniverCity as of 2015.

This financial success of the neighbourhood essentially changed the development context of the community. The community is now more desirable to homebuyers and thus to market developers; this emboldened the Trust to push for further innovations in the name of sustainability, including DE (Mikkelsen, 2015). In Section 5.2 I discuss how the financial success of UniverCity as an example of neighbourhood-scale sustainability contributed to the later implementation of the DE system.

4.3. Beginning of Phases 3 and 4 and district energy: 2006 to 2012

In this section, I explore the higher-level changes that are occurred which made energy in the built environment a more salient issue to the Trust, and I describe the actions that the Trust took to implement a DE system for UniverCity.

4.3.1. The changing global and provincial context

In 2006, a sea change occurred in the public's awareness of climate change and energy. Former US Vice-President Al Gore's documentary *An Inconvenient Truth*, released in 2006, is often considered as a cultural turning point in North America (Johnston, 2013) and worldwide (Norwegian Nobel Institute, 2007) for its dissemination of the urgency of the climate crisis to a general audience and for raising the profile of climate change within the global political agenda. In this movie, Gore communicated the urgent science behind climate change and asked viewers to take personal responsibility and ethical action for the planet's current state and future direction. Michael Geller himself appeared moved by the documentary, pointing to it in his monthly 'President's Message' on UniverCity's website in July 2006:

> If you haven't seen the new movie, *An Inconvenient Truth*, I heartily recommend it. It's very disturbing, even frightening. But I am beginning to believe that the message is right. And we should do our part to help address the problem. (Geller, 2006)

At the local level, climate action in British Columbia began to gain prominence around this time period. The province, under the leadership of then-premier Gordon Campbell, introduced several key plans and legislation aimed at reducing greenhouse gas emissions. In February 2007, the province introduced legislation committing to the reduction of greenhouse gas emissions to 33% below 2007 levels by 2020, and at least 80% below 2007 levels by 2050, as well as mandating a carbon-neutral public sector by 2010 (Dusyk et al., 2009). The latter piece of legislation, the *Greenhouse Gas Reduction Targets Act* (Bill 44), was enacted in 2008 and had significant impact on Simon Fraser University as a public sector organization that must become carbon neutral by 2010. Carbon neutrality meant that SFU must either reduce their annual carbon emissions to zero, or purchase carbon offsets to match the emissions the university generated each year. For 2009, the cost of carbon offsets for SFU was $500,000 (Bell, 2009), and for 2011 this cost was estimated to be $1 million (Gavel & Tam, 2011). Bill 44 is still in place as of the time of this research (late 2015) and is one of the influences behind the implementation of the Burnaby Mountain DE system, as I explain in Section 4.3.4.

Furthermore, at the provincial level, an explicit connection was being made between building energy use and GHG emissions. In 2008, the 2006 version of the BC Building Code was updated to introduce energy efficiency and water conservation objectives (BC Office of Housing Standards, n.d.). Additionally, the demand for green buildings in the region was gaining momentum, bolstered by the City of Vancouver's Green Building Strategy in 2005 and Green Homes Program in 2008, both of which mandated energy performance requirements in buildings (Dusyk et al., 2009). Low-carbon DE was increasingly becoming a common feature in model sustainable communities in BC. Two new high-profile neighbourhoods, Southeast False Creek in Vancouver and Dockside Green in Victoria, were built with renewable energy district heating systems. Both neighbourhoods had earlier been designated model sustainable neighbourhoods by their respective cities; SEFC in 1999 and Dockside in 2005 (City of Vancouver, 1999; Dockside Green, 2014). A biomass district heating system became

operational in 2009 at Dockside Green, and a sewage heat-recovery district heating system went online in 2010 at Southeast False Creek.[16]

This rise of interest in energy issues in the global and provincial context as it relates to the implementation of the BMDES will be discussed in Section 4.4.

4.3.2. Greater control over green building and energy-efficiency requirements

After the relative financial success of UniverCity Phases 1 and 2, and in light of the changing global and regional context on energy, climate and sustainable neighbourhood development, the Trust looked to strengthen their green building and energy-efficiency related requirements for the subsequent development phases of the neighbourhood. In their application of a comprehensive development (CD) zoning for the Phases 3 and 4 lands, beginning in 2006, the Trust negotiated with Burnaby to incorporate an updated set of development guidelines and requirements directly into the zoning bylaw for Phases 3 and 4. Development guidelines were already being used in Phase 1 and 2, but now the Trust wished to include explicit requirements in the green building section which included water conservation, energy efficiency, waste reduction, and indoor air quality.

In the minutes of the Planning Committee meetings held between the Trust's staff and Board of Directors in 2007, the desire of the Trust to pursue these requirements was apparent, as was the lack of appetite from the City of Burnaby to take on green building requirements:

> D Mikkelsen noted that the City of Burnaby is not as committed to the Green Building and Landscape requirements as previously expected. The City of Burnaby will reference specifically the requirements in the zoning bylaw, so it will in effect be 'required' as part of the bylaw, but will not be included specifically in the documentation. The bylaw shall require

[16] While these systems have been operating for several years by the time of this research, no energy performance reports were found. In general, there is a lack of reporting and accountability for the post-occupancy consumption levels of newly model sustainable neighborhoods, at least in British Columbia (Sussman, 2012; Hendrickson & Roseland, 2010). Refer to Section 6.2.3 for a discussion on this issue of accountability.

> [development] proponents to meet the requirements as administered and maintained by SFUCT. This provides the Trust some flexibility in the requirements to incrementally increase the requirements and/or change components that are not successful. The drawback is that the City is less committed as a champion to this significant bylaw/administrative change. SFUCT will endeavor to keep the City highly involved by having key staff attend all green building and landscape review sessions with each proponent as they move through their development approvals. Approvals by the Trust will be required at the PPA, Development Permit and Occupancy Permit, and will form a part of the approvals package by the City of Burnaby to ensure that these requirements, while administered by the Trust, retain rigour. (SFUCT 2007a).

These minutes revealed that the City of Burnaby was reluctant to take on the green building requirements and even preferred to let the Trust take the lead in setting and administering the requirements for green buildings, in addition to ensuring its rigour. This was confirmed by Robert Renger, Senior Current Planner for Burnaby:

> In this case the initiative [for green building requirements] came from the [Trust], so we enshrined part of it through the zoning because we referred to their guidelines. (Renger, 2015).

From a functional perspective, this arrangement meant that the Trust actually had more control over the green building requirements moving forward, as the content of the guidelines and requirements were not written into the bylaw itself. As Mikkelsen pointed out, the requirements can thus be updated as the Trust sees fit, without undergoing a lengthy rezoning process with Burnaby and thus can be considered a 'living' document. (Mikkelsen, 2015). This arrangement was favorable to district energy implementation, as the Trust could later explicitly require the new buildings of Phases 3 and 4 to be built with compatibility to district energy infrastructure; in other words, to use hydronic systems for heating instead electricity.[17] The Green Building Requirements are a significant policy framework that gives the Trust not only tighter control of the lower levels of the energy-choice hierarchy, but also helped to remove the leadership and economics barrier to district energy implementation. In Section 5.3, I will discuss in greater detail the role of the Trust in the development of the Green Building

[17] This change was officially made in 2010 with the release of the Phase 3 Development Guidelines and Requirements.

Requirements as a regulative framework for the governance network surrounding UniverCity's development.

4.3.3. District energy becomes relevant and a project champion emerges

Within the provincial policy context shifting towards an explicit connection between GHG emissions and energy use from the built environment and towards more climate action in general, the Trust revived the idea of implementing a DE system in time for the development of Phases 3 and 4. District energy, based on local examples from Southeast False Creek and Dockside Green, was by 2008 being considered a relevant sustainability option in the development of new neighbourhoods.

The DE initiative at UniverCity was largely facilitated by a new staff member, Dale Mikkelsen, who began working at the Trust in June 2006. As Mikkelsen explained, more significant climate action through energy-efficiency was being sought at the time, as well as the potential to make the community more adaptable to future energy sources:

> …so we wanted not only to increase energy efficiency, we wanted to reduce our carbon footprint, and we felt the only way forward with that was with a neighbourhood energy system, where we were in control of the source of the energy itself… if you provide a thermal energy system so you can heat it with [any source]. As long as you can warm up water, you can heat your home and provide domestic hot water. (Mikkelsen, 2015).

By implementing a shared heating system for the remainder of the development sites at UniverCity, the Trust gained influence over the highest level of the energy-choice hierarchy with the intention of reducing the GHG emissions from the community. However, credit for the built form of the neighbourhood that is suitable for DE implementation must be given to the influence of transportation issues that shaped land-use and density decisions made in the early days of the development (see Section 4.1.1). By 2010, the Trust still did not have explicitly stated targets for energy efficiency or GHG reductions, nonetheless, they began to procure a DE system for the neighbourhood.

The implementation process was led by Mikkelsen, whom research participants recognized as a key project champion not only for DE but also for other sustainable development initiatives at the Trust. His title at the time of his hiring in 2006, Manager of Planning and Sustainability, spoke to the Trust's increasing interest in sustainability, as no one at the organization had sustainability explicitly referenced in their job titles prior to this point. Before joining the Trust in 2006, Mikkelsen spent six years as a planner at the City of Vancouver and had experience working on the feasibility studies for the DE system at Southeast False Creek, as well as involvement in Vancouver's Green Building Strategy. Former president Michael Geller spoke to Mikkelsen's commitment to sustainability and DE, and long-time board member Mark Roseland credited Mikkelsen with championing DE at UniverCity:

> Dale is a believer, a religious zealot, when it comes to sustainability…he wanted [the DE system]. (Geller, 2015).

> …I would give a lot of credit to Dale, for pushing [DE] at UniverCity, and part of that is Michael [Geller] and Gordon [Harris] having the foresight to hire Dale and keep him, and people like me on the Board saying this is what we want from our staff, people who were pushing this agenda…[Dale] is definitely someone who lives and breathes [sustainability]. And you know what, that really makes a difference….we've had people before Dale, I don't remember who we had, and we had the 'Dale' kind of knowledge from consultants, and we've had previous people who were in charge of development who were really good people and really knew their business, but they were not really committed to things like district energy, and Dale is committed as well as competent and that makes all the difference in the world. (Roseland, 2015).

The introduction of Mikkelsen, with his experience and commitment to sustainable urban development as well as district energy, at a time when DE was becoming a relevant and current option for reducing GHG emissions from the built environment, meant a removal of the leadership and knowledge barrier. However, this was unintentional, as Geller confirmed that the Trust had no intention for a DE system when Mikkelsen was hired in 2006 (Geller, 2015) and the discussions of a DE system for Phases 3 and 4 did not arise until 2008.

4.3.3.1. New governance actors brought in

Having made the decision to pursue DE for the next phases of UniverCity in 2008, other actors with experience with DE implementation were brought in. Their appearance helped to overcome the human resources (HR) barrier according to the CDEA definition. In this case, the other key actors were Trent Berry and Corix Multi-Utility Services (Corix).

In 2008, Mikkelsen engaged the services of Trent Berry, an economics consultant who had also worked on the Southeast False Creek Neighborhood Energy Utility (SEFC NEU) (Berry, 2015; Mikkelsen, 2015), and the Trust began considering their options for implementing a DE system on Burnaby Mountain. One economic barrier commonly associated with DE implementation is the cost of feasibility studies to determine the business case and to select the technology for DE, which adds significantly to the upfront capital cost of DE (CDEA, 2012; UNEP, 2015). According to Mikkelsen, his experience with the SEFC NEU left him with the conclusion that a different procurement process would be a better use of the money meant for SFU's endowment.[18] Instead of the mimicking the process undergone at SEFC NEU, where the City of Vancouver paid for feasibility studies and selected the technology for the system prior to requesting proposals by DE providers, the Trust opted for a private ownership model and began the process by engaging the utility providers before undergoing feasibility studies for DE (Mikkelsen, 2015; Berry, 2015). Mikkelsen explained his views on this matter:

> I think feasibility and pre-feasibility studies were a waste of money…that was my experience from the City of Vancouver, because we did two pre-feasibility studies, we did one feasibility study, talked to other municipalities that had done feasibility studies, and almost every time either the project didn't proceed or it proceed with a technology that was different…than [the one] recommended through the feasibility study…So, I said to Trent [Berry], no feasibility studies. At the City of Vancouver I thought we had spent too much money on feasibility studies for an end

[18] The cost of pre-feasibility studies and feasibility studies can be significant. While this research did not uncover the costs associated with the BMDES, figures from 2011 for BC showed that prefeasibility studies could start at $70,000 CAD, and that feasibility studies could range from $100,000-$150,000 CAD (Burnaby, 2011b).

> result that didn't mirror the feasibility study….so why would we spend money that would otherwise go to the [SFU] endowment, for work that may or may not have any validity to the ultimate energy provider that we ultimately choose? (Mikkelsen, 2015).

Berry is an experienced consultant involved in many district energy implementation or expansion projects around the Lower Mainland; his client list includes the cities of Surrey and Richmond, the University of British Columbia (UBC), several major hospitals, as well as downtown Vancouver's Creative Energy (Berry, 2015). He explained the method of procurement that was used by SEFC and also by UBC in recent DE projects, and how it differed from the Trust's process:

> Some clients want to do feasibility first and then decided whether they want to [implement a DE system] or secure a partner to do it. [Other clients] do a very preliminary screening and then engage the market to do due diligence. So UBC was…another one of my projects…where [UBC] sponsored [feasibility studies] and we did all the feasibility before we engaged Corix. And then Corix was engaged after a competitive Call for Interest, and then Corix did final due diligence on the project. So in the case of UniverCity, [the Trust] decided very early on to go out to the market. (Berry, 2015)

The key difference here is the business model being proposed for UniverCity generally has lower financial risk to the public sector (UNEP, 2015). In this case, the Trust may be considered the public sector since they represent the public interest as the owner and master developer of the neighbourhood, and because of their affiliation with SFU, a public education institute. In this model, the Trust has influence over the DE system as the landowner granting the right to a private utility to sell heat in the neighbourhood, but they do not bear the risks of owning and operating the utility. After a selection process in 2008, Corix was chosen as the technology provider for the proposed DE system for UniverCity. In a novel financing arrangement, the Trust and Corix negotiated the cost of the feasibility studies to be borne entirely by Corix if the study demonstrated a viable business case for the DE system. If the feasibility study found no economic rationale for the project to go forward, the Trust would then be

responsible for only half the cost of the feasibility study (Mikkelsen, 2015). This significantly lowered the economic risk for the Trust in proposing a DE system initially.[19]

By selecting Corix, the Trust benefitted from Corix's experience as the utility provider for the biomass DE system at Dockside Green in Victoria, BC. The Dockside Green Energy (DGE) utility gained approval from the BC Utilities Commission in 2008 and began operating in 2009, but it had experienced much lower utility revenues than anticipated. For DGE, the rate of development of the neighbourhood, and thus the number of customers connected to the system, did not grow as anticipated due to the global housing market downturn of 2008 (CMUS, 2011). The lack of security of a customer base and uncertainty in market development conditions are common economic barriers to DE implementation, according to the CDEA. As UniverCity's Phase 3 and 4 residential developments were being planned over a period of 10 years, the BMDES would be exposed to similar potential risks as experienced by Corix at DGE due to the unpredictability of the development market (CMUS, 2011).

As a solution to the uncertainty in customer base, the Trust and Corix agreed to implement a temporary natural-gas fuel district energy system to which new buildings in Phases 3 and 4 would connect as they are built (Mikkelsen, 2015; Berry, 2015; CMUS, 2011). This strategy is meant to lower the risk to the capital investment in case the neighbourhood is not built according to the planned timeline. The heating system is to switch over to the low-carbon biomass renewable source only once a sufficient load is achieved; technical analysis found this to be 1,400 residential units connected to the system (CMUS, 2011; Mikkelsen, 2015). This phased strategy is the opposite of what was done at DGE, in which a full-size low-carbon district heating facility was built at the beginning of the neighbourhood's development in order to secure $1.5 million from the Technology Early Action Measures federal funding program (Dockside Green, 2008; CMUS, 2011).

In the UniverCity project, having several key actors with experience in designing and implementing district energy was a removal of the human resources barrier.

[19] Refer to Section 4.3.4.3 for a longer discussion on this business model, which is similar to a public-private partnership.

Moreover, having knowledgeable actors propose a different funding model for feasibility studies and a temporary system also meant a reduction to several of the economic barriers associated with DE implementation, such as the high capital cost of feasibility studies and of a full-sized low-carbon system, along with uncertainty in the customer base. From the perspective of the Trust, having an arrangement in which they minimized their own financial risk associated with the capital expenditure for feasibility studies was a further reduction of the economic barrier. A financial analysis of the temporary boiler strategy and the feasibility study funding model was not part of this research, so comments comparing the magnitude of either models as an economic barrier cannot be made. However, when combined, both of these solutions resulted in a reduction in economic barrier and were outcomes of negotiations between the Trust and Corix during the DE implementation process.

4.3.3.2. A new governance arrangement for DE

The introduction of Corix into the governance network surrounding UniverCity's development, while reducing the HR barrier, ended up creating a contextual barrier to DE implementation. The role of Corix, a private utility developer, in developing the DE system for the UniverCity neighbourhood, is analogous to that of the private land developers who are brought in by the Trust to develop land parcels into residential buildings. In both cases, the private sector invests in providing the neighbourhood with a product, be it heating or housing units, which is then sold to the market with some level of oversight from the Trust. However, in the later discussions for a joint system with SFU's Burnaby campus, which combined the private interests of Corix with the public interests of SFU, the presence of Corix posed additional challenges as the project becomes more like a public-private partnership. I discuss this contextual barrier in greater detail in Section 4.3.4.3.

4.3.4. The rationale for a joint system with SFU Burnaby campus

Although the SFU Community Trust and the UniverCity development are affiliated with SFU, a public institution, neither of them fall under the legal requirements of BC's Bill 44 for carbon neutrality, as the Trust is a separate corporate entity acting as trustee to developable SFU lands. However, UniverCity's affiliation and physical

proximity to the SFU Burnaby campus meant there is potential for sharing an energy system and is one of the reasons that made DE a possibility for the UniverCity development. A joint energy system using a renewable and low-carbon source shared between the SFU campus and UniverCity would help SFU reduce the cost of meeting its carbon neutrality requirements and also aligned with Trust's mandate to demonstrate model neighbourhood sustainability.[20]

In 2008, a process for the discussion, evaluation and public consultation of a joint heating system between SFU's Burnaby campus and the UniverCity residential neighbourhoods began, revolving around a system fueled by biomass from local wood waste that is considered both renewable and low-carbon (CMUS, 2010). SFU's Burnaby campus buildings on Burnaby Mountain are already connected via a heating network to SFU's district heating system that was built in the 60s and grew with the campus (Gavel, 2011). This heating system is fueled by natural gas and many of its components are nearing the end of their useful life (Berry, 2015; Mikkelsen, 2015). Many see the economic and environmental advantages offered by a joint system between the campus and UniverCity that would eventually be fueled by biomass wood waste from local sources (Mikkelsen, 2015; Berry, 2015; Roseland, 2015; CMUS, 2010). The proposed joint system is anticipated to reduce SFU's GHG emissions from heating by 80%, saving the university the cost of purchasing carbon offsets as required by Bill 44, estimated to be approximately $1 million/year (Gavel & Tam, 2011). However, actual plans for a joint system have not materialized as of Summer 2015 and this partnership with SFU was both a barrier and an enabler to a low-carbon district energy system, as discussed in the following sections.

4.3.4.1. The benefit of partnering with SFU

Having SFU, the Trust and Corix partnering on a joint heating system meant that SFU, as a public institution, could leverage their access to public funding targeted towards various GHG reduction efforts like DE, such as the Province of BC's Public Sector Energy Conservation Agreement (PSECA) fund. A challenge to privately owned and developed DE systems is the lack of access to capital grants to assist with the high

[20] Refer to Section 5.2 for a discussion on the Trust's mandate for model sustainability.

capital cost of DE which is a common economic barrier to DE implementation. This was explained in a presentation made by a representative of Wesgroup, the master developer of the River District, a neighbourhood located in south Vancouver that implemented its own neighbourhood energy utility in 2012. As a private developer, Wesgroup could not access public grant money from outside agencies and this was a significant challenge to financing their project (Petri, 2014). Wesgroup and others in the development community argue that while private developers are under various levels of pressure from local and provincial governments to reduce GHG reductions from their projects, there is insufficient financial support to realizing these goals (Petri, 2014; Fisher, 2014).

For the BMDES, having a potential for future connection to SFU helped to get a promise of $4.7 million in capital from BC's PSECA fund for the partnership to implement the joint thermal energy system. Early estimates of the cost of a joint system were approximately $12.2 million CAD, with a funding mix of private ownership through Corix ($4M), development lease charges from UniverCity developers ($2.2M), PSECA funding ($4.7M), and incentives from BC Hydro's Power Smart program ($1.3M) (CMUS, 2011). The PSECA fund is a $75 million grant established in 2007 to help BC's universities and other public sector organizations meet the province's goals for carbon-neutral government (Ministry of Environment, 2011) and available only to public institutions. The BC provincial government, in creating the PSECA funding, demonstrated leadership and political will according to CDEA's definition of barriers. Although this funding was not targeted to DE technology but instead to the overall GHG reduction goals for BC's public sector, in the case of the BMDES, the PSECA funding was an important enabler in opening up the potential for a joint heating system fueled by low-carbon biomass.

While the access to provincial funding by SFU as a public institution significantly reduced the perceived economics barrier associated with DE implementation, this did not lead directly to the implementation of a biomass DE, as a contextual barrier materialized as a result of a partnership between Corix, the Trust, and SFU, as I discuss next.

4.3.4.2. The downside to partnering with SFU

Although the province of BC committed funding to a joint DE project in 2011, no plans for such a system have been confirmed as of this research in 2015. The reason was revealed through interviews and document analysis. They are summarized as "funny accounting" by Mikkelsen (2015) and related to the province of BC's funding and accounting rules for public institutions. Trent Berry and Dale Mikkelsen explained that SFU, as a public institution operating under funding from the BC government, is not allowed to take on debt. By international accounting standards, signing a long-term service contract with Corix for the provision of heating to the SFU Burnaby campus would be considered by the Province as capital leases which are the accounting equivalent to taking on debt:

> The campus doesn't have access to capital, they have a grant...[Sometimes] when government agencies…instead of building a building maybe they just sign a lease on a building. Well, the international accounting standards have said those are actual capital leases, so you should be not just showing them as expenses but they're actually long-term obligations, they should show up in your capital plan. The university can't borrow more money so even though they're not physically borrowing money, they're signing a [long-term service contract with Corix] that's like repaying a loan because they're repaying capital. And that's become a huge barrier to doing a joint plant. So that has not been sorted out…and it remains an ongoing issue. (Berry, 2015).

> Any provincially funded organization cannot take on any debt…[SFU] still can't show new debt on the books… [With] SFU being the core load [for the proposed DES] then the way the province sees it…if Corix suddenly just went bankrupt…then the majority of the operating debt could fall to SFU. So they see it as, ultimately, even though SFU isn't carrying that debt, if Corix went bankrupt, the responsibility of that debt could fall on SFU. (Mikkelsen, 2015).

This issue with capital leasing cannot be neatly attributed as the leadership or economic barriers according to CDEA's definition. It is a contextual barrier specific to the project, likely due to the mixing of public and private interests in proposing to connect a public institution (SFU) to a private utility (Corix) for the long-term provision of a major service such as heating. Although interviewees did not frame the capital lease issue as an outcome of the mixing of public and private interests, what the interviewees attributed to provincial accounting oddities hints at this being the core of the problem. An in-depth

study of the financial accounting rules and motivations behind funding for BC's public institution is outside the scope of this research, however, an explanation of this contextual barrier lays in the literature on public-private partnerships (P3s).

4.3.4.3 Public-private partnerships and governance for sustainability

Public-private partnerships (P3s), a new model for financing and constructing infrastructure, emerged in the 1980s and gained mainstream status in the 1990s in North America (Boardman et al., 2005). Typical P3s consist of an ongoing contractual relationship between a government entity and one or more private sectors partners, in which the private sector finances, builds and operates a specified major infrastructure facility for a pre-determined time before transferring ownership to the public entity (Boardman et al., 2005). A joint heating plant supplying both the Burnaby campus and the UniverCity community but is privately owned by Corix fits the general description of a P3, although the details of whether ownership of the plant is expected turn over to SFU in the future are currently unknown.[21] The reasons why the Trust turned to this form of partnership are similar to the reasons why the public sector typically pursues P3s. Partnering with the private sector is thought to lower costs to the public sector, because of the easier access to private capital, more specialized knowledge and project management, and more efficient operations offered by the private sector (Boardman et al., 2005). Consultant Trent Berry had the following remarks from when the Trust began pursuing DE in 2008:

> What I observed very early on is that [the Trust] didn't want to own [a DE system]. They didn't have the capital and they didn't have the expertise; they're a small shop. So that kind of pushed you more towards having the private sector [deliver the DE system]. (Berry, 2015).

As Berry notes, the Trust did not have access to the needed amounts of capital and lacked the necessary expertise in-house to implement and maintain a DE system on their own. Along with the desire to minimize the costs of initial feasibility studies, as Mikkelsen explained in Section 4.3.3.1, the above reasons contributed to why the Trust pursued this form of partnership.

[21] Refer to Section 4.3.5.1. The details are to be discussed at the November 2015 SFU Board of Governor's meeting, which takes place after the writing of this thesis.

The contextual barrier faced in the BMDES project, disguised as 'funny accounting', reveals a contradiction in the reality of governance arrangements for sustainability. Governance for sustainable development, as I described in Section 2.3, is understood to be a collaboration of state and non-state actors, working through policy, market forces and grassroots initiatives, aimed at addressing sustainability problems (Griffin, 2010; Loorbach, 2007). P3s, as a contractual relationship between the public and private sector, is a formalization of such governance arrangements. In an ideal P3 arrangement, the public and private partners are expected to share decision-making and the risks associated with the project. Based on empirical studies, however, scholars have found many cases where risks and decisions were not equally shared, leading to misaligned incentives and less effective overall outcomes for the public (Boardman et al., 2005; Klijn & Teisman, 2004). Although this research does not delve into whether the BMDES, in its current form as a temporary system fuelled by natural gas that only supplies heat to UniverCity, could have been realized without the contributions of Corix, or some other private sector utility partner, it is likely that the partnership was crucial to its implementation. What the existing literature on the governance of sustainable development does not fully address are the complexities created when public and private financial interests are mixed in governance attempts to address sustainability issues.

This 'funny accounting' may be understood as an inconsistency of the Province, being on one hand willing to support this P3 governance initiative through the PSECA contribution but on the other hand not having established their institutional rules and processes to facilitate the partnership. Given the evidence provided by scholars on the ambiguous benefits that P3 projects provide to the public (Boardman et al., 2005; Klijn & Teisman, 2004), however, perhaps this inconsistency created time for more deliberative decision-making in balancing the urgency of climate mitigation action against the need for responsible public finance. Future scholars may be interested in conducting a detailed *ex post* analysis of this project through the lens of public financing and considering its implications on the governance of sustainable urban development projects. Nevertheless, this aligns with what Griffin points to as the need for "institutional, i.e. governance reform" (Griffin, 2010, p. 366) in governance attempts at sustainable development in BC today.

4.3.5. Moving forward on district energy

Even as the negotiations for a joint heating system continued in 2015, the Trust still faced development pressure from the first of the Phase 3 buildings to be provided with heating by Fall of 2012. Corix and the Trust moved ahead with the application for a Certificate of Public Convenience and Necessity (CPCN) with the BC Utilities Commission (BCUC) for a temporary smaller-scale natural gas system to serve the new buildings and gained approval for it in May 2011. The BCUC approval allowed Corix to lay the network infrastructure to supply heating to the new buildings, through the temporary natural gas system, with the intention to switch to a larger permanent system fueled by local wood waste once 1,400 residential units had been connected. This strategy of using natural gas as a transitional fuel is now commonly seen in the BC Lower Mainland and is employed by the DE systems at Surrey's City Centre and the River District neighbourhood in Vancouver (Lee, 2015), and is being proposed at University of British Columbia's Wesbrook Place neighbourhood.[22]

4.3.5.1. Current status of the district energy system

In April 2012, the Burnaby Mountain District Energy System became operational and as of January 2015 seven buildings at UniverCity are connected to it, out of a total potential of 41 buildings estimated for Phase 3 and 4 development. For this temporary system, the point at which a permanent biomass system was to be built was reached in 2013, when 1,400 residential units at UniverCity had been connected (Mikkelsen, 2015). However, this switch had not occurred as of September 2015 as the involved parties are still continuing negotiations for a joint plant with SFU. According to Mikkelsen, Corix and SFU have arrived at a compromise that would allow SFU to connect to a larger biomass facility owned and operated by Corix that also satisfy the provincial accounting rules for capital leasing. Details have not been released but a final decision is scheduled to be

[22] A DE system similar to BMDES is being planned at the University of British Columbia's Point Grey campus in Vancouver. UBC is in the early stages of developing the Wesbrook Place residential neighbourhood adjacent to the campus, and has also partnered with Corix on the development of a low-carbon DES. Although there is a proposal to eventually connect to UBC's academic DES serving the campus, the system being proposed is intended to serve residential customers for the foreseeable future. At the moment, the capital-lease issue that SFU is facing with Corix is not applicable to UBC's development.

made on the joint plant by the SFU Board of Governors at their November 2015 meeting. If the Board of Governors do not approve of the joint system, the Trust and Corix would have to proceed with converting the existing temporary system to biomass. They would need to go through the CPCN approvals process, and although a UniverCity-only biomass system would be smaller and have lower capital cost, there would also be no PSECA funding. It is uncertain how the economic analysis for this smaller biomass system would work out and how this might impact the utility rates for the existing and future customers of the BMDES.

4.4. Revisiting the barriers to district energy

In Section 2.2, I described the linear causal relationship proposed by the CDEA in explaining barriers to DE implementation as rooted in a lack of knowledge about district energy. In the BMDES project, I find that it was not the lack of knowledge of DE as a sustainability option that resulted in it not being implemented in the early phases of UniverCity. It was the lack of relevance that energy had within the discourse of sustainability at the time that was a key barrier, supplemented by a lack of leadership from other levels of government on this issue. This lack of relevance was an interaction of the knowledge and sustainability image barriers, as I discussed in Section 4.2.2.

My research finds that the general causal pattern proposed by the CDEA largely held true for the implementation of BMDES, with the exception of the sustainability image barrier which proved to be an important barrier. Once the knowledge and sustainability image barriers were overcome, the leadership barriers were less significant, followed by the economic and human resources barrier. In the case study, the knowledge barrier was partially overcome as the Trust had long known of DE as an option for reducing the GHG emission from the built environment, and they had already been shaping the governance network surrounding the development of UniverCity which allowed them to later take a leadership position on DE.[23] Next, the economic and contextual barriers were faced once the Trust made the decision to pursue DE. These

[23] The element of leadership of the Trust will be further explored in Chapter 5.

barriers were lessened with the removal of the leadership barrier through the emergence of a project champion and knowledgeable actors to steer the DE implementation through the funding stages. The project was aided by the Province's leadership in the provision of capital funding for a joint DE system as well as local examples of DE such as Southeast False Creek and Dockside Green; both these factors made energy a more relevant issue within sustainable neighbourhood planning. Of the lowest importance to this case study was the human resource barrier. Research interviewees did not point to a lack of knowledgeable actors as a barrier to implementing the DE project. Project champion Dale Mikkelsen already had experience with DE implementation before the decision to pursue BMDES was made, and he had access to another key actor in Trent Berry. Moreover, Corix was already active in providing district heating services in BC through their earlier involvement in the Dockside Green Energy System. All three actors benefited from experience with previous local DE systems, which meant that the reduced human resource barrier may be credited to leadership from cities such as Vancouver and Victoria in creating early demonstration DE projects in their model sustainable neighbourhoods.

While the CDEA framework of barriers was suitable for explaining the some of the events leading to the implementation of the BMDES, its linear causal relationship cannot account for changes that occurred due to the passage of time or to external influences. This is a known issue in researching barriers, in that while they do provide a useful "typology of factors that may inhibit action" (Burch, 2010, p. 7577), examining barriers by themselves cannot explain for why or how change occurs. Further insight into the implementation the BMDES may be provided by literature on socio-technical regime change. I provide a brief discussion below to supplement the explanation offered by the focus on barriers to DE implementation.

In socio-technical regime change literature, technology is understood as deeply embedded within social constructs such as markets, institutions, civil society, operating at scales known as the niche, regime and landscape levels (Smith et al., 2005). Regimes are the focus of this literature and consist of physical and social institutions (such as infrastructure, market rules and regulations, social practices). Regimes exist to serve socially valuable functions, such as transportation, energy, water, housing, healthcare,

education, and food; they are stable and resistant to change (Smith et al., 2005). Sitting conceptually above the regime level is the socio-technical landscape, comprising of the "social values, political cultures, built environments, and economic development and trends" (Dusyk et al., 2009, p. 389) within which regimes and niches develop and operate. The smallest level, or niche, is similar to the regime in that it consists of the same physical and social structures, but is smaller in scale and less stable than the regime level (Geels & Schot, 2007). Governance actors and networks exist at all three levels and their interactions either reproduce the existing regimes or enact changes to them (Smith, 2007). Loosely applied to this project, the regime level can be viewed as the governance network surrounding the planning and development of the UniverCity neighbourhood.

Socio-technical regimes are thought to change in a non-linear fashion, since the interdependent and quasi-evolutionary dynamics of actors, technologies, policies, and market competition make direct causal relationships difficult to draw. However, according to this literature, there are two broad causes of change in socio-technical regimes: a) the shifting of selection pressures from the landscape and their degree of focus on the regime; and b) the response of regime actors in adapting to these pressures (Smith et al., 2005). Selection pressures may come from sources at the landscape level, such as changes in pricing, competition, contracts, taxes and regulations, standards, liability, profitability, skills, knowledge, but also other factors such as activism and lobbying, demographic changes or the “ebb and flow of environmental attitudes in society” (Smith et al., 2005, p. 1494). For the BMDES, the external selection pressures came from the landscape level, in the form of a global shift in climate change awareness, the direct action of the BC government in framing energy use and the built environment as an important strategy for GHG reduction, and regional examples of model neighbourhood sustainability featuring DE systems. These pressures had the effect of reducing the interrelated knowledge and sustainability image barriers to DE implementation as discussed in Section 4.2.2.

While the Trust was not directly responsible for these external selection pressures, they did demonstrate significant adaptive responses to these pressures through their shaping of the institutional frameworks surrounding UniverCity’s

development. In the next Chapter, I turn to the leadership role of the Trust in creating institutional frameworks around UniverCity that was ultimately supportive to DE implementation and allowed this change to occur.

Chapter 5.

Understanding the 'leadership' of the SFU Community Trust

In tracing the history of the development of the BMDES, it is quite evident that the SFU Community Trust played a key role in overcoming the leadership challenge to DE implementation, which the CDEA considers to be the lack of thought leaders and project champions for DE. In turn, this is thought to result in the unsupportive regulatory and legislative environments which are to blame for the unattractive investment regime for DE. In Chapter 4 I outlined the sequence of key events that supported the realization of the BMDES, but a deeper understanding of the leadership barrier and its resolution can be developed through my examination of the Trust's activities in shaping the institutional frameworks surrounding the development of the UniverCity neighbourhood.

As the conceptual basis for this chapter, I refer to the regulative, normative, cognitive and imaginary aspects of institutional frameworks that the Trust shaped within the governance network responsible for the development of UniverCity and the BMDES. These ideas were previously developed in Section 2.3.2.

5.1. The normative framework – 'Sustainability Cornerstones'

The Trust created a normative framework that not only guides their own actions but also had influence on their negotiations with other actors in the governance network such as the City of Burnaby and market developers. In 2000, after the four ideas were articulated in the Design Charrette Brief authored by Condon et al. (2000), the Trust adopted Education, Equity, Environment and Economy as the four organizing themes for their community design and development principles. In 2002, in preparation for Phases 1

and 2 development, these four concepts were recast and publicized as the 'sustainability cornerstones' of the Trust. The Trust claims that all four ideas are held as equally important and are used to define and measure sustainability for UniverCity. The significance of these 'cornerstones' is that they form the basis of the normative framework for what the Trust understands to be sustainable development goals relevant to this community. While this research does not evaluate their implementation and overall sustainability impact, it was apparent from qualitative interviews that these 'cornerstones' were used within the governance network for UniverCity's development as all interviewees were aware of them. Recalling the definition of a normative element as one that "define[s] goals or objectives but also designate appropriate ways to pursue them" (Scott, 2014, p. 64), I show how the Trust used these ideas in their development guidelines and later requirements.

This normative framework was key to the later justification for DE. Its change over time demonstrated how the Trust's motivations for energy conservation evolved, from mainly being an issue of economic concern in 2000, to an environmental issue (among several) in 2002 and finally being explicitly stated as a call for low-carbon living in 2012. In the 2000 Condon et al. Design Charrette Brief, energy conservation was considered only under the goal of 'Economy', as a development goal to "provide attractive, compelling and profitable approaches to building design, energy conservation, infrastructure and servicing while ensuring that development responds to market conditions". The Brief noted that "any progress toward a more economically sustainable future require large per capita reductions in the amount of energy required for building conditioning and transportation" (Condon et al., 2000). Energy conservation was being considered only under the rationale of economic sustainability, or the ability of UniverCity to attract residents based on lower energy costs being offered by design approaches used in the community. Later on, between 2002 and 2012, the sustainability cornerstones posted on UniverCity's website still did not explicitly identify energy conservation as a key action area for the neighbourhood development. Hints to energy conservation in UniverCity's built environment were found under the explanation for the Environment cornerstone as the need for UniverCity to "provide sustainable, cost and resource efficient infrastructure and buildings" (SFUCT, 2002a).

Looking deeper into the documents produced by the Trust, an explicit connection between reduced energy consumption and impacts to climate change could be seen within the Green Building section of the 2002 Development Guidelines. In these guidelines, the justification for lowering energy consumption in buildings is framed as reducing the "potential impacts of the climate of greenhouse gas emissions (global warming) from fossil fuel consumption" (BMCC, 2001, p. 65). While the connection between energy use and climate impact is at least being pointed out within the 2002 Development Guidelines, this rationale for reduced energy consumption is just one issue amongst a number of other green building topics recognized by the Trust.[24] The issue of energy and related climate impacts was not being highlighted at the level of the sustainability cornerstones, as energy conservation is still only loosely identified within the goal of resource efficiency within the context of cost.

In 2012, however, sometime after the BC Utilities Commission's approval of the BMDES, the web version of the sustainability cornerstones was updated. Now, one of the two goals stated under the Environment cornerstone explicitly acknowledges the carbon outcomes relating to the built environment, in aiming to "maintain the smallest carbon footprint possible for buildings, transport and amenities" (SFUCT, 2015) (see Table 4). Although the timing of the web update of the sustainability cornerstones may not correlate exactly to the implementation of the BMDES, the higher visibility given to this issue does indicate that the Trust had shifted to a more specific focus on carbon reduction by 2012. The new emphasis on carbon footprint specified at the level of the normative institutional framework can be considered a reduction to the leadership barrier to DE.

Table 4: The 2015 version of four sustainability 'cornerstones' of the SFU Community Trust and their principles. Source: univercity.ca (2015)

Sustainability Cornerstone	Key Principles/Goals
Environment	Preserve or improve natural resources on Burnaby Mountain.
	Maintain the smallest carbon footprint possible for buildings, transportation and amenities.

[24] The 2002 Green Building Guidelines also included justifications for environmentally-sensitive site strategies, water conservation, resource efficiency, waste reduction, healthy buildings and indoor air quality.

Equity	Provide a healthy, safe and affordable place to live and work.
	Provide a mix of home ownership choices that nurtures a complete community.
Education	Enhance the education of students and lifelong learners to prepare them for the future economy.
	Energize university life, academic endeavour and campus activities.
Economy	Generate revenue to maximize the long-term value of SFU's endowment.
	Encourage innovation in commercial and social enterprises to engage all community stakeholders.

While my research did not reveal exactly when the idea of the carbon footprint became a significant topic of internal interest for the Trust, nor did it draw direct connections to how it influenced the pursuit of DE, the fact that the Environment cornerstone was updated in 2012 to publically identify carbon footprint as a goal was indicative of the shift in the Trust's priorities as a response to external changes such as global awareness of climate change and the provincial focus on GHG reduction, and local examples of district energy in model sustainable neighborhoods. These selection pressures, as I described in Sections 4.3.1 and 4.4, had the effect of changing the normative framework over time. This evolution speaks to how long change can take; despite a shift in the Trust's official view of energy and the built environment as early as 2002, a governance outcome in the form of a DE system did not materialize until 2012. A broader question that may shed greater insight into the governance of sustainability attempts is whether the time lag between the Trust making changes to the normative framework to prioritize energy and the eventual implementation of DE was representative of other large-scale urban sustainability initiatives.

In the following section I discuss the interaction of the cognitive and imaginary elements of the institutional framework surrounding UniverCity which also contributed to overcoming the leadership barrier to DE implementation.

5.2. The cognitive and imaginary frameworks interact– the mandate for profit and model sustainable development

A second key element to overcoming the leadership barrier can be described as an interaction of the cognitive and imaginary elements of the institutional framework. The cognitive element describes the shared mental maps or what shapes the "patterns of thinking, feeling and acting: mental programs, or the software of the mind" (Hofstede, 1991, in Scott, 2014). In the context of governance networks, it represents the causal beliefs and knowledge shared by and between its actors. The imaginary aspect of governance networks is about the identity-formation potential of shared worldviews, as well as a belief in the obligation of actors to promote this worldview. Through the imaginary element of governance networks, actors "produce identities, ideologies, common hopes and visions" (Marcussen & Torfing, 2003, p. 3) that guide their actions towards their public purpose. The Trust has a mandate which guides their internal actions, but from this sprang two important elements which informed negotiations between actors of this neighbourhood development's governance network: 1) the development of a model sustainable neighbourhood as a shared ideal guiding the governance network and 2) the cognitive belief that sustainable development can be profitable. These two ideas are related and reinforce each other, which is why I consider an interaction of these two elements as a factor in the Trust's success in DE implementation.

The Trust, from its inception in 1995, has been driven by two mandates: 1) to establish a complete community which complements existing and future university development and 2) to establish an endowment fund and other sources of revenue to support university purposes (Stubbs & Copeland, 1995). While the second, or financial, mandate has not changed significantly in the intervening years[25], the first mandate has evolved over time, as seen in Table 5. This evolution is telling of the role of this mandate

[25] The financial mandate has only changed to reflect the passage of time. In 1995, this mandate was 'to establish an endowment fund and other sources of revenue to support university purposes" (BMCC, 1998), and the 2011 (and current) mandate is to "build an endowment fund to support teaching and research at SFU" (SFUCT, n.d.).

in shaping the imaginary element for the governance network within which the Trust works.

Between 2000 and 2008, the first mandate had evolved into "to establish a complete community which complements existing and future university development, **worthy of local and international acclaim**" (SFUCT, 2002) (original emphasis). This motivation for being a development of acclaim can be traced back to the 1996 joint statement by SFU President John Stubbs and Burnaby Mayor William Copeland, which pointed to the university's desire to "design and develop a model community integrating residential, commercial and academic uses in a manner that will bring international acclaim, both to the University and to the City of Burnaby" (Stubbs & Copeland, 1996). These ideas were later echoed in the 1998 community visioning process and then re-articulated in the 2000 Design Charrette Brief. This brief laid out the goal that "the Burnaby Mountain community should serve as a self-evident or revelatory living laboratory of new and intelligent community design…this community should be a place that explains itself, and in so doing, attracts visitors from around the globe in search of new and more attractive models of living in the new millennium" (Condon et al., 2000). The idea of building a model community based around sustainability principles didn't appear publicly until 2002 as a development principle under the 'Education' sustainability cornerstone to "creat[e] a model sustainable community that educates and inspires" (BMCC, 2002).

Table 5: The first mandate of SFU Community Trust, from 1995 to present. Bolded italics added to denote change from previous version. Source: Web archives of UniverCity.ca.

Year	SFU Community Trust's first mandate
1995	To establish a complete community which complements existing and future university development.
2000	To establish a complete community which complements existing and future university development, ***worthy of international acclaim***
2004	To establish a complete community which complements existing and future university development, worthy of ***local and*** international acclaim
2008 - present	***Create*** *a* complete community ***on Burnaby Mountain, with a diverse selection of housing and a full range of shops, services and amenities.***

Research participants Michael Geller and Mark Roseland, who were both involved in the early days of UniverCity development, corroborated this initial desire for acclaim through 'sustainability'. Dale Mikkelsen, the current Director of Development at the Trust, even considered the current mandate as demonstrating sustainability, although the current mandate (see Table 5) does not explicitly reference sustainable development:

> …I wanted to create a sustainable community and not be shy about letting people know it was a sustainable community…(Geller, 2015)

> …the mandate of the Trust is to build a community of local and international acclaim for sustainability…(Roseland, 2015).

> …so it's really clear why we are making money but our goal is to make a developer's profit on the project, and then the second goal is to demonstrate model sustainability...(Mikkelsen, 2015).

So it is clear from the evidence that the image of building a model sustainable neighbourhood of acclaim was a common vision for the actors within this governance network, but the origins of this idea as well as its reinforcement can be attributed to the Trust. The City of Burnaby documents reviewed in this research demonstrated the prevalence of this idea within the governance network, since UniverCity is often referenced as an 'innovative, sustainable and complete community'. Burnaby Planner Robert Renger attested to Burnaby's support for making UniverCity a model of neighbourhood sustainability, but he is clear that the initiative came from the Trust. Renger gave his perspective on the model sustainability or 'showpiece' aspect of the UniverCity, and referenced another sustainability demonstration project in the neighbourhood, the UniverCity Childcare Centre[26]:

> We were enthusiastic about [the Trust's] desire to make [UniverCity] an environmentally sustainable project…to make this a showpiece of a project…I think UniverCity really wants to be a showpiece. So district

[26] The UniverCity Childcare Centre is expected to be the first building in Canada to achieve Living Building Challenge certification (SFUCT, 2014a). The Living Building certification program is self-described as the "most rigorous performance standard" for the built environment with performance requirements in the areas of water, energy, indoor environmental health, etc. (ILFI, n.d.)

> energy was one thing that they could deliver to show that they were [a] living laboratory, you know, with the [UniverCity] Childcare [Centre] and the Living Building Challenge, [which] was another aspect of that. (Renger, 2015).

Again, this imaginary element of 'model sustainable neighbourhood' was known by all research participants. However, the Trust also actively cultivates this image by applying for external validation through industry awards for sustainable community development, and a complete listing of the awards they have won is provided in Appendix B. While it is unclear whether the Trust had an active role in soliciting each of the ten awards they have won relating to community planning, evidence from the Trust's Board of Directors meeting minutes indicated that staff had a role in preparing applications to at least one of the awards - the 2008 American Planning Association's National Planning Excellence Award for Innovation in Green Community Planning. Furthermore, the Trust is also active in outreach efforts to present the UniverCity case at various planning or sustainability conferences and workshops around North America and internationally, promoting UniverCity as an exemplar of neighbourhood-scale sustainability. Evidence of this external outreach was documented in both the President's Messages posted by Michael Geller from 1999-2006, as well as the meeting minutes of the Trust's Board of Directors. Typically, presentations or tours were given by Geller or the development manager at the time, and today Mikkelsen and current-CEO Gordon Harris continue these efforts. Such outreach efforts reinforce the idea of UniverCity as a model of neighbourhood sustainability, contributing to the imaginary element of the institutional framework within which UniverCity's development and BMDES implementation took place.

This imaginary element of UniverCity as a model of sustainability is intricately tied to the Trust's cognitive and cultural belief that sustainability and profitability are not mutually exclusive goals. This belief can be traced back as far as 2000, in the Design Charrette brief which explained that "the BMCC and [SFU] Board of Governors are of the opinion that a profitable project and a sustainable project are mutually supportive goals" (Condon et al., 2000). This cultural belief, however, is self-reinforced through the initiatives that the Trust selectively pursues. Mikkelsen explained the Board of Directors' general criteria for approving development initiatives as "check[ing] two boxes: promotes

sustainability and makes financial sense" (2015), and Mark Roseland, board member of the Trust, confirmed the Board's attitude to sustainability initiatives:

> As long as [the Trust staff are] coming to us with [sustainability initiatives] that make business sense, [the Board will] go as far as we can go… the Board is quite supportive of these things…if we're not losing money then go ahead and do it, that's [our] attitude. (Roseland, 2015).

Since the Trust actively maintains the vision of UniverCity as an acclaimed model sustainable neighbourhood as well as the cultural belief that sustainable development can be profitable, a supportive policy environment for large-scale, capital-intensive initiatives like DE is created. If governance actors can rationalize DE economically and can cast DE as fitting within the image of a model sustainable neighbourhood, then the project would be pursued, as was done in this case. The CDEA, in describing the leadership barrier, lamented that "if DE is unable to develop a message that is capable of inspiring leaders, it will be unable to gain the momentum it needs to experience significant growth into the future" (CDEA, 2011, p. 25). However, what if, in the name of promoting the growth of the DE industry, the source of inspiration for leaders should not focus on DE technology itself, but on the ideals of neighbourhood-scale models of sustainability and how DE might contribute to them? I discuss this idea further in Section 6.2.2.

Next I discuss the regulative aspect of the institutional framework surrounding UniverCity that contributed to the removal of the leadership barrier to DE implementation.

5.3. The regulative framework – a different approach to community energy planning and development

Lastly, I explore the regulative elements of this governance network and the Trust's role in shaping them. To reiterate from Section 2.3.2, the regulative aspect of governance networks are the set of 'rules, roles and procedures' (Marcussen & Torfing, 2003, p. 10) that guide network negotiations. For the development of UniverCity, the Trust shaped the regulative element in two areas. First, they altered the development

process by negotiating a comprehensive development zoning approval with Burnaby, inserting the Trust in the role of the planning and development authority over the UniverCity site. Secondly, the Trust established rules within the governance network by creating community plans and development policies which they have ultimate control over.

As I described in Section 4.2.1, the typical development procedure in the City of Burnaby was established as the Preliminary Permit Approval (PPA) and the Building Permit (BP) process through the Planning Department prior to the development of UniverCity. Through negotiations with Burnaby for a comprehensive development zoning approval, a new procedure was set up in which the Trust vetted all development proposals using their own set of guidelines and requirements before proposals could go to Burnaby for approval. This was an important innovation in the governance of sustainable development. Although this added an additional layer of authority to the development process, the market actors in the governance network did not feel negative effects in the form of longer approval timelines which equate to lower profits, as I explained in Section 4.2.1.1. By the Trust's own estimates, this initiative saves developers at least 6 months of time that they would otherwise have to spend in the municipal zoning approval process (CMUS, 2011). The developer interviewed for this research confirmed that based on their experience, the involvement of the Trust did not add time to the development process (Developer, 2015).

At first, this may appear to be a counterintuitive outcome. How can the Trust insert themselves as an extra level of authority in the development process and add new guidelines and requirements beyond the typical development in Burnaby, while saving time for the developers? A full answer to this question cannot be provided here, but research interviewees attributed the time savings to the amount of effort the Trust expended on negotiating the comprehensive development zoning with Burnaby, setting up the development guidelines, and helping developers understand and achieve these guidelines (Developer, 2015; Yip, 2015) throughout the planning and development process. This demonstrated how the Trust shaped the regulative institutional framework in a direction which privileged market actors, and this strategy is rooted in their cognitive believe that sustainability and profitability can be mutually satisfied, as I've described in

Section 5.2. The question of whether this is justifiable is cannot be addressed here, but in this case this strategy at least helped to create a more supportive environment for various sustainable development initiatives and for DE. Perhaps current research on governance for sustainability, which I explained in Section 2.3, can benefit from more analytical focus on whether regulative frameworks that are aligned to on market incentives can more effectively contribute to delivering greater numbers of urban sustainability projects.

The second way through which the Trust shaped the governance network around UniverCity was in the form of creating the rules of the development around sustainability. In the 2002 version of Development Guidelines created for Phases 1 and 2, the Trust began to promote the use of green building and energy-efficiency standards and practices. While these guidelines were the responsibility of the Trust to create and maintain, they were not created in isolation by the Trust and were the result of negotiations through the governance network. From the documents analyzed, it was clear that the Trust sought advice and input from a variety of sources, such as the City of Burnaby, planning and sustainability consultants, energy experts, and a PhD researcher. Market developers were also consulted through three workshops hosted by the Trust. These were held first in 2001 during the development of Phase 1 and 2 guidelines, and then in 2007 for Phase 3 and 4 guidelines and requirements (BMCC, 2001b; SFU Community Trust, 2007b), and most recently in 2014 after the implementation of the BMDES (Mikkelsen, 2015; Hepting, 2015; Developer, 2015).

In creating the Development Guidelines and Requirements, the Trust drew together what can be called an 'advocacy coalition', which to an extent is analogous to the concept of governance network in that they consist of state actors at various levels of government as well as non-state actors such as journalists, researchers, policy analysts, etc. (Sabatier, 1988, as cited in Bennett & Howlett, 1992). Policy scholars such as Bennett and Howlett (1992) might identify these changes in the regulative framework surrounding UniverCity as outcomes of policy learning. An area of future research can be to examine in detail the policy learning processes that the advocacy coalition around the development of UniverCity went through, and to trace the influence of lessons drawn from development processes and policies from other places and to understand to what

extent these lessons were adapted to suit the UniverCity context.[27] An acknowledged issue with studying policy learning and transfer is that "we may only know that learning is taking place because policy change is taking place" (Bennett & Howlett, 1992, p. 290). It is difficult to test for whether policies changed only because learning took place and not due to other influences (Bennett & Howlett, 1992) such as selection pressures as I described in Section 4.4. Policy learning, however, is a form of regime adaptive response to external selection pressures, as I discussed in Section 4.4. In this case, it can be conjectured that policy learning partially accounted for some of the success in overcoming the knowledge and leadership barriers to the implementation of the BMDES, but the extent to which policy learning occurred warrants further investigation.

Together, these two aspects of the regulative framework which the Trust shaped around the development of UniverCity contributed to the reduction of the leadership barrier to DE implementation. The development guidelines which the Trust set up in the beginning for general green building and sustainability practices was the policy instrument through which later requirements facilitating the BMDES was made clear to the market. The Trust was able to mandate that building heating systems for Phases 3 and 4 must be compatible to DE, and in 2012 when the BMDES system became operational, the Trust updated the requirements to mandate connection to the system. This reduced the economic risk of uncertain customer base. Furthermore, the Trust having set up a process which made DE and other sustainable development initiatives acceptable to the market was a removal of the leadership barrier.

5.4. Leadership in summary

In this chapter I have explored the key elements of the 'leadership' barrier that were overcome through the work of the Trust in shaping the institution frameworks in its governance network for the development of UniverCity, even prior to the introduction of

[27] Research participants noted that some inspiration for the Trust's energy requirements came from unspecified 'European' codes (Mikkelsen, 2015) and from Santa Monica, California (Geller, 2015). A detailed examination of these policy influences and their adaptation at UniverCity may be of interest to scholars seeking to study policy learning and transfer.

a DE system. This highlighted how sustainability initiatives such as DE are enabled through leadership actions that did not necessarily originate with a specific issue focus on energy. The Trust does not explicitly reference community energy planning principles, but has focused on demonstrating model neighbourhood-scale sustainability which set the stage for DE implementation. In Section 5.2 I showed that the 1996 rationale for the UniverCity development was set around gaining local and international acclaim and increasing the university's endowment fund. It was around 1999-2000 that the normative framework around sustainable development was introduced as a means to achieve such acclaim. Over time, the Trust actively changed the normative, cognitive, regulative and imaginary aspects of the institutional framework surrounding the development of UniverCity, which made DE implementation not only economically feasible and acceptable but even desirable as part of its drive for model sustainability. Some barriers were lowered in part due to selection pressures from areas outside of the Trusts' realm of control, such as the global shift in climate change awareness and the Province of BC's focus on GHG reductions. I described in these pressures in Section 4.4 in the context of socio-technical regime change. What the Trust demonstrated was an adaptive response to these selection pressures, which created a more supportive environment for DE implementation.

While the CDEA's definition of the leadership barrier is a lack of thought-leaders and project champions, there is more to leadership than simply having a thought-leader or project champion in place, as my research has shown. The project champion or thought-leader must also be situated within a governance network whose regulative, normative, imaginary and cognitive frameworks are open to change, and also he or she must be in a position where they can enact further change. While the project champion for this project, Dale Mikkelsen, is largely credited with the implementation of BMDES as I described in Section 4.3.3, he only came into the picture in 2006. Since 1999, various actors within the governance network had been involved in setting up and managing the institutional frameworks surrounding UniverCity's development around sustainability ideals as I described in Chapter 5. Only in 2008, when the idea of DE as a feature associated with model neighbourhood-scale sustainability began to take hold in the local region alongside changes at the global and provincial level, and at the same time the development opportunity for Phases 3 and 4 materialized, was DE pursued for

UniverCity. The project champion was able to recognize the opportunity for action offered through the existing institutional framework and to leverage them for DE implementation, but cannot be fully credited for overcoming the leadership barrier.

Timing, of course, has been an important factor to the success of DE implementation in this project, and will also be a factor in all sustainability governance projects. While scholars studying large-scale change towards greater sustainability cannot focus on 'time' alone as an enabler or barrier to change, they concentrate on studying policy and governance levers which would speed up these sustainability shifts.[28] The development of UniverCity and the BMDES are indeed examples of policy levers and governance arrangements that help shift towards a more sustainable future, but their overall impact on building up greater selection pressure towards broader change towards urban sustainability can be further examined.

Finally, I acknowledge that it is impossible to prove that the Trust's involvement in shaping the governance network around the development of UniverCity was the only driver for the implementation of the Burnaby Mountain District Energy System. However, it is unlikely that the DE system would have been eventually realized through solely leadership from the City of Burnaby. As I've shown in Section 1.3.3, Burnaby still does not demonstrate any significant commitment to GHG reduction from community sources. Instead, Burnaby looks to UniverCity as a leading example of sustainable development, and have gone as far as authorizing a pre-feasibility study for DE in one of its regional town centres at Metrotown. This study was approved by Council in late 2011, but as of 2015 the results of the pre-feasibility study have not been released and it is unclear how Burnaby intends to move forward on this issue. Broadly speaking, the existence of UniverCity may even be viewed as a hindrance to advancing urban sustainability in Burnaby. It is an example of model neighborhood sustainability that Burnaby can easily point to, instead of being motivated to develop policies to address urban sustainability issues in the city. While my research does not investigate this, future research should

[28] For example, refer to Smith et al., (2005), Smith (2007), van Zeijl-Rozema et al. (2008), and Verbong & Geels (2007).

scrutinize the degree to which model sustainable neighbourhoods advance or hinder the development of urban sustainability policies within their host cities.

Chapter 6.

Conclusion and further research

6.1. Answering the research question

This thesis research sought to answer the question: *what barriers were faced in the implementation of the Burnaby Mountain District Energy System, and what was the role of the SFU Community Trust in overcoming these barriers?* In the preceding chapters, I have laid out the barriers that were experienced by the Trust and built upon the framework of barriers that the Canadian District Energy Association has identified as facing DE implementation across Canada. I have also considered the dynamic interactions of barriers posed to the BMDES. I used ideas from governance and institutional studies to understand the role of the Trust in shaping the institutional framework surrounding the development of UniverCity that enabled the eventual implementation of a DE system. I have identified the barriers that were reduced or overcome not solely by the initiative of the Trust, but were results of the Trust's adaptive response to external selection pressures. In doing so I have added to the CDEA's definition of the leadership barrier. I have also found that although governance for sustainability requires greater partnership between the public and private sector, in the implementation process challenges arise when public and private financial interests are mixed. Finally, I found that although in this case the Trust added an additional layer of authority to the governance network, they did so in a way that did not negatively impact market actors; this helped make sustainability initiatives and DE more acceptable to the market.

First, the contribution I bring to the CDEA definition of leader is that there is more to leadership than simply having more thought-leaders or project champions for DE. The project champion must also be situated within a governance network whose regulative,

normative, imaginary and cognitive frameworks are open to change, and also he or she must be in a position where they can enact further change. As I described in Section 5.4, although the Trust had a project champion in Dale Mikkelsen, he only came into the picture in 2006. Since 1999, various actors within the governance network had been involved in setting up and managing the institutional framework surrounding UniverCity's development to promote sustainability. In 2008, DE was pursued for UniverCity only after the idea of DE as a feature associated with model neighbourhood-scale sustainability began to take hold in the local region alongside changes at the global and provincial level, and at the same time the development opportunity for Phases 3 and 4 materialized. The project champion was able to recognize the opportunity for action offered through the existing institutional framework and to leverage them for DE implementation but cannot be fully credited for overcoming the leadership barrier.

Secondly, the 'funny accounting' contextual barrier I described in Section 4.3.4.3 which is still holding back the implementation of a joint low-carbon heating plant between SFU Burnaby campus and UniverCity actually reveals a contradiction in the realities of governance arrangements for sustainability-related outcomes. Governance of sustainable development seeks the collaboration of state and non-state actors, and public-private partnerships (P3s) are the contractual formalization of such relationships. In this case, the contextual barrier is an inconsistency between the Province being willing to support this P3 governance initiative through their PSECA funding contribution, but not having adapted their institutional rules and processes to facilitate the partnership. This demonstrated the need for "institutional, i.e. governance reform" (Griffin, 2010, p. 366) in governance attempts at sustainable development in BC today.

Finally, in section 5.3, I discussed the counterintuitive outcome of the Trust inserting themselves as an extra level of authority in the development process and add new guidelines and requirements beyond the typical development in Burnaby, while reducing any negative impacts on the market actors in the form of extended processing time. This demonstrated how the Trust shaped the regulative institutional framework in a direction to privilege the market actors, which in turn created a more supportive environment for the Trust's various sustainable development initiatives and DE implementation.

6.2. Suggestions for further research

The research presented in this thesis is a contribution to the understanding of district energy as one of a number of available sustainability policy options for reducing GHGs from the urban built environment. This issue of urban sustainability is becoming increasingly important in planning for our urbanizing society and district energy systems are thought to present significant potential to improving the environmental sustainability of our built environment. However, its contributions to environmental sustainability in the BC context is still to be determined, and the social sustainability outcomes are neither well-understood nor well-explored. In the following sections, I provide the context for a number of outstanding issues with district energy viewed with an integrative sustainability perspective. This topic is vastly interesting and I strongly encourage policymakers, planners, developers, and urbanists to thoughtfully and critically engage with district energy, not as the sole option, but as one of many solutions available in a toolkit of policies aimed at shifting our cities in more sustainable directions.

6.2.1. Notions of sustainable development

In Section 5.1, I discussed the normative framework that the Trust has shaped through their 'sustainability cornerstones'. Now I turn to a discussion of its broader implications, in context with the Trust's cognitive stance that "a profitable project and a sustainable project are mutually supportive goals" (Condon et al., 2000). Perhaps an appropriate explanation can be synthesized from the current literature on the conceptualizations of sustainable development and the policy approaches associated with each conceptualization, and I will discuss how the Trust's view of sustainability may have contributed to the success of DE implementation.

Researchers and commentators on sustainable development describe a continuum between 'weak' and 'strong' sustainability when interpreting the definition of sustainable development. Social theorists base this continuum upon two separate worldviews founded on the perception of the interactions between humans and the natural environment (Williams & Millington, 2004; Rees, 1995; Jordan, 2008; Jepson, 2001; Sussman; 2012); the 'expansionist', or 'weak sustainability' worldview, and the

‘ecological’, or ‘strong sustainability’, worldviews. The expansionist view upholds humanity as having the right of dominion over the natural world, where “nature is valued mainly as a source of resource and a sink for wastes” (Rees, 1995, p. 345) for the purposes of human development. By contrast, the ecological worldview sees humanity as indebted to the natural world and completely constrained by its resources, and nature is understood to have an intrinsic value of its own regardless of its benefits to humankind (Rees, 1995; Williams & Millington, 2004). In the context of sustainable development, the expansionist worldview holds that the goals of both human development and natural preservation can be satisfied simultaneously because human technology will bring forth solutions for more efficient use of natural resources or perfect substitutes for natural resources. On the other hand, the ecological worldview holds that sustainable development requires a fundamental shift in human behavior, values, and attitudes that define our understanding of human development, in order to sustain the natural world (Williams & Millington, 2004) on which we are completely dependent for our survival.

Applied to urban development, these foundational interpretations of sustainability lead to three distinct policy approaches that can be generalized as status-quo, reform, or transformative approaches (Lombardi et al., 2011; Rees, 1995), on a continuum from weak to strong sustainability. The status quo approach emphasizes technological fixes that require minor or no changes to current lifestyles, and is implicitly optimistic about our ability to problem-solve our way out of environmental constraints. The reform approach seeks fundamental changes to human values and behavior but without major changes to existing social structures. The transformative approach asks for a deep examination of the existing socio-economic and power structures and strives for a radical transformation of both systems (Lombardi et al., 2011).

In her dissertation research on Southeast False Creek in Vancouver, a model sustainable neighbourhood development of a similar physical and temporal scale to UniverCity, Sussman found that the City of Vancouver, who led the planning and development of this neighbourhood, took a status quo and borderline reform approach to sustainability (2012). She states that ‘rather than being a breakthrough response to global ecological change, [Southeast False Creek] was planned as an incremental improvement over existing local models of development.” (Sussman, 2012, p. ii). She

criticized the planning process of this neighbourhood as ineffective in addressing the ecological concerns of greenhouse gas emissions from the urban environment and concluded that a transformative shift was too much change to ask for at the time. While she found evidence of attempts at transformative approaches to sustainable development in the early planning stages of the neighbourhood, ultimately "the transformative perspective of sustainability…was simply too far to shift in one project, in the contexts of Vancouver planning and politics, and North American experience with sustainable urban planning in the late 1990s and 2000s" (Sussman, 2012, p. 299). While my research has not examined UniverCity's development through the same lens of weak and strong sustainability and affiliated policy approaches, perhaps some of the same conclusions may be made about energy planning at UniverCity and the Trust's approach to sustainable development.

Throughout the history of UniverCity, the Trust has attempted to influence both the demand and supply side of community energy planning, first by creating a walkable urban form and requiring building energy performance standards, and later by implementing a district energy system with the intention of switching to a low-carbon fuel source. Such actions indicate a reliance on technological solutions and not a focus on significant lifestyle changes, and are emblematic of the status quo/reform approach (Lombardi et al., 2011);

In a parallel literature from policy studies of technological and institutional system change, the status quo/reform approach taken at UniverCity is what Unruh (2002) would label the 'continuity' approach. This approach envisions change being made to work within the limits of an existing system, where change is targeted at 'offending' subcomponents of the system at an incremental pace, in order to maintain continuity, "as much similarity as possible between existing system and new configuration" (Unruh, 2002, p. 318). In the UniverCity case, the pace of change of energy performance standards was incremental (Mikkelsen, 2015; Geller, 2015) and within the confines of existing market development mechanisms; interviewees attested to their desire to not jeopardize the market success of the neighbourhood with too many sustainability demands (Mikkelsen, 2015; Geller, 2015; Roseland, 2015). The implementation of the DE system is a replacement of a subcomponent of the urban energy system. From the

perspective of DE implementation, could this continuity strategy, based on the Trust's conception of sustainable development which is closer to the 'weak sustainability' end of the spectrum, be considered an enabler to district energy? Could this success in district energy implementation be attributed to the fact that the Trust worked largely in making changes to the governance network and institutional frameworks of UniverCity's development to allow for incremental technological changes in the energy system, and not through targeting lifestyle and behavior changes relating to energy consumption? Based on the Trust's current mandate and conception of sustainable development, is there room for more drastic changes advocated by a transformative approach? In Section 6.2.5 I further discuss the question of behavior changes in energy consumption and encourage further research in this direction.

In the meantime, perhaps this incremental, status quo/reform approach based on a weaker conception of sustainability is still the only currently acceptable one, as Sussman suggested for Vancouver's Southeast False Creek (2012). My research has not revealed any particular transformative approaches to energy consumption pursued by the SFU Community Trust for UniverCity. Jordan, in reference to the Brundtland Report's definition of sustainable development[29], points to its "intuitively appealing message" (Jordan, 2008, p. 17) in the possibility of having both economic prosperity and environmental protection as the reason for its worldwide popularity and ability to spark international debate and an academic research agenda (Jordan, 2008). Perhaps what may be said is that the Trust's implementation of the 'weaker' sustainable development agenda, based on their cognitive view of the compatibility between economic gains and environmental protection and exemplified by their reliance on technological improvement, is the only way any sustainability features, including district energy, could have been realized at this time. Further research comparing the environmental outcomes associated with different approaches to sustainable neighbourhood planning could provide insight into how or whether perceptions of sustainable development manifest in different environmental outcomes.

[29] The Brundtland report's definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meeting their own needs" (WCED, 1987) is the most commonly stated definition of sustainable development (Lombardi et al., 2011).

6.2.2. District energy and the ideal of model sustainable neighbourhoods

In Section 5.2, I've shown how the ideal of a model neighbourhood-scale sustainability has enabled the acceptance of DE technology to the governance network surrounding the development of UniverCity. However, the origins of 'model neighbourhood sustainability' in planning and a more precise understanding of its impact on this case study cannot be adequately explored within the scope of this research. While there has been a rise in the level of interest in district energy within new model sustainable neighbourhood developments in British Columbia[30], just how much district energy is becoming part and parcel of the package of amenities that model sustainable neighbourhoods provide needs further research.

There is potential that literature from mimetics, or a study of memes, could inform such future research. Memes in the social sciences are analogous to genes in the biological sciences. Memes are thought of as cultural units of information that are reproduced by various human agents over time and space but can evolve with each reproduction, akin to genetic expression and evolution (John, 2003). In the context of sustainability governance and urban development, it might be useful to consider how and whether imaginaries or shared visions of model neighbourhood-scale sustainability act as memes in planning, and how district energy fits into such ideas of sustainability. For an organization like the CDEA who is interested in inspiring leaders of the importance of DE, it would be fruitful to delve into a study of mimetics and how that might help shape the imaginary element of institutional frameworks in urban development governance networks to make DE more 'inspiring'.

In the broader picture of sustainable urban development, mimetics might also offer greater insight into how district energy is being included in international examples of model sustainable neighbourhood and how such planning ideas are reproduced and changed across diverse social, cultural and political contexts. Holden et al. (2015) point

[30] Recent example of model sustainable neighbourhoods in BC include Vancouver's' Southeast False Creek and River District, Victoria's Dockside Green, and Whistler's Cheakamus Crossing Athlete's Village. All are new neighbourhoods that feature district energy systems as part of a package of sustainability amenities.

to the global proliferation neighbourhood-scale planning projects with integrated sustainability goals, and many of these neighbourhoods have district energy strategies. The idea that district energy is a key utility or amenity to be included in such neighbourhoods should be further investigated.

6.2.3. Accountability in community energy planning

In considering the Trust's work in district energy implementation, the subject of accountability must be addressed. Although the Trust created, maintained and administered the additional approvals process associated with their Development Guidelines and Requirements, actual GHG reductions resulting from these guidelines are unknown. No verification of the neighbourhood's environmental performance has been found; this corroborates with a dearth of post-occupancy review done to determine the effectiveness of such planning guidelines and policies in terms of real GHG reductions (Sussman, 2012; Hendrickson & Roseland, 2010). Sussman's analysis on Vancouver's Southeast False Creek neighbourhood concluded that the published policies and standards for this neighbourhood would yield approximately 8% per capita GHG reductions compared to the Vancouver average (Sussman, 2012), but no quantitative performance review has been done since the occupancy of the neighbourhood. Similar research for UniverCity has not been done, and in the course of this research, adherence to the Trust's Design Guidelines and Requirements could not be determined, and so the potential for the dilution of environmental performance requirements is unknown.

While the Trust commissions a residential survey every two or three years to gauge resident satisfaction and to solicit suggestions for future community amenities (Mustel Group Market Research, 2014), no verification has been done from an environmental performance perspective. In light of the fact that the Trust has yet to set up a specific energy or GHG reductions goal, what is the true environmental performance of the neighbourhood from this standpoint? Additional research into the actual performance of UniverCity and other model sustainable neighbourhoods would fill a gap in the critical evaluation of the outcomes of sustainable urban developments.

6.2.4. Potential conflicts with other energy policies and the lock-in effects of district energy technology

While the future is always uncertain and it is important to act based on the precautionary principle[31] against the urgency of the current climate crisis, there is also a need to examine how district energy technology fits with other climate action policies towards lower energy consumption from the built environment. Several of the newer strategies available today are Passive House, net-zero and even net-positive buildings. Passive House is a low-energy design and construction standard that originated in Europe in the 1990s which dictates annual energy usage of 80-90% below typical construction in Canada (CANPHI, 2012). Net-zero and net-positive buildings are buildings that have no net energy usage, as the buildings' on-site or nearby renewable energy systems are expected to supply an equivalent (in net-zero buildings) or an excess of energy (in net-positive buildings) compared to the amount of energy consumed by the building, leading to no net-CO2 emissions in the operation of the building (Frappé-Seneclauze & Kniewasser, 2015; Roberts & Melton, 2015).

The European Union in 2010 introduced the European Commission's Energy Performance of Buildings Directive for member nations to set national targets for 'nearly net-zero energy buildings' by 2020 (EPBD, 2014). While it is a vague directive and leaves the definitely of 'nearly net-zero' up to member states, this directive does put the concept of a net-zero buildings on the international climate action agenda. Closer to home, BC's current interest in net-zero buildings can be traced to its 2013 non-binding agreement with the Pacific Coast Collaborative. This agreement listed a number of shared goals for carbon reduction and a clean energy economy between the American states of California, Oregon, Washington and the province of BC (Frappé-Séneclauze & Kniewasser, 2015). Among these initiatives is a commitment to "transform the market for energy efficiency and lead the way to 'net-zero' buildings" (Pacific Coast Collaborative, 2013, p. 1). Furthermore, the City of Vancouver in June 2015 updated their green building policy for rezoning to include a Passive House standard as a compliance option.

[31] The precautionary principle advocates that even in the absence of direct evidence of harms created by human action, we should still take steps towards reducing the harms associated with such actions (UNESCO, 1995), or in layman's terms, "better safe than sorry".

This rezoning policy has been part of Vancouver's strategy to reduce GHG emissions from the built environment since its creation in 2010 (City of Vancouver, 2015). This recent policy update boosts the legitimacy and profile of the Passive House standard as a building design and construction strategy in the region.

With the current push towards ever lower energy consumption in buildings, how does a utility such as DE, whose infrastructure is long-lived and incurred significant capital investments, fit? The business case for DE implementation and operation is dependent on a specified energy load which must be stable over the life of the utility, typically at least 50 years. Will the motivation to keep DE systems profitable over time introduce a bias to maintain certain energy loads in connected buildings, reducing the motivation for Passive, low-energy or net-zero energy buildings? The Pembina Institute, in studying the policy pathway to net-zero buildings in BC, recommends the adoption of net-zero requirements to in the buildings code within the next 10-15 years (Frappé-Séneclauze & Kniewasser, 2015). While this recommendation is based on their most accelerated projections of policy implementation and actual implementation will likely take longer, it is still possible that such policies will become the norm in the next 20-50 years. What is the potential that current commitments to DE policy would impede future, more aggressive energy-efficiency requirements in new buildings?

The use of DE, in this view, may be considered an example of technological and institutional lock-in. In his studies of carbon techno-institutional lock-in, Unruh (2000) points to the institutional conditions that lead to carbon-emitting technologies being perpetuated or 'locked-in' despite having known negative outcomes and the availability of alternatives. Unruh describes technology not as a standalone artefact but as embedded within the institutions and markets that use them, and considers techno-institutional lock-in as a state where systemic forces make it difficult to switch from existing technologies, creating market and policy barriers to alternatives. In Section 6.2.1 I describe DE technology as a continuity approach in the literature on techno-institutional lock-in. Unruh points out that while continuity strategies reduce the short-term costs of change and thus are more popular with policymakers, there are ultimately long-term performance trade-offs and often future "system-wide performance must be sacrificed for the sake of backward compatibility" (Unruh, 2002, p. 319). As a policy option, could DE

mean future ‘backwards compatibility’, if it can hinder future aggressive energy-efficiency building policies because of the sunk investments in DE systems? These ideas warrants further investigation to understand the longer term lock-in impacts of committing to DE systems for new buildings and neighbourhoods.

6.2.5. Lack of feedback to the energy consumer

Although the BMDES is a success story in overcoming barriers to district energy implementation, it cannot claim to have significant influence on residents’ behavioral changes in energy consumption. The DE system at UniverCity is designed only to meter the amount of thermal energy used by the entire connected building, and not by individual units (or sub-metering). In this set-up, buildings receive a single monthly utility bill which is typically divided between residents based on a unit’s floor area compared to the overall size of the building. This does not provide consumers with the information or feedback needed in order to change their energy-use behavior, since they do not see any direct cost reductions from their individual efforts.

In fact, residents may even be disincentivized from conserving energy in such situations. Hendrickson & Roseland (2010) describe a phenomenon that occurs in residential buildings in Vancouver where suites are provided with natural gas fire places for heating but residents are billed on natural gas usage as an entire building. They note that because “it is cheaper for a developer to install a single-monitor gas fireplace system than provide individual monitoring inserts….Households ultimately keep fireplaces lit out of self-interest because they view the heat as a shared but limited resource. No incentive or penalty for turning off the fireplace results in overuse and waste as the ‘tragedy of the commons’ gets played out in living rooms across the region” (Hendrickson & Roseland, 2010, p. 20). Likely the same mentality could apply to residents who are connected to the DE system but do not pay for individual usage, resulting in similar outcomes of energy overuse instead of reduction.

In the absence of direct feedback and incentives for conservation, or any other behavioral change programs implemented at the building or neighbourhood level, the amount of energy saved through connection to a higher-efficiency district heating system

could be negated by the behavioral effects of energy consumption. Future research should target the design, implementation and outcomes of energy conservation behavior change programs for buildings connected to district energy systems, or compare the effectiveness of suite-level metering policies against behavioral change campaigns in the affecting actual net energy savings from the buildings.

6.2.6. Low-carbon energy policies and affordability

Finally, future research should assess the impact of low-carbon district energy systems on urban housing affordability. DE systems are commonly being implemented as a feature in new model sustainable neighbourhoods which boast of higher quality public amenities, better transportation access and generally more energy-efficient buildings. These 'sustainable' neighbourhoods tend to be highly sought-after which typically means higher housing prices, since the array of amenities offered in these neighbourhood has the effect of commodifying the neighbourhoods (Dale & Newman, 2009). This effect is keenly felt in urban centres where a majority of sustainable neighbourhood development projects occur, and these urban centres are where affordability issues are already a significant concern (Dale & Newman, 2009). Such sustainable neighbourhoods may even be in danger of becoming "premium ecological enclaves" whose benefits, in terms of higher quality of living and access to green space, are not equitably distributed across all sectors of society but only available to those who can afford it (Hodson & Marvin, 2010).

The City of Vancouver has conducted preliminary research comparing the costs of low-carbon district energy systems around the Lower Mainland, showing that these systems in general cost more than a conventional natural gas heating system, and is roughly equivalent in cost to electric heating (City of Vancouver, 2014). Proponents of district energy claim that DE systems provide an additional level of thermal comfort and reduce long-term maintenance costs, but additional research should be conducted to quantify such claims. Since the ultimate costs of low-carbon urban energy policies are passed through to the energy consumer, more research should be conducted using a clear sustainability framework to evaluate these impacts on overall affordability.

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Appendix A: Qualitative Interview Guide

The following questions form a guide for the qualitative interviews conducted for this research project. The interviews were semi-structured, thus the questions below were not asked verbatim but were touched upon in each discussion.

1. What is your role in the development of the UniverCity neighbourhood and the Burnaby Mountain district energy system? What other similar projects in the region have you been involved in?
2. What were key features of this project that differed from other neighbourhood development practices at the time?
3. Why was district energy or other sustainability goals targeted for this neighbourhood development?
4. What were the key enablers and barriers to the implementation of this district energy project? Were there any aspects of district energy implementation that were considered but were not carried through and why?
5. Who were the actors (individuals or organizations) involved with these key enablers or barriers and how were the project outcomes shape by these enablers or barriers?
6. What was the role of the SFU Community Trust in this development and what particular outcomes of the project could be attributed to the Trust?
7. Is there something unique about this neighbourhood and district energy development when compared to other projects in your opinion?
8. Is there something unique about the Trust that helped facilitate the development of this district energy project?
9. Is there anything else you think might be relevant to my research interests in district energy implementation in the Lower Mainland?

Appendix B: List of awards received by UniverCity

Source: UniverCity. (2015). Awards and Recognitions. Retrieved from http://univercity.ca/overview/awards-and-recognition/

Awards specific to community planning and sustainability

1. 2012 Planning Institute of British Columbia - Award of Excellence: Planning Practice, City & Urban Areas
2. 2011 Canadian Institute of Planners - Award for Planning Excellence: Neighbourhood Planning
3. 2011 Federation of Canadian Municipalities -Sustainable Communities Award for Integrated Neighbourhood Development
4. 2009 Urban Land Institute - Award for Excellence: The Americas for Best Practice in Design, Architecture and Development
5. 2008 LivCom Awards - Gold Award and third place-ranking overall in the Sustainable Projects Category
6. 2008 American Planning Association - National Excellence Award for Innovation in Green Community Planning
7. 2007 Urban Development Institute - Award for Innovations in Creating a More Livable & Sustainable Region
8. 2007 City of Burnaby - Environment Award for Planning and Development
9. 2006 Planning Institute of British Columbia - Award of Excellence for Site Planning and Design
10. 2005 Canadian Home Builders' Association - SAM Award for Best Community Development in Canada

Awards specific to energy planning

11. 2013 QUEST Community Energy Builder Award - Quality Urban Energy System of Tomorrow

Awards specific to buildings:

12. 2013 Canadian Green Building Award - UniverCity Childcare Centre
13. 2013 Canadian Society Landscape Architects Award - Award of Excellence: UniverCity Childcare Centre

14. 2013 CaGBC National Leadership Awards – Green Building Champion Award, UniverCity Childcare Centre
15. 2013 Great Vancouver Home Builders' Association Ovation Award - Best Multi-Family Lowrise Development: Origin
16. 2013 FortisBC Award for Excellence - Excellence in Energy Efficiency in New Construction: Origin
17. 2012 Vancouver Regional Construction Association Award of Excellence - Silver Award: UniverCity Childcare Centre
18. 2012 City of Burnaby Environment Award - Planning and Development: UniverCity Childcare Centre
19. 2012 Urban Development Institute Award of Excellence - Most Sustainable: UniverCity Childcare Centre
20. 2012 Vancouver Regional Construction Association - Silver Award of Excellence, Sustainable Construction: UniverCity Childcare Centre
21. 2012 City of Burnaby - Environment Award: Planning and Development for the UniverCity Childcare Centre
22. 2008 CMHC - Best Practices in Affordable Housing Award for the Verdant @ UniverCity
23. 2008 City of Burnaby - Environment Award for Planning and Development for the Verdant @ UniverCity
24. 2007 Urban Development Institute - Award to the Verdant @ UniverCity for Innovations in Creating More Sustainable Development
25. 2007 Urban Development Institute - Award to the Verdant @ UniverCity for Innovations in Creating More Affordable Housing
26. 2005 Canadian Home Builders' Association - Georgie Award to The Cornerstone for Best Environmental Consideration and Energy Efficiency
27. 2005 City of Burnaby - Environment Award for Planning and Development for The Cornerstone
28. 2005 Urban Development Institute - Award for Excellence in Urban Development for the Cornerstone
29. 2005 BC Hydro Power Smart Excellence Award - Residential Building Developer for The Cornerstone

Other awards:

30. 2005 Association of University Real Estate Officials (AUREO) - Award of Excellence

31. 2005 Burnaby Board of Trade - Newsmaker of the Year Award