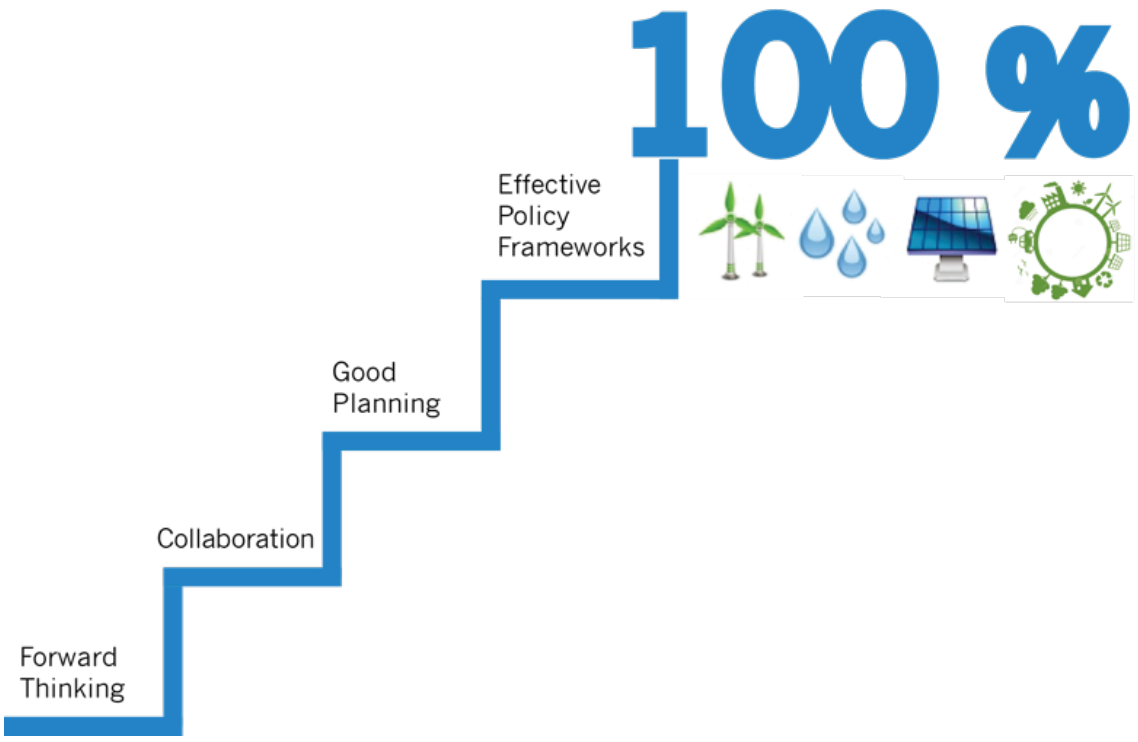
Closing the Planning Gap: Towards 100% Renewable Energy Communities



environmental studies | YORK UNIVERSITY

Kathy Mirzaei
Fall 2015

Closing the Planning Gap: Towards 100% Renewable Energy Communities

Kathy Mirzaei
November 30, 2015

A Major Paper Submitted to the Faculty of Environmental Studies in Partial fulfillment of the requirements for the degree of Master in Environmental Studies

York University
Toronto, Ontario, Canada

Student Signature	**Supervisor Signature**
_____	_____
Kathy Mirzaei	**Jose Etcheverry**

I. Acknowledgments

This paper is the result of a collaborative effort. The completion of this paper would not have been possible without the support of the great individuals who have held my hand to walk on this path. First, I would like to recognize my supervisor, José Etcheverry, who has inspired me from the first day I have met him at the orientation session for the Master's Program in the Faculty of Environmental Studies, York University. His passion about making a difference and changing the world to be a better place, through innovative breakthroughs in the field of RE has inspired and shed light on the path I wanted to take. His constant encouragement and guidance has been formative in my progression.

In addition, I would like to acknowledge Professor Laura Taylor, for her constant support in not only the academic aspect of my work, but also on the personal side as well. She is a true role model at the faculty and I am grateful for all her help. I would also like to recognize Professor Justin Pudor, my advisor, who has guided me every step of the way to continue my education. I would like to thank other York University members; Barbara Crow; dean of faculty of Graduate Studies, Noël Sturgeon; Dean of Faculty of Environmental Studies, and Leesa Fawcett; Associate Professor & Associate Dean Students. These individuals have gone above and beyond their duties to support my decision in pursuing my studies at the Faculty of Environmental Studies, York University.

Thank you to Peter Robinson, Dale Littlejohn and the wonderful team of Community Energy Association of British Columbia for having me as their student intern from May to October 2015. In particular, I would like to thank Peter Robinson, without whom this learning process would not have been so rewarding. His encouragement and feedback throughout the duration of my volunteer work with the association is very much so appreciated. Also, thank you, Lily Riahi, for selecting me as part of the research team during the development of the United Nations Environmental Program publication "District Energy in Cities: Unlocking the Full Potential of Energy Efficiency and RE".

I would also like to thank Robert Thornton, Brad Bradford and the wonderful people from the International District Energy Association for allowing me to attend the IDEA Conference in 2014. Also, I would like to thank QUEST Canada’s wonderful team, in particular Eric Campbell, for allowing me to attend conferences in 2014 (Vancouver), and 2015 (Toronto) respectively. Attending these conferences have proven to be invaluable in my learning’s.

I owe a debt of gratitude to the one person who has made me re-think my life purpose, Nariman, my life companion and friend. His patience, guidance, and continuous support have strengthened my will in pursuing what I am truly passionate about. I would also like to thank my family, in particular my father, and my friends in specific, Faegheh for always being there for me. At last, I would like to thank my colleagues at the Faculty of Environmental Studies who have been great supporters and motivators along the way; Stefan Ferris, David McMillan, Maral Jamali, and Mustafa Nazari, the friendships we have made during this journey is for a lifetime.

II. Abstract

As municipalities in Canada seek out ways in which to address the issues related to climate change, urbanization, and increase in population, energy is an ever-increasing concern. It's connection to land use, urban forms and infrastructure highlights the importance of local governments role in addressing these related issues. Many local governments are considering community energy plans as a solution to address issues related to the energy sector at the community level. The purpose of this paper is to understand and create a draft manual on how to close the planning gap that exists in community energy plans through understanding the development of proper policy frameworks primarily for planners and other municipal staff interested in renewable communities. It further seeks the methods a municipality should consider in planning to achieve 100% renewable community.

Given the interdisciplinary nature of planning towards RE communities, a mixed-methods approach was followed. Municipalities in British Columbia have been studied, successful cases have been reviewed, interviews with municipal staff have been taken place, and literature review and non-academic papers have been read to yield important practical lessons regarding required steps to develop policy frameworks that would result in the increase in energy efficiency targets and increase in RE implementations at the local level.

The predominant challenge for local governments in addressing climate change issues is that the adopted community energy plans, as mitigation and adaptation strategies, have targets in regards to the energy efficiency and RE that are not being fully implemented. Lack of internal alignment, capacity, funding, and policy frameworks have been identified as main barriers. In this paper steps required in developing policy frameworks have been studied to better guide communities that aim to achieve RE communities. Planning for 100% RE communities can build the leadership and commitment that is necessary to move towards implementation of energy targets in the absence of national regulatory support.

There is a substantial opportunity to close the gap between energy planning and the implementation of energy targets at the local level. However, as there is no one size fits all, each municipality has to develop their own policy actions using local policy tools. The policy frameworks provide the general information on how to best develop a successful policy. However, using incentives and political buy-in have been identified to play a key role in the implementation of energy targets to achieve 100% RE communities.

III. Foreword

I have entered the Master's of Environmental Studies Program with a single question in mind "why not capturing the available, unlimited, and free energy for our daily energy usages?" to answer this question, I have looked at the issue from an interdisciplinary lens by taking courses in policy, economics, planning, energy, climate change, business, and law.

To better understand the complexities of the current urban energy systems and to understand different methods for capturing RE, I have participated in a training in Germany, took part as a research member in developing a report on District Energy systems by UNEP, attended QUEST and IDEA conferences, and worked with CEA of BC on developing policy frameworks that would result in increase in energy efficiency measures and RE systems in smaller municipalities.

Community energy plans have been adopted by many communities across Canada as an energy management tool used to address climate change at the local level. During the program, I have identified that there is a gap between planning for RE targets and their actual implementation. Therefore, as part of fulfilling the requirements of the program, in this MRP, I tried to understand how communities can fill this gap through design of policy frameworks at the local level.

Through a volunteer collaboration with CEA, I have become familiar with policy design frameworks at the local level and its importance in the deployment of renewables. This MRP is meant to be used as a guideline for municipal governments interested in closing the gap between planning for renewables and achieving the targets in their community energy plans. It further suggests, it is not enough to only plan for small percentage of integration of renewables into the current energy systems. In order to battle climate change a 100% RE target is required by all communities and cities. This report is linked to the learning objectives of my plan of study and the area of concentration "Regional Energy Planning: Roadmap to 100% Renewable Communities".

IV. Contents

V. Acronyms

AR5 Fifth Assessment Report
BC British Columbia
BCBC British Columbia's Building Code
CARIP Climate Action Revenue Incentive Program
CEA Community Energy Associations
CEP Community Energy Plan
CEEP Community Energy and Emissions Plans
CHP Combined Heat and Power
CH4 Methane
CO2 Carbon dioxide
DCC Development Cost Charges
DE District Energy
EEA European Environmental Agency
GGRTA Greenhouse Gas Reductions Target Act
GHG Greenhouse gases
GWh Gigawatt-hour
ICEM Integrated Community Energy Models
ICLEI International Council for Local Environmental Initiatives
IEA International Energy Agency
IPCC International Panel on Climate Change
IRENA International RE Agency
kW Kilowatt
kWh Kilowatt-hour
LICs Local Improvement Charges
MRP Major Research Paper
N2O Nitrous oxide
NRCan Natural Resources Canada
PV Photovoltaic
QUEST Quality Urban Energy Systems of Tomorrow
RE RE
REC RE Certificate
REN21 RE Policy Network for the 21st Century
RVTE Revitalization Tax Exemption
UN United Nations
UNEP United Nations Environment Programme
UNFCCC United Nations Framework Convention on Climate Change
UNFPA United Nations Population Fund
USA United States of America

VI. Figures and tables

Section 1: Introduction

1.1. Context

Climate change, which is predominantly triggered by fossil fuel combustion, is identified by many scholars as the main problem of our era. In the Fifth Assessment Report (AR5), the warming of the climate system has been identified as a phenomenon that is a direct result of anthropogenic greenhouse gas (GHG) emissions, particularly carbon dioxide (CO_2). CO_2 is associated with deforestation and the burning of fossil fuels for transportation, manufacturing, electricity generation, heating and cooling (IPCC, 2013). The potential impacts of climate change are far reaching; they will deeply affect human societies and all earth ecosystems.

The energy supply sector, according to the Intergovernmental Panel on Climate Change (IPCC), is the largest contributor to global GHG emissions. The energy supply sector is defined by the IPCC as "all energy extraction, conversion, storage, transmission, and distribution processes" (IPCC, 2014, p. 519). This sector converts over 75% of the world's total primary energy supply (e.g. oil, natural gas, and coal) into forms used by end users (e.g. electricity, transportation, industrial activities, and heat). Additionally, when conversions take place energy losses account for 29.3% of the total primary energy supply emitting heat to the atmosphere, which result in increased average global temperatures (IPCC, 2014, p.519).

In 2011, the world population surpassed the 7 billion mark (UNFPA, 2012). Additionally, it has been predicted that the world population will grow to over 9 billion by mid-century (UN, 2011). This global expansion of energy consumption increases the dependence on finite resources. It has been predicted by experts that these resources will be depleted by 2050 (Simon, C., 2007), which will have a direct effect on the price of these commodities. According to the economic model of supply and demand, as demand goes up for a scarce resource, so does its price.

Energy availability and plentiful access are critical elements in modern economies as discussed by Simon (2007). The energy sector is, in fact, a critical factor for the Canadian economy. Canada is among the largest producers and highest per-capita users of energy due to its resources and climate (NRCan, 2015). The energy sector (stationary combustion sources, transport, and fugitive source sub sectors) in Canada contributes to about 80% of the GHGs produced, which include the emission of CO_2, CH_4, and N_2O (Environment Canada, 2015). The majority of our GHG emissions result from the combustion of fossil fuels (Figure 1), and the majority of Canada's GHG emissions are from CO_2 (Figure 2). As a result, the sustainable production and usage of energy resources present both challenges and opportunities for Canadians.

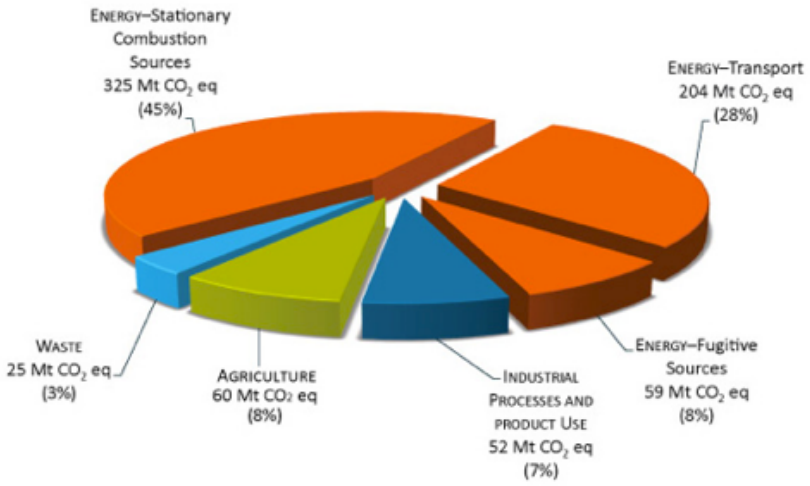


Figure 1. Canada's Emissions Breakdown according to the Intergovernmental Panel on Climate Change (IPCC, 2013); Source: Environment Canada

Energy resources in Canada include both conventional (oil, natural gas, coal) and renewable energy (RE) sources (wind, sun, water, geothermal, and biomass). However, most of Canada's primary energy is currently provided through polluting methods; only 17% of the total energy is derived from renewable sources (NRCan, 2015). The breakdown of Canada's emissions by economic sector demonstrates that in 2013 the oil and gas sector produced the most GHG emissions of 25%, followed by transportation sector at 23% (Environment Canada, 2013, p. 16). These results call for immediate changes to Canada's energy infrastructure to reduce climate pollution.

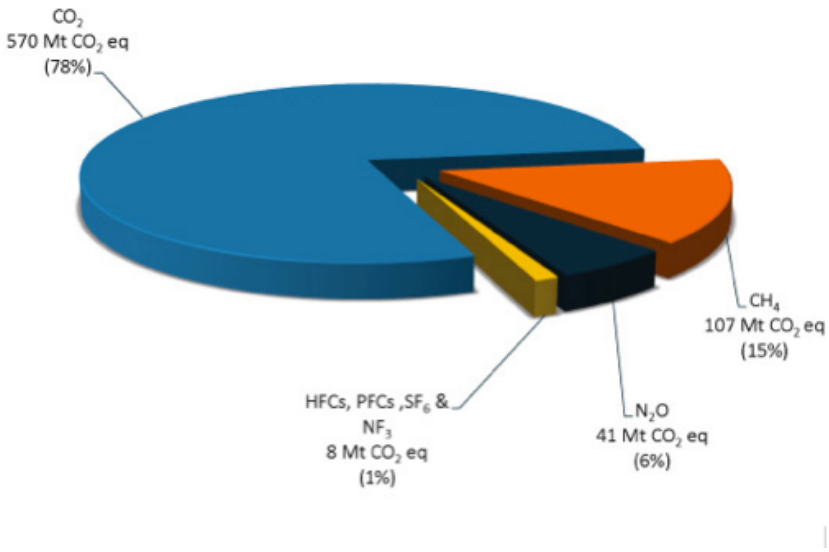


Figure 2. Canada's Emissions breakdown by Greenhouse Gas (2013)

Source: Environment Canada

Harnessing and distributing the available RE efficiently and effectively requires good planning, effective policy measures, collaboration, and forward thinking. In his article "Planning to make the future renewable: The role of local authorities in RE resource assessments", Michael Harper explains how making local adjustments to our methods of harnessing and utilizing energy will protect the global environment (1993). Harper believes these actions must be initiated at the local level, residents cannot rely on the national government to plan and execute the necessary changes. When planning the path of action, both energy efficiency and RE must be considered (Harper, 1993).

Today, the aim of many local communities and cities is to reduce the GHG emissions responsible for the changing climate. Therefore, they are looking into solutions for developing sustainable urban areas that utilize renewable energies (Burton & Williams, p. 251, 1996). Increased dependency on energy imports from finite resources, with unstable prices, demands a change to the energy systems (Ćosić, B., Krajačić, G., & Duić, N., 2012). However, since these cities and communities were developed many centuries ago, introduction, utilization, and the development of sustainable energy sources presents real challenges. As it has been noted by authors of "The Compact City: A Sustainable Urban Form?", cities are complex as they are made up layer upon layer of physical, historical, economic, and social systems (Jenks, M., Burton, E., & Williams, K., 1996, p. 2). Therefore, making changes to the current energy systems is complex and represents many challenges for local governments.

In "Transforming barriers into enablers of action on climate change", Sarah Burch concludes that Canadian municipalities can work independently to establish sustainability (2010, p. 2). Transitioning into a large-scale urban area of subsystems from the centralized fossil-fuel based energy systems is the challenge of many communities (Verbong & Loorbach, 2012). The challenge is in the updating and renewal of a well-established system which, in some communities, dates to the past century (Rae & Bradley, ,2012).

However, RE technologies have been identified as drivers of this energy transition happening at the local level (Verbong & Loorbach, 2012). More so because it has been concluded in many studies that the development of renewable systems within the existing technology is possible (Ćosić, B., Krajačić, G., & Duić, N, 2012).

In his September 2014 discussion, Ban-Ki-moon, the United Nations General Secretary, emphasized that all countries in the world should develop strategies that aim at decreasing GHG emissions to avoid an increase of 2 degrees in the Earth's climate. Translating national guidelines such as that and making them relevant to each local situation is key in addressing climate change. As people move into cities in search of opportunities and societies become more affluent, the increase in energy consumption becomes the central focus of many communities.

According to the United Nations Population Fund, more than half of the planet has been urbanized (UNFPA, 2011). In fact, over 80% of the Canadian population inhabits urban areas (Simmons, J., & S. Bourne, L., 2003). Rotmans, Van, and Vellinga (2000) argue that, nowadays, cities are seen as motors for sustainable development. As cities grow globally, local governments are challenged to meet the needs of the citizens and adapt to changes in demands for energy, infrastructure, and space. Therefore, it is

inevitable that communities will have a key role to play in improving the energy sector. As a result, transformation from the current urban energy regime to urban planning focused on RE is identified as crucial for dealing with issues such as the changing climate and resource deprivation.

Today, more than 170 Community Energy Plans (CEP) have been developed in Canada (National Report on Policies Supporting Community Energy Plan Implementation., 2015). These plans have been identified as tools for making the necessary changes, and they shed light on the required energy targets for achieving national and provincial GHG reduction targets. However, limiting CEPs as an adaptation and mitigation strategy does not facilitate the increased deployment of RE and/or energy efficiency targets. Additionally, scholars have identified a lack of political and social support as the main obstacles for achieving 100% RE deployment at the local level.

1.2. Research Scope and Purpose

This Major Research Paper (MRP) attempts to create a draft manual for municipalities that are interested in re-shaping their communities. It is a draft guide to the impending move away from fossil fuels and toward a more sustainable, reliable, and independent RE system. This MRP focuses on the most fundamental form of sustainable urban development: a renewable

community. It demonstrates, through findings based on firsthand data gathered from twenty small-to-medium sized Canadian municipalities, how interested local governments can design policy frameworks that can assist in the implementation of energy targets (in terms of renewable and energy efficiency) set in their community energy plans. It also provides guidance on the next steps towards becoming a 100% renewable community by 2050, including three different phases and timeframes.

Four main research questions guided this MRP: How do current municipalities respond to climate change effects in their communities? Do CEPs help to advance RE targets? How can communities bridge the gap between targets set in CEPs and their implementation? And, how can smaller municipalities pave the way towards 100% RE communities using their power to implement policies at the local level?

To answer these questions comprehensively, a mix methodology approach was employed. Municipalities in British Columbia have been studied. Several quantitative and qualitative databases were constructed and analyzed to understand the existing policies supporting the energy targets in CEPs. Interviews were conducted with key actors in the sustainability and energy teams of chosen municipalities. Successful cases have been reviewed, and the

findings were juxtaposed with the literature review and other reports to support the findings.

CEP is best performing in its broadness of scope, sources of data used, and cross-sectoral collaborations identified by findings in this MRP. The decision to focus on CEPs as a tool for improving RE deployment and increasing energy efficiency arises from its increased adoption among Canadian municipalities and the available financial support from higher levels of government in the recent years. As energy planning for a 100% renewable community is a collaborative approach and requires integrated energy sources, it is wise to use a tool that is already deemed practical by Canadian municipalities.

RE is defined as energy derived from renewable resources such as solar, wind, geothermal, biomass, hydro, or tidal power. When properly designed and implemented, increasing the penetration of RE can be an appropriate climate mitigation strategy. RE can also be a viable energy security strategy due to its smaller footprint and lower environmental impacts compared to fossil and nuclear energy (Ellabban, Abu-Rub, & Blaabjerg, 2014). This research paper outlines not only how to achieve ambitious RE and energy efficiency targets in community energy plans, but also how to act as a guideline to achieve

aggressive goals to reach 100% RE in local communities in three phases and three time frames (i.e. 2020, 2030, and 2050).

The 100% RE goal cannot be achieved without proper efficiency measures, step-by-step planning, effective policy frameworks, the collaboration of different stakeholders, and an interdisciplinary approach in the integration of energy sources. Sawyer (2015), development director for the Low Carbon Pathways Group of the CMC Research Institute, noted on a recent news report:

> "We need credible policy at all levels of government to signal that carbon will be more expensive and will need to be managed. This will drive innovation across Canada's entire economy and prepare Canada to excel in a decarbonizing world"

1.3. Methodology

The policy framework analyzed in this paper [Chapter 3] is the result of firsthand working experience with the Community Energy Association of BC; the association supports local governments in developing and implementing community energy and emissions plans, carbon neutral action plans, and other local energy-related action plans. This collaboration provided an opportunity to work with twenty selected municipalities in BC that are interested in the implementation of policy frameworks towards increased sustainability measures within their communities. In addition to achieving practical work

experience, I was able to conduct an extensive and comprehensive review of both academic/peer-reviewed and non-academic literature, which helped me elaborate on the findings gained during my professional experience.

To develop an effective policy framework, I also analyzed current policy measures in one hundred communities with populations of less than 75,000 people within the boundaries of BC Hydro (the public electricity provider in BC). My analysis first focused on population levels, electricity use, and projected population growth rate. Then, forty municipalities with Community Energy and Emission Plans (CEEP) were surveyed in depth to achieve a better understanding of the related policy measures used in their community energy plans as tools for implementing their energy targets.

Survey analysis was performed based on twenty responses and ten interviews, which were conducted after mapping the collected data and conducting qualitative analysis. Through this analytical process, five policy measures have been identified as assertive and were chosen for further study focused on policy framework development regarding energy efficiency and RE target implementation. One of those policy frameworks, a sustainability checklist, received the council's approval for implementation during the time of my work with CEA. Through interviews and direct work with Canadian municipalities, insights were gained on the overall steps of policy

development, time frame for implementation, and barriers in the adoption of proposed strategies [please see details in Chapter 3].

For the second part of the paper, I focus on successful cases regarding the implementation of 100% RE in communities that were studied as a guide for deployment strategies of 100% RE at the local level (which includes examples from communities in the United States (city of Palo Alto), Canada (Oxford County), and Germany (Rhein-Hunsruck). Based on that analysis, several steps are recommended for achieving 100% RE communities and are adapted to fit the Canadian context.

1.4. Report Organization

This paper is divided into two parts. Part I is titled "First stop for local governments addressing energy sustainability and climate change in Canada" consists of a synthesis of key findings from direct work with municipalities in BC, literature analysis, interviews, and a project report on findings from the case study of developing a detailed energy policy framework for a Canadian municipality (i.e. the City of Duncan, BC). Part I is focused on municipalities that have developed, or are in the process of developing, a CEP and would like to know the steps required for the implementation of their energy targets in the coming years.

The purpose of part I is to discuss the conceptual aspects of energy planning for the implementation of RE and energy efficiency targets in CEPs. Section I included several learning objectives: to better understand the role of CEP in the deployment of RE targets, to see the level to which municipalities can influence the promotion of RE targets, to identify municipal barriers, and to understand the steps required for developing policy frameworks and assisting in implementation.

Part II is titled "Steps Towards 100% RE at the Local Level through Community Energy Plans" and is a combination of a literature review and an in-depth study of communities that have been successful in achieving (or are targeting) 100% renewable goals. Part II is designed to reflect on the reality of policy development towards 100% RE targets with the aim of understanding changes that facilitate the energy transition at a small community scale. Part II is complementary to Part I in the way it analyzes municipalities that have already implemented energy targets in their CEP, but would like to plan further for 100% RE targets as the second phase of their community energy plans.

The purpose of part II is to develop guidelines for achieving 100% RE communities in Canada using community energy plans in three phases and three different timeframes including 2020, 2030, and 2050. Achieving 100% renewable targets cannot happen overnight given the complexities of the Canadian political framework and the energy systems present in any given local government. Therefore, the review of successful case studies from North America and Europe is used to provide guidelines within the Canadian context for municipalities interested in the deployment of RE targets aimed at becoming 100% renewable by 2050.

The key learning objectives for Part II are as follows: to understand what a 100% RE community means, to better understand the role municipalities can play in the adoption of strategies to increase the deployment of RE, to utilize the best practices to develop a general model that can be used as the first steps for municipalities to push the targets in their CEPs further to benefit the greater good.

Section 2: Addressing Climate Change Issues at the Community Level

"The trouble with our times is that the future is not what it used to be." Paul Valery, French Poet and Essayist 1871-1945

2.1. Climate Change Impact from a Community Perspective

Many around the world have felt the impacts of climate change as the Earth's average temperature increases. Climate change has already led to an increased occurrence of floods, hurricane winds, heatwaves, sea level rises, droughts, storms, soil erosion, and other detrimental events. As reported by the IPCC in the AR5, "The globally averaged combined land and ocean surface temperature data as calculated by a linear trend, show a warming of .85°C [0.65 to 1.06] over the period1880-1900"; warming of the climate resulted in unprecedented changes observed in recent years (2013). It has been revealed in the 2014 Climate Change Synthesis Report that:

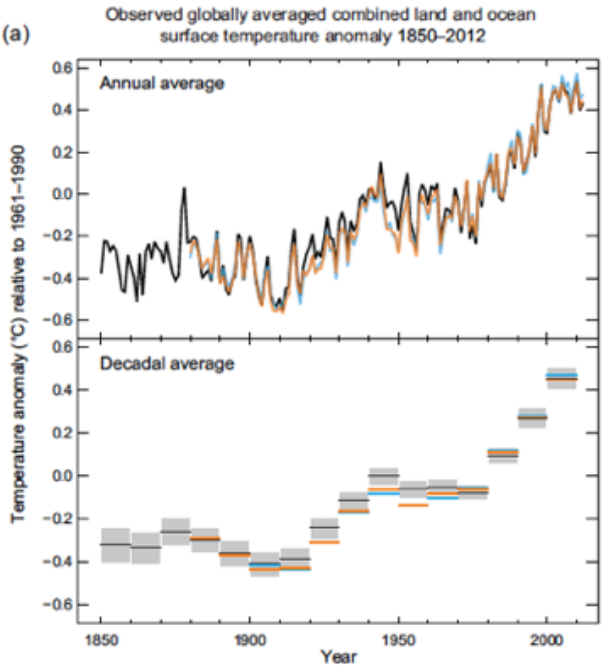


Figure 3. Observed change in average surface temperature 1800-1900

Source: Fifth Assessment Report of the Intergovernmental Panel on Climate Change

> "continued emission of greenhouse gases (GHG) will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems."

Extreme weather generates a significant risk to ecosystems, societies, and economies at large (IPCC, 2012). The increase in the frequency and intensity of extreme climate events could result in significant implications for societies at the local level, including disruptions to public health, infrastructure, the environment, energy, and the economy (Canada's Emissions Trend, 2014).

According to Environment Canada, the average annual temperature in Canada rose by 1.6°C between 1948 and 2010, representing one of the fasting warming rates worldwide (2015). This warming means the climate is expected to undergo substantial changes in the coming years. These changes could include variations in the amount of "rain, snow, ice and the risk of extreme weather events such as heat waves, heavy rainfalls and related flooding, dry spells and/or droughts, and forest fires" (Environment Canada, 2015). Additionally, provinces could experience changes in the ocean environment, altered ice conditions, and sea level rise.

2.1.1. Environmental Impact of Climate Change

Greater surface ozone and particulate matter levels result in increases in certain pollens in some regions, while smoke from wildfires result in deteriorating urban air quality (Harlan, S., Ruddell, D., 2011). Ecosystems provide us with clean water and air, timber, fish, scenery, flood control, and

other goods and services through which communities and the provincial economies thrive. Many of these environments and ecosystems are vital to our economy and overall well-being, and they are impossible or extremely costly to replace (Environment Canada, 2010).

Climate change will have a profound impact on many ecosystems across Canada. For example, snow packs are projected to decrease, and snow is projected to melt earlier in some areas of Canada. This means less runoff in summer and less water for agriculture, hydropower, industry, communities, and fisheries. Forests and woodlands that encompass a broad diversity of species are likely to be impacted by climate change in varied ways; water resources, air quality, and biodiversity will be all affected by climate change in one way or another (Rocca, M., Brown, P., MacDonald, L., & Carrico, C., 2014). The increased seasonal droughts demonstrate the vulnerability of communities and the irrigation of water supplies. Overall, extreme weather conditions mean more damage to the built environment.

2.1.2. Social Impact of Climate Change

Climate change impacts, including increases in the temperature of the surface of the Earth, could influence human health in several ways, which result in general social impacts. One example is the increased occurrence of heat-

related deaths during heatwaves (Donaldson et al., 2001 and Kosatsky, 2005).

Climate change also affects the health of humans by spreading certain diseases such as malaria, yellow fever, which increase the health related costs to society at large (Colwell, 1998). Furthermore, warmer temperatures in the atmosphere could also enhance the existence of other pollutants by changing the amounts of anthropogenic emissions.

2.1.3. Economic Impact of Climate Change

The overall cost of extreme events, based on damages to buildings and infrastructure, is on the rise everywhere. Communities are facing more frequent floods, rising sea levels, storms, and forest fires, which affect buildings and infrastructure in urban areas. For example the fires of 2003 in British Columbia destroyed more than 334 homes and many businesses. The total cost of those fires is estimated at $700 million (Filmon, G., 2003).

Climate change could affect electricity systems in different ways. It could alter the demand for electricity, the timing of that demand, and the efficiency of generating power at capacity (Amato et al., 2005). For example, warmer conditions increase the demand for air conditioning, which results in increased greenhouse gas emissions through greater demand for the production of electricity required to run air conditioners (Grimmond, S.,

2007). Under this scenario, an increase in the usage of air conditioners, particularly during heat waves, might result in higher electricity peaks in some communities, which would require consideration for building new generators, transmitters, and distribution infrastructure (Miller, Hayhoe, Jin & Auffhammer, 2008).

The U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability identified these extreme weather conditions as one of the main causes of electrical disturbances as of 2013. Electric power, as part of the energy system, is the backbone of every city and community. Douglas W. Kimmelman, senior partner in Energy Capital Partners, comments:

> "A developed society cannot function without electricity, and its importance grows as usage expands into such areas as digital applications, mobile computing, and electric vehicles."

For example, the winter storm in Toronto, Ontario on December 21-22, 2013 resulted in substantial damage to municipal infrastructure and left over 300,000 Toronto Hydro customers without power. The cost of the storm to the City of Toronto was pegged at $171 million (Extreme Winter Storm Event Report, 2013).

The National Round Table on the Environment and the Economy (2011) indicated that "climate change is expected to impose accelerating costs, rising from an average value of $5 billion per year in 2020 to an average value of between $21 billion and $43 billion per year by 2050" (p. 40). In addition, impacts on the environment and society have a direct relation to the local economy. For example, the impact on forestry from more frequent forest fires, damage to coastal infrastructure from rising sea levels, costs to health care due to more exposure to heat and climate related diseases, and changes to tourism all present economic impacts on communities (Environment Canada, 2010, p. 24).

2.2. Local Governments Leading the way to Low-Carbon Communities

2.2.1. Why a Local Approach?

Thousands of cities and towns around the world have active plans and policies to address climate change. According to Auld and Mclver (2005), even small changes in the climate will result in large consequence for existing infrastructure. Additionally, every municipality experiences climate change differently, which depends on the geographic location and its distance from the challenges presented by extreme weather (e.g. closeness to the water line).

Glave, J. et al. (2013) note that the number of extreme weather events is on the rise with the warming of the climate, and "energy and climate-change expenditures are increasingly expensive for municipalities" (p. 14). They specifically point to the increasing cost of infrastructure, emergency response, and environment-related damages (Glave, J. et al., 2013, p. 14).

Energy, as an essential source for human development, is a necessity in all modern cities. The Global Energy Assessment Report mentions that energy is essential to the continuation of economic success and human advancement (2012). As a result, energy security is a key driving force behind energy policy at the local level. The energy systems of today are significant contributors to the changing climate and atmospheric pollution in local communities (Johansson, T., Patwardhan, A., Nakićenović, N., & Gomez-Echeverri, L., 2012).

Local governments have direct or indirect control of 45% of the national GHG emissions driven by energy consumption (Glave, J. et al. 2013, p. 11). Some Canadian municipalities are also energy producers and providers through locally-owned electric and gas utilities. That is, however, a great advantage as it can allow municipalities to make decisions on how to operate their utilities at the local level.

As agents for ensuring energy supply, local governments have a great responsibility in addressing climate change mitigation at the community level. Municipal approaches to climate change mitigation are very critical, especially as most forms of energy usage can be influenced by local government policies (Pitt, 2010). Moreover, municipalities can engage local communities, and other stakeholders, and easily coordinate with neighbouring jurisdictions in their energy and climate planning procedures (Pitt, 2010). Furthermore, municipalities can share their success stories and become a point of reference for other local governments.

The negative effects of climate change at the local level, due to the high GHG emissions resulting from high population density and high-energy consumption, are a large part of the challenge local municipalities must overcome with astute planning and development (Maric, I. et al., 2015). The negative effects of climate change, as Carter, J et al. (2015) argue, can be used as opportunities to address climate change mitigation and adoption: (1) Urbanization, which is shaping the 21st century communities (2) City design that create microclimates, which can help moderate temperature increases (3) Heavy reliance on the current infrastructures that could magnify climate change risks. All of these opportunities can be seen as turning points for local governments (Carter et al., 2005).

In terms of urbanization and its relation to the municipal level, local actions become more significant in securing a sustainable energy system as more and more people relocate to urban areas. This will further increase by 2050, as 89 countries are expected to become more than 80% urban (UN, Population Division 2014, p. 8). Khare et al (2011) also see this exponential growth in urban areas as an opportunity to address the changing climate. According to Corfee-Morlot et al (2009), cities are centres of innovation and can advance clean energy systems with access to up-to-date climate science, impacts, and vulnerability assessments. Local authorities can also work with community stakeholders to design and implement effective adaptation strategies. Currently, municipalities in Canada have the potential to create sustainable communities once they escape their innate dependence on conventional ways and path dependency in dealing with local barriers (Burch, 2010).

In communities and urban systems, human activities have a direct effect on the climate, which affect their health and well-being. For example, the rapid transition of the natural landscape to dense urban areas results in "heat-retaining impervious surfaces and building materials that inhibit night-time cooling" (Harlan, & Ruddell, 2011). This makes the urban areas warmer than surrounding rural areas. "On average, urban temperatures may be 1–3°C warmer, but under appropriate meteorological conditions (calm, cloudless nights in winter) air temperatures can be more than 10°C warmer than

surrounding rural environments" (Oke, 1981). Regarding different areas of a community, the degree of change depends on the human activities, meteorological conditions, and the nature of the specific area's environment. All these challenges could be addressed at the local level through sustainable planning.

If municipalities hope to build more sustainable communities, they cannot rely on the same network of national infrastructures that shaped the current energy systems. Instead, they will need to develop their own, localized energy infrastructures. In a recent report by the United Nations Environmental Program (2014), District Energy in Cities: Unlocking the Potential of Energy Efficiency and RE, district energy (DE) systems have been proven as an infrastructure solution for cities and communities where the density load is high. DE systems also provide an ideal platform for the integration of RE sources into the heating and cooling sectors.

DE systems, for the local production and distribution of thermal energy for heating and cooling, consist of networks of underground pipes that carry hot water, steam, or chilled water from a central plant to the intended buildings (King, 2012, p. 6). "When steam, hot water, or chilled water arrive at a customer's building, they are ready to use. They are almost 100 percent efficient "at the door", compared with 80 percent efficiency or less when

burning natural gas or fuel oil for heating at a building. In addition, district energy systems can use the "reject heat" that results from burning fuel to produce electricity at a power plant, dramatically increasing the overall efficiency with which useful energy is extracted from the fuel" (District Energy Organization, 2015). Municipalities can also benefit from DE systems as a disaster mitigation strategy as they continue to operate during disasters that paralyze centralized energy supply lines (Bryant, 2011).

In his book *The Hidden Potential of Sustainable Neighborhoods: Lessons from Low-Carbon Communities (2013),* Harrison Franker warns that climate change is no longer a mere theory discussed by climate scientists or reported by the Intergovernmental Panel on Climate Change. The real consequences are now seen and felt across the globe (Franker, 2013). Therefore, local governments, as practitioners of good governance, are not only best positioned for developing responses, but also responsible for protecting their citizens, environment, and economy. In support, Glave, J. et al. (2013) point out, "Municipalities are well positioned to help develop, implement, and benefit from better choices in the direction of Canada's energy policy" (p. 9). Through land-use bylaws, re-zoning, property development, infrastructure choices, tax mechanisms, and other policy tools, municipalities are at the heart of influencing energy usage within communities (Glave, J. et al., 2013).

2.2.2. How Are Local Communities Addressing the Climate Change Challenge?

Communities across Canada are shifting the focus to reducing GHG (St. Denis & Parker, 2009). All communities are looking for adaptation and mitigation strategies as the Earth will continue to warm for decades to come. Even if the emission of GHG is kept at medium level, Canada is expected to warm 2°C by 2050 and 4°C by 2080 (Warren and Egginton, 2008). This temperature increase and warming will be felt across the country. Local communities can achieve a mitigation strategy to reduce GHG emissions through behavioural changes, increased energy efficiency, and the development of more RE systems (Cartel et al, p. 51, 2015).

A climate change adaptation strategy can be used to find methods that address climate change impacts and assess vulnerabilities from the local communities' perspective through vulnerability and risk assessments.

It has been noted by Jackson et al., (2011):

> "While neither adaptation nor mitigation actions alone can prevent significant climate change impacts, taken together they form a comprehensive climate change response strategy that will prepare communities for the climate impacts underway while working to avoid even worse future effects" (p. 10).

Adaptation and mitigation strategies, however, should not contradict each other. For example, if there is need in the community for more summer cooling as temperatures increase, the installation of more air conditioning

systems would contradict the mitigation objectives of lowering GHG emissions produced (if the electricity is generated using fossil fuels). However, adapting to the increasing temperature by planting more trees and planning for green roofs would result in more energy efficiency while bringing comfort to communities. Droege (2008) has identified climate change as the main driver behind establishing emission reduction targets and climate adaptation and mitigation strategies that will contribute to the pursuit of sustainability goals at local levels (p. 50).

2.2.2.1. Adaptation Strategy

One of the responses of local communities to the increased challenges presented by climate change at the local level is to create adaptation strategies. NRCan (2015), has described adaptation to climate change as activities that minimize the negative impacts from climate change or activities that takes advantage of new opportunities that might occur because of climate change. As climate change happens over time, the impacts will be different in each region of the country. Therefore, adaptation strategies are meant to be in a local context. Cartel et al. (2015), discuss that adaptation resides more locally, and it will be a local activity in response to locally specific climate risks and opportunities. In addition, it has been discussed by the European Environmental Agency (EEA) that adaptation decisions are ‘context specific’, meaning they depend on local circumstances.

Municipal governments across Canada have started to include initiatives or actions in response to actual or projected climate change impacts to reduce the effects of climate change on built, natural, and social systems. The central goals of adaptation policies have been defined as reducing vulnerability and increasing adaptive capacity at the local level (Smit and Pilifosova, 2003: Smit and Wandel, 2006). Vulnerability is defined as weaknesses that arise from the negative impacts of climate-related impacts, and adaptive capacity is the capacity to deal with the climate change impacts and cope with the results. (Vogel, & Henstra, 2015).

2.2.2.2. Mitigation Strategy

Mitigation strategies are now widely adopted by many local governments to reduce the emissions of GHG contributing to climate change. These strategies are meant to offer long-term benefits not only at the local level, but at the global scale, as emphasized by the writers of the I.C.L.E.I. report Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation. Pitt, (p.2, 2010), defines climate change mitigation policies as policies enacted by local governments to reduce energy usage and GHG emissions within their residential, commercial, and transportation zones. Pitt (2010) also emphasizes that in order to achieve this goal, policy initiative,

citizen participation, and institutional cooperation are necessary parts that would result in the reduction of local communities' carbon footprints.

Municipalities might apply new policies alongside regulatory or project-based measures to limit or reduce GHG emissions (Pitt, 2010). They may also create RE programs, build more energy efficient frameworks, or promote substitutes for fossil fuels (Pitt, 2010). Local governments are well positioned to encourage and facilitate such efforts at the community level, (Pitt, 2010). This can be seen in the adaptation of CEPs across Canada in recent years.

2.2.3. What Should the Local Climate Policy Goal Be?

To respond to climate change in a comprehensive manner, policies should be designed to achieve both mitigation and adaptation (Painter, 2015; Lee, 2015; Schellnhuber, 2004). The complexities of climate change and the uncertainty inherent in possible scenarios require an integrated policy approach across all policy arenas: energy, transportation, buildings, urban development, and planning (Lee, T., & Painter, M., 2015).

Lee and Painter (2015) contend that a comprehensive local climate change policy must include city planning, comprehensive mitigation, preparation, and implementation. Additionally, Corfee-Morlot, (2003) believe incorporation of the risk from an irreversible catastrophic climate change episode, with regards

to the local situation, increases the optimal level of investment in mitigation and adaptation strategies. Schneider (2004) argues that mitigation policy strategies could significantly decrease the large-scale climate disturbance.

Each city is unique in its structure and has its own physical and socio-economic attributes. Therefore, local climate policy goals should reflect local attributes. Hence, it is important that each local municipality collects GHG inventory systems on the sectors within its jurisdiction; these inventories can then be used for GHG reduction targets and energy targets. Integrated action plans with appropriate supportive policies are also required to implement the targets. Additionally, it is viable for local governments to monitor performance and make changes to the policies as they see fit (Krause, 2012).

It can be concluded that local climate policy goals should have the active engagement of municipalities and non-government organizations within private and public sectors. As argued, local climate change policies have multilayered components; a single approach does not ensure the achievement of its comprehensive goals (Lee and Painter, 2015).

2.3. Transition Towards an Energy Revolution

2.3.1. Path to Sustainability at the Local Level

To address global climatic change, resource scarcity, and the challenges raised by the threat of catastrophic events, and to achieve long-term energy security, it is necessary to change our current energy systems towards sustainability (Solomon and Krishna, 2011). Immediate actions must be taken by local, provincial, and national governments (Myhrvold and Caldeira, 2012). At the local level, achieving objectives, such as clean, low-carbon, reliable, resilient, affordable, and sustainable energy systems, results in resilient communities where everyone benefits from strong and healthy ecosystems, localized economies, and secure and clean energy systems. This task entails local governments using their planning and policy tools to incentivize the deployment of RE technologies to reduce or eliminate GHG emissions and the unhealthy dependency on fossil fuels. In addition, promotion of a culture of energy conservation is vital in the acceleration of the transition towards sustainable energy systems (Chu & Majumdar, 2012; Droege, 2008).

At the global scale, the transition towards a more sustainable electricity sector has been on the rise. According to Key World Energy Statistics (2015), the 2013 world total primary energy supply consisted of 31.1% from oil, 28.9% from coal, 21.4% from natural gas, 10.2% from biofuels and waste, and 4.8% from nuclear (IEA, 2015). Other sources, such as renewables, accounted for only 1.2%. However, oil, coal, and natural gas are still the most popular energy fuels for all energy sectors.

According to the RE Policy Network for the 21st Century (REN21, 2014), 140 countries have had RE targets and policies in place such as feed-in tariff programs, renewable portfolio standards, net metering schemes, tax reductions or exemptions, grants, low-interest loans, and public competitive bidding/tendering systems. These policies have been used to promote the increase in RE production and capacity (REN21, 2014). According to the International RE Agency (IRENA), the use of these policy tools has led to growth in RE investments and has resulted in cost reductions of renewable technologies, as well as greater economic prosperity for regions (Gielen et al., 2014).

Local communities, in seeing the value of transitioning towards an energy revolution, should design strategic action plans that would increase resiliency within their communities. To enable affordable, sustainable, and reliable energy in communities, investments in infrastructure must be planned, and capital must be deployed in a strategic manner. Municipalities, on a community or neighbourhood scale, can promote and facilitate the development of sustainable energy infrastructures such as district energy systems, thermal storage, and cogeneration. They can, through policies and standards, increase the overall energy efficiency within communities and can promote the deployment of more RE systems. Through planning principles,

they can encourage a reduction of transportation emissions by promoting high-density areas and site design.

Peter Newman discusses in his book *Resilient Cities* that, global governance has recognized what impats climate change could have for cities, and has required all cities to decrease the use of fossil fuel in their activities every passing year. According to Resilient City, a not-for-profit network of urban planners, architects, designers, engineers, and landscape architects, resilience is defined as proofing the cities and their infrastructures in response to the climate change stresses in the upcoming years.

In other words, resilience is ability of a system to endure disruption and keep its control (Newman, 2008; Gunderson & Holling, 2002). There is an increased awareness among municipal authorities surrounding their crucial role in securing a living and working environment for their citizens. A resilient city and neighbourhood will focus on energy, resource conservation, and enhancement, among other things, to support everyday life activities. Communities around the world are responding to global governance warnings and national climate change action plans by setting visions to achieve a low carbon economy.

For communities to be resilient, they need to reduce their oil dependency (Newman, Beatley, & Boyer, H., 2009). The reduction from oil usage for energy related activities will bring innovative thinking to achieve RE communities. Community energy solutions could bring considerable benefits in meeting community energy objectives such as reduced energy costs, reliable energy systems, and reduced GHG emissions. In order to adjust to climate change and overcome the rising energy demands, it is essential that urban areas become more sustainable (Franker, 2013, p. 8).

2.3.2. Converting to Clean Energy Technologies - A New Vision

The adoption of RE technologies has proven to be an effective climate change mitigation strategy (e.g. Moomaw et al., 2011). RE technologies can result in the decrease or total elimination of fossil fuel technologies. Electricity, for example, can be generated from renewable sources available from the wind, water, biomass, and sun. Municipal solid waste, heat waste, animal manure, and other residues can also be used as energy sources (IPCC, 2011). Infrastructure, such as cogeneration plants with district energy networks, should be used to feed the renewable sources and to provide cities with heating, cooling, and electricity services. Therefore, it is inevitable that renewable technologies are much cleaner than the conventional technologies

being used to date, particularly those technologies that require fossil fuel burning.

Evidence from various studies of the GHG emission life cycle support the claim that RE technologies are cleaner than those run by fossil fuels (Xiaoyu and Zhang, 2011; Weisser, 2007). The GHG emissions associated with RE systems do not occur during the generation of electricity, rather, it is emitted during the manufacturing of the equipment, that transportation of that equipment, and the installation process (Weisser, 2007). In a recent study by the International RE Agency (IRENA), it has been demonstrated that wind, solar, and geothermal technologies, during their life cycle, emit 10 to 120 times less emissions compared to natural gas.

The current pattern of today's commercial energy development is focused mainly on fossil fuels and centralized electricity systems. This has resulted in environmental degradation and extensive GHG emissions over the years. It is recommended in the literature that local and global environmental concerns are considered along with current energy needs for successful ecological development of a region (Hiremath, Shikha, & Ravindranath, 2007). This supports the development of decentralized energy systems based on clean energy technologies at local levels.

It is clear that serious mitigation and adaptation strategies are required to incorporate policies that are specifically designed to promote RE penetration. According to Etcheverry (2011), the benefits of these clean energy technologies should be provided to ensure it receives the political attention and support required for its penetration. It is, after all, what we decide to build today that will shape the foundation for a system that our future generations will grow on.

2.3.3. Community Energy Planning - A tool for Canadian Municipalities

In Canada, the energy jurisdiction is shared between the provincial and federal government as per Constitutional Act, 1867. The provinces are responsible for electricity systems within their boundaries and are owners of their ground resources (Parliament Canada, 2015). The local governments at the municipal level do not have a major role in energy jurisdictions. However, in recent years, due to climate related events, planning for energy at a local level has been on the rise. Energy in the form of heat, transport fuel, and electricity is integral to the functioning of all communities in Canada.

In response to the global climate change and fossil fuel depletion, many communities have started considering energy during their planning. As discussed by Tozer (2013) Canadian municipalities are developing community energy plans to bring focus to the energy needs of their communities in

response to the need in developing a energy system that is efficient, economical, and environmental. Across Canada, provincial and territorial governments have established energy objectives related to the GHG reduction, economic diversification and development, clean-technology development, and alternative energy development to increase the resiliency of their communities in response to Climate Change (Bell et al., p.1, 2015). Therefore, developing CEP for assessing the supply, demand, and the GHG emission inventory of each sector of the economy seems to be the right path for local communities to take.

According to the National Report on Policies Supporting Community Energy Plan Implementation (2015), CEPs are also commonly referred to as Local Action Plans, Municipal Energy Plans, Community Energy and Emissions Plans, Energy and Greenhouse Gas Management Plans, or Integrated Community Energy Plans (p. 2). Even though variations exist in name and content, these plans are unified in viewing the community as an effective level for energy planning. The city of Burlington in Ontario has described CEP as "A holistic view of how energy is used, conserved, generated, distributed and potentially stored, with a focus on how community partners can work together to improve the current system" (CEP Burlington, p. 19).

It has been identified by Quality Urban Energy Systems of Tomorrow (QUEST), a non-profit organization that conducts research, engagement and advocacy to advance Smart Energy Communities in Canada, that "Canadian cities, towns, and villages have influenced more than 60% of energy consumption and over half of all GHG emissions in Canada" (Bell, et al., p.5, 2015).

Jaccard, Berry and Failing (1997) were among the first researchers who developed a method for CEPs to integrate energy planning, urban planning, and policy into a single model of community energy management. It seems inevitable that community energy plans at the local level are vital to addressing GHG emissions and the energy priorities of communities as the way forward. Since 2006, more than 170 CEPs have been developed in Canada (National Report on Policies Supporting Community Energy Plan Implementation, 2015).

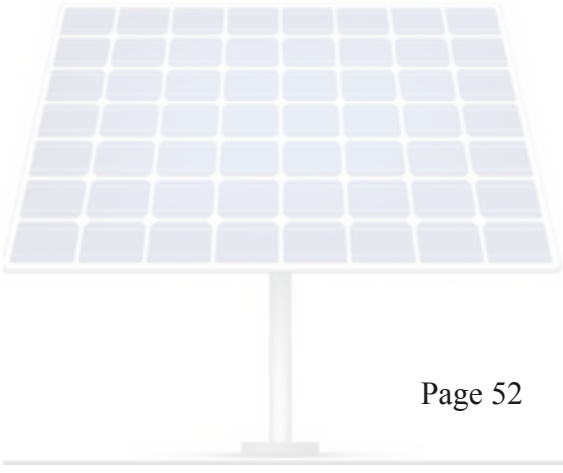
This shows that, in Canada, mitigation and adaptation to climate change is increasingly being addressed at the local level, rather than by the federal government. Although not all of the information on community energy planning has been published in journals, books, or other peer reviewed articles due to the newness of the discipline, these plans have been identified by many municipalities as key strategic planning documents for guiding

communities' energy initiatives towards sustainability. This is evident in the fast adoption of these plans by local level governments.

CEP, as a mitigation and adaptation tool, has been identified to "define community priorities around energy with a view to improving efficiency, cutting emissions, and driving economic development" (Bell, et al., 2015). This tool provides municipalities with a general framework, however, major barriers exist at the local level in the transformation of the current energy systems to RE systems. Many municipalities across Canada have identified these barriers as a lack of internal alignment, capacity, funding, and policy frameworks (QUEST Conference, 2015).

While many communities in Canada have developed CEPs, there is a gap between the planning and implementation of targets. In Chapter 3, through a demonstration of policy framework development, I explore how to overcome one of these barriers as an attempt to bridge the gap between planning and implementing the energy targets assigned in CEPs.

Section 3: From Community Energy Planning to Policy Implementation



3.1. Exploring the Process for Making a Sustainable Energy Policy Framework- A Learning Journey in British Columbia

3.1.1. Planning Initiatives

To stabilize the climate of the Earth, significant reductions in GHG emissions are required. Directed efforts by national governments, as a way of dealing with a global challenge, are necessary (IPCC, 2007; Pacala and Socolow, 2004; Wigley et al., 1996). Local governments across the world have significant potential to contribute to national efforts through exercising their direct regulatory authority and their capability to "act as catalyst for broader policy changes" (Engel, 2009; Kamal-Chaoui and Robert, 2009; Ostrom, 2010). In Canada, climate policy is more advanced at the sub-national level (Fankhauser, Gennaioli, & Collins, 2015).

In BC, the government passed the Greenhouse Gas Reductions Target Act (GGRTA) in 2007 based on the findings of the IPCC in regards to climate change and the emphasis to reduce the GHGs. The province set bold targets to reduce GHG emissions by 33 percent below the 2007 levels by 2020, and 80 percent below 2007 levels by 2050 (BC Climate Action for the 21st Century).

This provincial climate action plan resulted in a substantial shift in the provincial energy plan and climate policies (BC Ministry of Energy Mines

and Petroleum Resources, 2007). The province had also committed to energy efficient building standards. As a result of this plan, the province put its foot on a path to a low-carbon future (Climate Action Leadership, 2015). The provincial government has since introduced a number of climate-action legislations to support GGRTA (e.g. GHG industrial reporting and control act, GHG reduction targets act, carbon tax act, cap and trade act, local government (green communities) statutes amendment act, and clean energy act), which frames BC's approach to reduce GHG emissions.

These climate change actions at higher levels of government have resulted in influential municipal actions in BC (Bunch, 2010). Many local governments across the province have started working towards improving their energy performance in buildings to reduce energy costs and GHG emissions and to contribute to the overall sustainability of their communities. Since the launch of the Climate Action Plan in 2008, 74% of the municipalities in BC have equipped their communities with Community Energy and Emissions Plan (CEEP) to address climate change mitigation and adaptation such as GHG reduction goals, increased RE production, and energy efficiency targets at the local level (National Report on Policies Supporting Community Energy Plan Implementation, 2015).

CEEP, as a tool to define local priorities around energy, has been widely adopted at the community level to establish energy objectives. The local government statutory authority in BC is derived from the Local Government Act and Community Charter. These laws empower local governments to use a range of policies to advance energy efficiency and RE in communities. Therefore, local governments have a direct role in achieving energy and GHG emission reduction targets. However, the province, as an initiator adaptor of CEEPs, identified gaps in the implementation of the energy and emission targets in smaller communities.

This chapter analyzes the policy approaches and frameworks used in BC to implement energy measures required to build sustainable communities. Further, it aims to understand how the gap between energy targets and their implementation could be filled through policy development in local communities. BC is known as the champion of CEEP with 74% of the communities adopting this tool.

3.1.2. Role of Crown Utility in the Implementation of CEEP Targets

Once the province of BC had set the GHG reduction goal, the crown utility, BC Hydro, started a program to help smaller communities either equip their communities with a CEEP or get support for implementing the GHG and

energy targets assigned in their municipal planning. The name of the program is “CEEP Quickstart”. It aims to help communities with populations of less than 75,000 receive assistance in the adaptation and implementation of the energy targets assigned in their local CEEPs.

This program was established to support the creation of a practical project plan, based on the specific policy, regulatory, fiscal, and operational actions of smaller municipalities that can result in GHG and energy savings. From the inception of this program in 2009 up until March 2015, the CEEP Quickstart program supported more than fifty communities in different areas of BC within the territories of BC Hydro. Forty-three communities received help developing CEEPs and fifty-two communities received help in the implementation of their energy targets.

The population of those BC communities (54 communities that received either implementation assistant or CEEP assistant) total about 430,000. Their CEEPs contain 400 GWh of potential annual electricity savings by 2020 through energy efficiency and RE targets. The 400 GWh of savings is equal to the electricity consumption requirements of 40,000 households (BC Hydro QuickFacts). This plan provides engaged communities with a sense of ownership in their community energy and emissions planning.

The main challenges, discovered by researching the communities that were unable to implement CEEPs, were identified as the lack of capacity to move plans forward. Capacity constraints were presented as limited local government funds to assign dedicated staff or to develop CEEPs, high rates of turnover, lack of expertise within the human capital, and limited funding to pay for the deployment of RE systems. However, through receiving support with the Quickstart program, approximately 100 more CEEPs were created in BC.

To address the question of "How to bridge the gap between targets set in CEEP and their implementation?" it is key to gain familiarity with the state-of-the-art of policy measures that the local governments of BC have taken to implement, mandate, or encourage more sustainable energy practices. These policy and practices ranges from Development Permit Areas, Development Cost Charge reductions, Rezoning Policies, Solar Ready bylaws, and Zoning Bylaw updates.

3.1.3. A Framework for Community Level Policies and Strategies for Energy Target Implementation

The following steps were taken to complete policy frameworks. As a result, three policy frameworks (Sustainability Checklist, Home Labelling, and Building Fee Rebates) were developed. These frameworks could be used as

guidelines for developing policies that work within the context of local communities. They help to achieve the energy targets planned in CEEPs and to bridge the implementation gap.

3.1.3.1. First Step- Market Analysis

A thorough market analysis of the study area (143 municipalities in BC-Hydro territory) was completed in terms of the total population level, electricity consumption, and population growth rate. Additionally, a study of the current planning and policy measures of municipalities with a population of less than 75,000 (who were addressing their actions towards energy targets) was undertaken as part of this paper.

The results show that the study area was characterized by a combined population of 1,300,000 people, an annual electricity consumption of 15,562 GWH (excluding large industrial facilities), and a 0.75% annual population growth rate. This annual growth of 0.75% for 1,3 million translates to 9,750 new people per year [Appendix A]. These municipalities have implemented policy measures from two sources: 1) Climate Action Revenue Incentive Program (CARIP), and 2) CEEP Quickstart Program. In the CARIP program reporting from 2009-2013, 89 BC Hydro communities of <75,000 identified themselves as conducting policy measures related to energy sustainability. This is shown in the following table:

	Planning & policy measure implemented												Outreach		
	Sustainability checklist	Development permit guidelines	Solar ready bylaw	Revitalization tax exemption bylaw	Rezoning	Covenants	Building / subdivision bylaw	Building code enforcement	DCC reductions	Density bonus	Other / general	Outreach	Energy / climate committee	Energy incentives provided by local government	Green building leaders project
Number of communities (out of 89)	28	22	29	10	7	1	10	2	3	3	60	45	8	20	4

Table 1: 2009-2013, policy and planning measures implemented by Climate Action Revenue Incentive Program (reproduced from: Market Analysis Report by CEA, page 4, 2015)

From this information, the most widely used to the least widely used policy implementation tools can be identified as mandatory policies, more persuasive policies, and policies that would either cost money (e.g. Development Cost Charges (DCC) reduction), or those that require more effort to implement.

Through the CEEP Quickstart Program, 37 communities of <75,000 population have received implementation support. From the 37 communities that have received implementation assistance from the Quickstart Program, 400 GWh of annual electricity savings is to be achieved by 2020 through the implementation of energy targets in their CEEPs. The actions these communities are interested in implementing are as follows:

Action	% of the 37 CEEP QS communities interested in implementation
1.1 Promote BC Hydro DSM programs	100%
1.5 Improve building code enforcement	88%
2.1 Sustainability checklist for buildings / developments	97%
2.2 Use rezoning to define desired energy performance	63%
2.3 Density bonus for energy performance	59%
2.4 Expediting permit approvals, fee rebates, other financial incentives	50%
2.5 Tax exemption bylaw	66%
2.6 Development cost charge (DCC) reductions or waivers for GHG's	50%
3.1 Sign on to solar-ready building code provision	78%
3.2 Education to developers - renewable energy technologies and efficiency	81%
4.1 Promote Business Energy Advisor program / Host climate-smart program delivery	78%
5.1 Land use suite "lite"	78%
5.2 Land use suite "enhanced"	78%
5.3 Street design	81%
5.4 Flow RGS, OCP, and local area plans through to zoning	84%
8.5 Long-term, deep community engagement (culture change)	81%

Table 2: Implementation actions to be taken in 37 CEEP (reproduced from: Market Analysis Report by CEA, page 5, 2015)

In summary, after analyzing the CEEP data for the communities within the study area it can be concluded that:

- The target market comprises a significant proportion of BC's population, a high electricity demand, and, overall, has a growing population.
- Measures implemented by these communities are quite impressive, with a significant proportion having already conducted a variety of planning and policy measures.
- There is a significant appetite for conducting more actions by implementing planning and policy measures and community outreach. This is based on an analysis of the actions communities have completed.

Based on these findings, it was decided to analyze more of the communities in the target market focusing on planning and policy measures related to energy

sustainability and deeper community outreach. This can result in the adoption of more planning and policy measures related to energy sustainability.

3.1.3.2. Second Step- Questionnaire Design & Survey

A questionnaire was designed to understand the planning and policy measures related to energy sustainability. The purpose of this survey was to determine which policy tools communities were mostly interested in adopting. In the design of the questionnaire, it was important to understand the policy and planning measures that communities have the most interest in adopting or that require further implementation assistance. This would help to approach the policy design considering different strategies (e.g. regional collaboration).

Therefore, the survey questions addressed the following outcomes:

a. already adopted no further support needed

b. already adopted but need further support

c. not adopted but interested in receiving support

d. not adopted and no interest in receiving support

This survey (Appendix B) was sent out to 37 small- to medium-sized communities (see the map below) in the study area, and 20 responses were gathered (Figure: Map 1). The municipalities were color-coded based on their populations. In the map below, yellow indicates areas that have a population

of less than 5000 people, green shows populations of 5000-10,000, red shows populations of 10,000-30,000, and pink demonstrates populations above 30,000 people. The map was made using geocoding, and is available for review using the link https://goo.gl/Sem0zi.

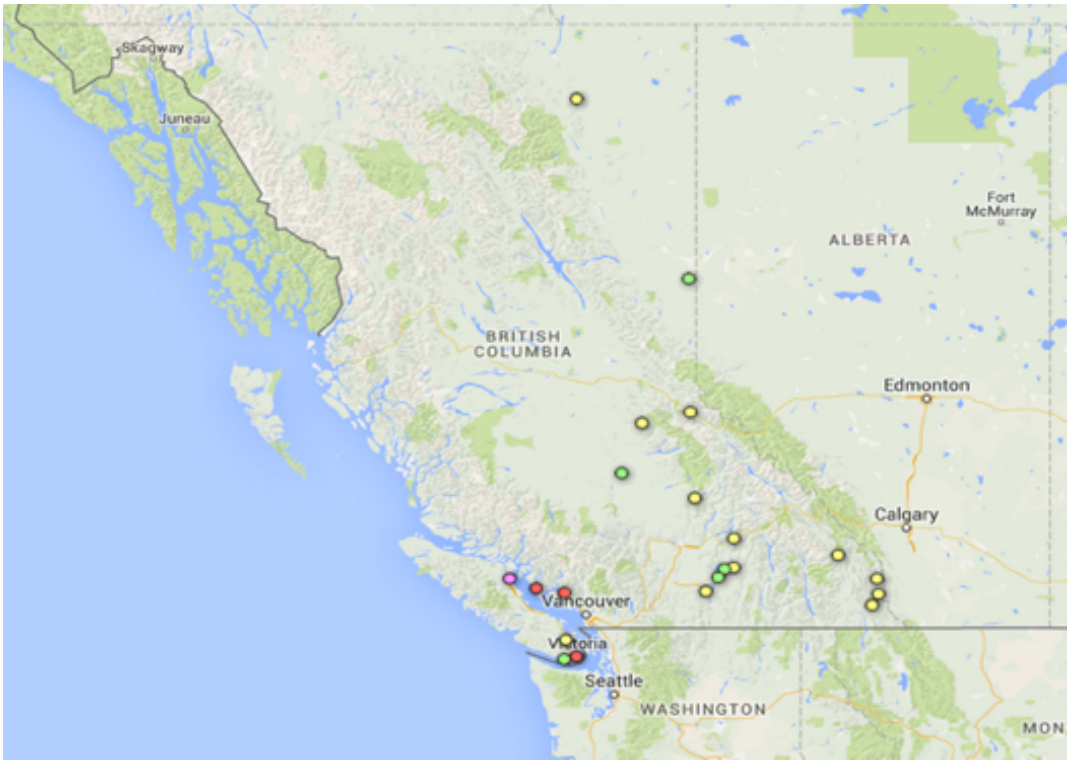


Figure : Map 1, Survey Results

3.1.3.3. Third Step- Data Analysis

The survey analysis identified the top five policy measures that would assist in the implementation of the energy objectives set in CEEPs. These choices based on the high interest initiated from municipalities, growth rates, and

populations. These policies were identified as key policy measurements for further implementation:

1. Sustainability checklist
2. Home Labelling
3. Permit Fee Rebates
4. Rezoning bylaw
5. Density Bonus Bylaw

Some of the results drawn from mapping of the policies are demonstrated below. For example when choosing density bonuses and revitalization tax exemption bylaw (RVTE) among communities >3000 population (in yellow) and those that are growing (in green), we get the following results.

Density bonus[1]:

- 5 communities – Coldstream, Lake Country, Peachland, Campbell River, Powell River
- Combined population – 71,573 people
- Combined growing at 1,149 people per year (1.61%)

[1] Density bonuses allows developers to increase allowable density in exchange for amenities identified as important by the community (e.g. affordable housing, parks, solar charger)

RVTE[2]:

- 4 communities – Coldstream, Peachland, Sparwood, and Williams Lake
- Combined pop – 30,013
- Combined growing at 279 people per year (0.93%)

From this data, the focus shifted to policies that seemed more effective in communities with a higher percentage of growth and population. (e.g. Density Bonusing)

During the terms of this project, the first three policy tools (sustainability checklist, home labelling, and permit fee rebate) were studied in further detail to identify how energy efficiency measures and RE targets could be implemented. As a result, best practices policy briefs were developed for each. The best practice document can be used as a guideline for interested municipalities that are looking to implement those policies. Due to space and scope considerations, for the purpose of this MRP, only one of these policy tools, the sustainability checklist, is further analyzed below through an example.

---

[2] Revitalization tax exemption by law is a tool used by councils to encourage different types of revitalization to achieve environmental, economical, or social objectives (e.g. revitalize properties that install solar panels to conserve energy)

3.1.3.4. Fourth Step- Best Practice Policy Brief

Based on the initial data gathered [table.x], 97% of the 37 municipalities in BC-Hydro territory showed interest in adopting a sustainability checklist as a policy tool for implementing the energy targets. In addition, the analysis of the survey questionnaire resulted in the sustainability checklist being one of the top five policy tools for encourage the energy target implementation.

To better understand this policy tool's advantages and disadvantages and to assess its effectiveness in terms of energy objective implementation, interviews were conducted with 10 municipalities who have already adopted this policy tool. [Please see Appendix C for Questions Asked]

As a result of the interviews and research results from other checklists used within BC, a brief titled "Policy Brief for BC Local Communities: Best Practices in Sustainability Checklist" was developed by me and is included in the next section. This best practice brief is now being shared by CEA with municipalities that are interested in using this tool to increase the implementation of their energy targets.

This checklist includes overall community sustainability targets, such as increasing the number of trees, increasing the energy efficiency target by

setting a minimum required percentage as a requirement, or increasing the RE targets by asking for a minimum percentage of RE generation to be implemented at any new site. The tool has been reviewed and data has been collected on the scoring system focusing on the enforcement level of the policy tool, the incentives associated with it, and the overall satisfaction of the municipalities who have used this policy measurement as an implementation tool. The tool has been identified, more than anything, to be a negotiation tool. Although, when it is mandatory it can result in gradual achievements of energy targets related to both efficiency and renewables.

Policy Brief for BC Local Governments

Best Practices in Sustainability Checklists

Overview

In recent years, there has been substantial interest in BC local governments adopting sustainability checklists in order to drive community sustainability, including energy efficiency. A sustainability checklist can be an excellent tool to initiate a conversation with developers and builders about how their development can support local government sustainability objectives, but they will not necessarily increase community sustainability if they are not reinforced by another policy. They can also be cumbersome to administer if

not designed correctly. The following best practices are meant to support local governments as they develop and adopt effective sustainability checklists.

Sustainability checklist uses

Sustainability checklists can be used to:

- Increase awareness of sustainable buildings
- Communicate sustainability options
- Negotiate more sustainable buildings (e.g. rezoning and development permit processes)
- Incentivize more sustainable buildings

Sustainability checklist best practices

Sustainability checklist best practices, identified through CEA's research, are:

1. Keep it simple – keep the checklist simple in all regards to keep it user-friendly, including with respect to design, language, and the scoring system. The scoring system in particular can be Yes/No or 0/1 point. Complicated rating systems frustrate developers and local government staff.

2. Make completion of the sustainability checklist mandatory – this will help the checklist to be taken more seriously by developers.

3. Highlight existing utility incentives in the checklist – the utilities offer incentives for energy efficient new construction, and these represent a good opportunity to encourage energy sustainability at no cost to the local government.

4. Coordinate local government incentives with utility incentives – any local government incentives for energy efficient new construction should be coordinated with utility incentives. This helps to increase the level of incentive for developers, thus increasing the amount of energy efficient new construction that will take place, and will keep things simpler for developers. The combined incentive level should be large enough to entice developers to build to a higher standard, compensating them for some of the increased costs associated with building better buildings.

5. Sustainability checklists should reinforce existing policy – be consistent with the content of the Official Community Plan, Local Area Plan, Community Energy and Emissions Plan, other planning documents and any other building-related incentive programs (such as development cost charge reductions or revitalization tax incentives).

6. Use energy targets that are quantifiable and achievable – a quantifiable measurement helps in performance evaluation. Research has identified that if there is no quantifiable target, then developers are not clear on what needs to be achieved. When considering your target and scoring system, take into account what is a good fit for your community, the community's goals for GHG reduction, and the capacity of both small and large developers. There is a balancing act in selecting a target that is achievable while stretching developers somewhat beyond the code.

7. Keep the checklist up-to-date – update the checklist regularly to reflect changes, e.g. new policies/incentives, and updates to the BC Building Code.

8. Require submission early in the permitting process – it's advantageous to engage developers from an early stage and ensure that they know what is expected of them. The earlier sustainability is considered in the decision making process for a new development, the easier it can be incorporated.

9. Use existing green building standards – local governments do not have to reinvent the wheel and create their own green design standard. There are many existing green building standards. BC utilities have already analyzed them and identified ENERGY STAR® for New Homes as the most advantageous for enhanced energy efficiency. It is recommended that local governments leverage the standard utilities being used.

Once I completed the best practices policy brief, a webinar was hosted through CEA for interested municipalities. Though I did not present the webinar myself, I attended to answer questions and provide feedback on the process that has resulted to the "Policy Brief for BC Local Communities: Best Practices in Sustainability Checklist". This webinar was taken place on October 21, 2015 and was used as a learning tool to share the knowledge gained with other municipalities and to respond to questions from the local government's interested in implementing this tool.

3.1.3.5. Fifth Step- Policy Framework Design for Council Meeting

Example: City of Duncan Sustainability Checklist

City of Duncan has expressed interest in working with CEA to make changes to its Sustainability Checklist. The city had originally designed a Community Sustainability Checklist few years' back; however, the checklist was not used to its maximum capacity and had delivered low results in improving energy efficiency and RE deployment within the development applications received by the city.

The best practice policy brief was used as a guideline to highlight the important points required for the success of the checklist. Through collaborative thinking with the city's staff and CEA team, a new Community Sustainability Checklist [Appendix D] was developed by CEA (myself as part of the team) and City of Duncan Planners to better serve the needs of the municipality.

The re-design of the City of Duncan's Sustainability Checklist took CEA team and the city planners about six months. At the end, the new checklist gained the approval of the council. Once the final draft of the checklist is reviewed, this policy tool will be required for all applications submitted to the city for Zoning Bylaw Amendments, Development Permits, and Development

Variance Permits. The tool encourages developers to integrate energy efficiency measures higher than what is required by the province's building code; it also requires new developments to provide a percentage of their energy from renewable resources.

The design of this policy framework is based on a point system that promotes the use of sustainable measures in reaching energy targets. Additionally, there is an incentive tied to this policy, which is expected to greatly impact its adoption; a 25% reduction in Development Cost Charges is applied when an application scores 75 or higher on the sustainability checklist. The promotion of RE (solar and geothermal heating), solar ready buildings, and meeting new home energy labelling standards are included in the energy section of the checklist. The city of Duncan will monitor the improvement in the overall energy and GHG emission targets of their CEEP for five years, at which point it will decide whether it is necessary to tighten some of the actions required by developers.

3.1.3.6. Sixth Step- Implementation and Feedback for Improvement

In this step, municipalities who have implemented a policy framework can monitor the progress and the impact of the policy in achieving the energy targets. However, because this step takes a longer time to evaluate, further details cannot be provided as they are outside the scope of this MRP.

3.2. Major Findings and Lessons Learned

3.2.1. Municipality's Role in Policy Framework Development

Through this research process, I have witnessed the leadership roles municipalities in BC have taken in increasing sustainability in their communities. Based on the direct experience gained it can be concluded, that the role of municipalities in policy framework development has been to regulate, facilitate, and advocate the increase in energy efficiency and RE targets set in the CEEP.

3.2.1.1 As Regulators and Planners

Municipalities operate closest to the citizens and stakeholders in their area. Therefore, as regulators and planners they can design policy frameworks that work well within the context of their communities. Municipalities can also provide methods, which result in the increased implementation of energy targets through setting priorities and experimenting with policy tools.

3.2.1.1.1 Design Context Base Policy Frameworks

Municipalities can effectively increase energy efficiency and RE targets through their roles as regulators and planners. Local municipalities, through

the adoption of local regulatory frameworks, can set the vision and encourage increased energy targets by using creative policy tools attached to current planning and policy regulations.

For example, municipalities can design policies that provide co-benefits, such as environmental, economic, and health related advances (Kousky, C., Schneider, S.H., 2003). Municipalities in BC aim to bring down building's GHG emissions through achieving higher energy efficiency targets than what is required by British Columbia's Building Code (BCBC). As a result, they have developed a policy framework that informs builders of the benefits of achieving higher energy efficiency. These policies can be powerful motivators for all stakeholders. For example, it has been identified through research by Pembina institute that almost 70% of homebuyers are willing to pay about $5,000 more for energy efficient homes (Frappe-Seneclauze et al., 2014, p. 17).

3.2.1.1.2. Set Policy/Action Priorities

Local officials have a key role in public infrastructure and energy control that is central to climate adaptation strategies. Additionally, many local governments are limited in their resources and capacity, this could encourage municipal policy makers to prioritize which aspects of a problem to address

and in what order (Vogel, B., & Henstra, D., 2015). According to Smith et al. (2014), setting priorities is a political activity that involves conflict over values and interests. Local governments, more than any other jurisdiction, are aware of the vulnerability in their communities. As a result, they can tackle several priority areas for mitigation of climate change, including GHG emission reductions and land use changes (Khare, A., & Beckman, T., 2013).

Based on the research findings during this project, the priority in the smaller- to medium- sized municipalities of BC is to increase energy efficiency in the new buildings as their short-term strategy reducing GHG emission. Energy plays a significant role in the economic wellbeing of the municipalities. Energy demand and supply are key in community planning as every sector of the economy is dependent on them. Identifying energy supply and demand issues as the priority, municipalities can address issues such as rising prices and the lack of energy security.

3.2.1.1.3. Experimenting with Policy Tools

Formulation of policy involves feasible policy choices to address a problem (Wu et al., 2010, p.29). At the local level, policies can be tested for their results. Innovative policy experimentation practices once tested at smaller scale can be replicated in other communities (Vogel, B., & Henstra, D., 2015).

This experimentation with policy or policy tools for a short term will provide cities and communities with the opportunity to measure the performance of a policy over a period and to make changes according to the local needs. This is an important role that local level governments can play to increase energy targets. There is no "one size fits all" policy that would work for every region.

For example, to support municipal energy planning and to promote RE technologies, municipalities can design policies or use policy tools that would result in encouraging RE and energy efficiency at the local level. Municipalities could lead the way by developing policies that will help support the transition of the conventional energy systems to renewables. At the local level, some adaptation principles are integrated into community official plans in the form of a vision or a regulation (Baynham and Stevens, 2014). However, if the municipalities realize that a regulation set in the CEEP is not working, they can reframe or change that policy to make it work in their local context through experimentation with different policy tools.

Therefore, experimental policy tools could be integrated into planning processes and be tested for their results. In several BC municipalities the sustainability checklist is being tested as a tool to encourage both energy efficiency and RE policy objectives. Cities can experiment with specific policy designs suitable for the promotion of renewable targets appropriate to

their region. For example, high sunshine regions can provide incentives for the promotion of photovoltaic systems across the region.

3.2.1.2 Cities as Policy Facilitators

3.2.1.2.1. Establish Effective Partnerships with all Stakeholders

As it was demonstrated in this chapter, there are a wide variety of actions and policies that local governments can pursue to address climate change issues at the community level. However, these actions have much more influence if they are part of comprehensive and integrated climate policies for fostering urban development in the changing global climate. Comprehensive policies, according to Lee & Painter (2015), are an "integrated approach in planning and implementing of climate change mitigation and adaptation policies". This requires strong relationships among all stakeholders, a common interest, and a sense of ownership (Hein, L., van Koppen, K., de Groot, R., & van Ierland, E., 2006).

Local municipalities can act as the glue that binds organizations together, i.e. facilitating access to resources, and sharing the knowledge gained (Hein, van Koppen, de Groot., & van Ireland, E., 2006). Local governments can, therefore, facilitate the engagement of other stakeholders and involve a variety of organizations in civil society (e.g. citizens group, businesses,

builders, or financial institutions) from the early stages of energy planning. Together they can address the challenges presented by climate change.

Local governments are well positioned to connect all stakeholders interested in achieving a common goal and sharing successful strategies. Additionally, their close proximity to stakeholders, the public, and other municipalities enables them to design strategies that are tailored to the broader local community needs based on their exposure and knowledge gained through discussions with stakeholders (Auld and Maclver, 2007). For example, municipalities can look into region-wide policies to increase energy efficiency or RE deployment. In BC, four communities including North Cowichan, Cowichan Valley Regional District, Ladysmith, and City of Duncan, are looking to collaborate on some of their policy implementation tools to maintain a standard among the communities and to use the benefits that a successful collaboration can bring.

Municipalities, through communications with local stakeholders, policy-makers, and using alternative scenarios to consider different outcomes, could propose solutions that address these local priorities (Van Aalst et al., 2008). Each community has its own specific socio-economic and physical attributes that should be considered in the climate policy formation. As a result, cooperation between community stakeholders and policymakers at the local

level enhances their understanding of the challenges and issues (Lee, T., & Painter, M., 2015).

3.2.1.2.2. Provide Incentives

Municipalities can encourage homeowners, builders, and commercial buildings to implement more energy targets through incentives. At a small scale, the Regional District of Nanaimo in BC provides incentives between $500 to $1,000 for homeowners and builders if they achieve a higher EnerGuide rating from what is required by British Columbia Building Code (Solutions, 2015). According to an interview with the Sustainability Coordinator of this municipality, incentives do play a key role in the implementation of energy targets.

Municipalities can promote the installation of RE systems at the local level through incentivizing the use of solar hot water, photovoltaic, geothermal, and micro wind for homeowners. The Regional District of Nanaimo in BC provides direct financial incentives to encourage RE deployment as a strategy to deal with energy security in the region (Solutions, T., 2015).

3.2.1.2.3. Local improvement charges (LICs)

Local improvement charges (LICs) have been long used by municipal governments to cover the costs of infrastructure improvements such as sidewalks, roads, etc. However, LICs can play a major role in improving RE and energy efficiency in homes. Through the facilitation of this tool, municipalities can ensure financing is available to homeowners improving on their energy efficiency and of the incorporation of RE systems in their homes. These financing options, available to homeowners, have the benefit of being attached to the home's property tax (Pembina Institute, 2004).

The facilitation of LICs is both cost effective and good for the environment. LICs help homeowners improve their energy systems, whether by funding efficiency measures or renewables. These improvements boost the environmental performance at the local community and help those mostly affected by the rising energy costs to afford and make these energy changes to their homes, which will stay with their home and be passed on to the next owners.

3.2.1.3. Cities As Sustainability Advocates

Municipalities can show their involvement in broader policies to push for RE systems and increases in energy efficiency at the local level. As sustainability

advocates, municipalities have a vital role in increasing awareness and building capacity among citizens and professional stakeholders.

3.2.1.3.1. Increasing Public Awareness

A broader understanding of the benefits of energy efficiency and RE systems is required within the current energy dialogue, both for professional stakeholders and citizens. Municipalities can use tools, such as education campaigns, websites, social media, energy mapping, and promotions through utility programs, to explain the importance of shifting perspectives on RE systems and on increasing energy efficiency. For example, to increase awareness on RE sources, the BC Regional District of Nanaimo has created a residential RE Systems Guidebook (Regional District of Nanaimo, 2012).

Raising awareness about the benefits of RE systems and energy efficiency measures is key to achieve widespread adoption. Civic partnerships, professional stakeholders, and community organizations are all essential groups for addressing climate change issues and transitioning from a fossil fuel society.

3.2.1.3.2. Building local Capacity

Capacity building is required at different stages of policy framework design and energy planning. It is important to educate both the community and the builders. In the research done for this MRP, it was interesting to find that builders are enthusiastic about educational programs from local governments on policies, energy efficiency measures, and requirements for renewables. They, too, see the benefit in building more sustainable communities, as they understand their role in addressing climate change issues.

3.2.2. Energy Efficiency Targets versus RE Targets at the Community Level

The International Energy Agency (IEA) noted in 2013 that buildings are the largest energy-consuming sector in the world economy. This is one of the reasons that many municipalities started taking actions to reduce the energy consumption within their building sectors by initiating energy efficiency targets. It was not a surprise to find this trend in the work line of municipalities in BC. Most of the emphasis seems to be placed on the energy efficiency measures of the buildings, rather than an equal approach to both energy efficiency and RE.

In many CEEPs, RE is often addressed indirectly within other themes such as green programs, sustainability, or climate change. Additionally, while there are RE targets within the CEEPs, they are very minor, and there are not many

incentives or policy frameworks to encourage its deployment. Energy efficiency requirements for buildings, as the largest energy-consuming sector, could be set quiet low at the provincial level. As a result, to improve energy efficiency measures above what is required by provincial building codes, municipalities are searching for methods that would encourage builders to increase the required minimum EnerGuide rating (e.g. required EnerGuide for new buildings in BC is 77 effective 2014).

An EnerGuide rating system, designed by Natural Resources Canada, is an energy efficiency rating systems that shows the energy performance of an individual home's energy efficiency (Natural Reserouces Canada, 2015). It can be used to compare the energy efficiency performance of one house against another house. It is on a scale of 0-100; a rating of 0 represents a house that has major air leakage, no insulation, and high-energy consumption, and a rating of 100 percent represents a house that is well insulated, with no air leakages and requires no purchased energy on an annual basis.

3.2.3. Lessons Learned During Policy Framework Design

3.2.3.1. Understanding Available Policy Options

The goal of energy policies is to increase the adoption of measures such as technologies and behaviours that would increase energy efficiency and the

deployment of RE. However, these energy policies vary in terms of how they contribute to this overall goal. Therefore, it is important at the local level to understand the dynamics of different types of policies and their market transformations.

At the research and development stage, the goal is to innovate new policies or improve current policies or methods to deliver energy services that are more energy efficient and include a percentage of renewables. At the early adoption stage, policies may fall into three categories: voluntary, mandatory, or incentive-based.

Voluntary policies usually rely on information to reduce barriers that would instead increase the uptake of energy efficiency or RE measures. These policies do not provide any incentives, or they are not a requirement. It has been learned through this research that the most voluntary policy used is education. However, educational campaigns are limited in their capacity to convince stakeholders to implement energy efficiency or RE targets. These policies do not fuel the market for sustainable energy adoption. Instead, they simply increase awareness and support more effective policies.

Mandatory policies require the use of a specific target achievement, technology development, or behavioural change to meet performance

standards. For example, a mandatory policy can require that all new homes must be solar ready. It seems that these kinds of policies are adopted when a huge market transformation is the main goal.

Incentive policies provide a benefit in exchange for update to the energy objective standard set within the CEEP. The incentives could be financial, such as monetary payouts for an achieved target, or they can also be non-financial, such as a faster application approval process. A policy may start in the form of a voluntary action and then get promoted with an incentive before being adopted as mandatory step (e.g. Sustainability Checklist for City of Duncan).

3.2.3.2. Assess Policy Based on Key Criteria's

Another important lesson learned was the need for assessing a policy once it has been identified by a municipality as a good fit. There are key criteria for each policy being adopted. For example, an energy efficiency policy's criteria could be energy saving potential, cost effectiveness, capacity of the municipality, its impact on the development, and affordability.

The appropriate policy mix to advance energy targets will be different in each community. However, the key influential factors could include the market conditions, community priorities, and local government capacity. Many local

policy tools are found to be complementary. For example, the sustainability checklist aims at improving both energy efficiency and RE targets.

3.2.3.3. Effectiveness of Policy

Once a policy has been selected, the design of its details within the context of the specific municipality should be determined. Therefore, the best practices policy developed in this research provides a unique advancement for municipalities ready to adopt new policies or improve their current policies as they can assess the effectiveness of the policy based on their local context.

3.2.3.4. Implementation of Policy

Once a policy has been approved, such as the sustainability checklist in the City of Duncan, the final step is implementation. This could take place in four different components: operations, communications, training, and evaluation. In the operations stage, it is required to review the processes that are affected by this policy. In the communication stage, materials should be distributed to promote its existence. In the training stage, internal staff should be informed of the benefits that result from the new policy. Additionally, some policies could benefit from training for developers and property owners, such as energy efficiency policies. In the evaluation stage data should be collected

and feedback should be gained to better understand if the policy is actually serving its original purpose.

From plans to policy implementation, the six steps explained in this chapter are suggested for municipalities who have already adopted a CEP. The steps and lessons learned could be used as a guideline for developing suitable and achievable policy frameworks that address the need for quicker responses in dealing with climate change at the local level. In addition to that, research, questionnaire design, interviews, and webinar sessions have greatly provided an insight on how municipal policy decisions are made, the time frame required for a plan to become policy, the advantages of local energy planning, and the limitations of local municipalities in addressing climate change by focusing on energy policies.

3.3. Summary for Local Policy-makers

The following items provide an overview of take-home messages for policy-makers:

1. At local level, engagement of stakeholders early on is key. Therefore, regular meetings through multi-stakeholder governance with municipal leadership are advised. This way, governance bodies act as channels for comprehensive energy and climate strategies.

2. Community Energy Plans are more like a guideline to place municipalities on the right path. To achieve results, it is vital for the CEPs to be integrated into existing planning tools in the community, such as the local Official Plan.

3. Lack of capacity in smaller municipalities may result in a lack of focus on achieving RE and energy efficiency objectives. As noted by an interviewee, a small municipality usually has one or two planners who are extremely busy with development applications. Municipalities should use their human capital wisely.

4. "Policy framework design should have a political buy-in," said one interviewee. Otherwise, achieving energy objectives higher than what is required by the province becomes extremely difficult.

5. Incentives go a long way if they are easy to get and the amount is set appropriate to the size of the development. Therefore, they can be used to increase energy target implementations.

6. Raising financial capacity through innovative ways is key for smaller municipalities with no link to financial resources. The financial capacity should be long-term to remain effective.

7. Monitoring a policy action and making it measurable is key to understanding the performance result of a policy. Municipalities, therefore, should commit to continuous improvements of their energy policies.

8. Municipalities can be very slow in their processes. Therefore, it may delay the adoption of the right policy at the right time. Setting priorities to collaboratively respond to the energy policies is key.

9. The energy efficiency of buildings seems to be the focus of many small- to medium- sized communities, mainly because they avoid long term planning and look into short-term solutions such as conservation. However, implementation of RE systems is just as important in the transformation of communities.

10. RE deployment is only easier at a smaller scale if council leadership exists and the right policy or incentive is in place. It is key that more and more municipal leaders attend conferences and learn the possibilities of making a difference at the local level.

Section 4: 100% Renewable Energy, the Ultimate Target

"There is nothing more powerful than an idea whose time has come". Victor Hugo (1802-1885)

4.1. Applying Policy Lessons

The policy lessons acquired by analyzing the experience of BC communities is applied in the next section in regards to communities aiming at achieving 100% RE targets.

4.2. What does it mean to have a 100% Renewable Energy Community?

According to Droege (2010), 100% RE quite simply means zero fossil or nuclear fuel content in operational, embodied energy or stationary usage of energy (p. 5). According to the Global 100% RE campaign (2015), an international network of NGOs that shares the vision of achieving 100% RE, there are 8 Countries, 55 Cities, 60 regions, 9 utilities, and 21 nonprofit institutions, that totals to more than 53.3 million people, who are shifting or have already shifted to 100% RE in at least one sector of electricity, heating/ cooling, or transportation.

The Global Status Report on Local RE Policies, 2011 defines 100% renewable cities, towns, or regions as those that have assigned a political 100% RE target. This includes all places that have either achieved the target, or are on their way to doing so. However, the definition of 100% RE is not clear-cut. Some define energy only as electricity, while others define it as other energy end-uses such as transportation, heating, and cooling. Energy in the context of

a community means heating, fuels for transport, and electricity. For the purpose of this MRP and to better understand the meaning of the 100% RE target, three cases from Europe, Canada, and the United States of America were chosen for further review.

4.2.1. Oxford County, Ontario (Canada)

Oxford County is located in the southwestern part of Ontario, Canada with a population of 105,719, according to Statistics Canada (2011). The County was the first municipality in Ontario and the second in Canada—after the City of Vancouver—to commit to achieving 100% RE by 2050. The decision was made on June 24, 2015 after the county's council unanimously adopted the motion to become 100% renewable by 2050 [see Appendix E].

In order to coordinate and facilitate the 100% RE target, Smart Energy Oxford comprised of partnership among many stakeholders including municipalities, sustainable energy businesses, local distribution companies, sustainable energy advocates and private citizens was established to promote RE in Oxford County. (Smartenergy Oxford.ca., 2015). To achieve the goal of 100% or more of the energy demand coming from renewable sources by 2050, the county has proposed a framework that, once established, would set the county on the path to: 1) energy conservation and demand for reducing overall energy

needs in the county; 2) energy production from renewable sources available at the local level (e.g. solar, wind, water, biomass, geothermal and heat recovery); and 3) opportunities to foster the expansion of RE production, advancement of energy efficiency, and their application throughout the county.

Through an interview with the County's Chief Administrative Officer in October 2015, the main reason for the 100% RE commitment was aimed not only to protect land, air, and water in order to deal with climate change, but also to build a sustainable local economy. The county acknowledges the challenges the municipality would face in terms of implementing this target. However, it is finding solutions by engaging stakeholders, learning from the best cases around the world, and utilizing the research and development assistance from universities across the province.

As the County's Chief Administrative Officer said, the decision to set the target for 100% RE was "the right thing to do" knowing the evidence of a changing climate and its effects on the community. He also pointed out that the county wished that more local communities would follow their path to sustainability. However, since Oxford County has only recently set its 100% renewable target it has only started to map strategies to achieve this goal and it has not yet developed the policies that are required for the implementation

of this target. Instead the county, at this stage, is building capacity through resources available at the county level, the engagement of the community, and financial assistance from the council. (Source: Interview with County's Chief Administrative Officer).

In Canada, city of Vancouver that has recently adopted a strategy to shift to 100% RE by 2050 is a good reference point for Oxford County's attempt in reaching its target. City of Vancouver has adopted an integrated plan to achieve multi-benefits through considering the three pillars of sustainability (social, economic, and environmental). The city has recognized that to achieve the 100% RE target it would require regional, provincial and federal policy to support the use of RE sources and to reduce the energy usage across sectors.

Therefore, cooperation with a wide range of stakeholders from early stages had been accounted towards this strategy. The city has also identified major energy sectors that require a change and placed priorities to address the required actions. The main focus of the city is on zero-emission buildings, renewably powered transportation, RE city services, economic opportunities of RE and increase in neighbourhood's RE systems (Renewable City Strategy (Vancouver), 2015).

4.2.2. Palo Alto, California (U.S.A)

The city of Palo Alto is located in California's Bay Area, South of San Francisco. The city has a population of approximately 63,000 people (US Census Bureau). In July 2013, the City Council voted for a 100% renewable electricity power target as part of its commitment to carbon neutrality (City of Palo Alto Council Agendas). The city owns its energy utilities and, therefore, can choose how to operate them. In order to enroll in the 100% renewable plan, Palo Alto electricity customers have agreed to pay a slightly higher fee (3$ added cost per year). In return for this investment, each household that participated avoided the emission of approximately 9500 Ibs of CO_2 (equal to not driving a vehicle for 10 months).

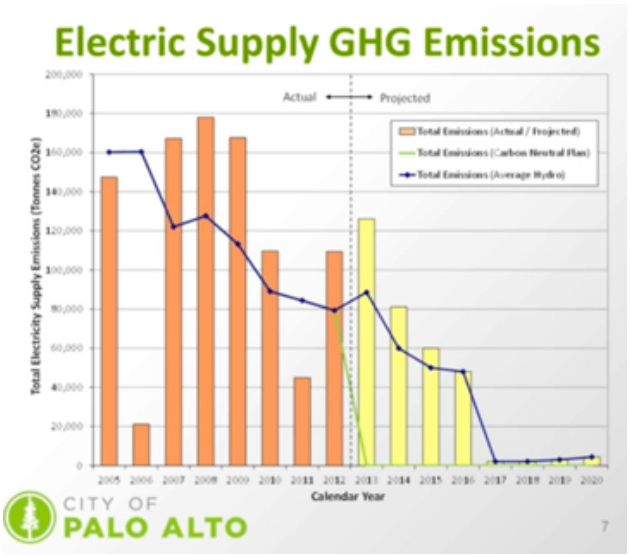


Figure 5: City of Palo Alto Electricity Supply GHG Emissions

Source: City of Palo Alto Website

In the current electricity supply mix, the city generates more than 50% of its electricity from hydro, 25% from wind, and the rest is a mix of natural gas, solar, and biogas. When the city purchases non-RE supply, it offsets it by

purchasing RE certificates (RECs). One REC is created for every 1000 KWh of electricity that is placed on the grid from a RE generator (United States Environmental Protection Agency). As of 2017, the city will no longer continue with RECs as all of its power supply will be achieved through RE sources. This is mainly due to the new contracts the city has signed for large-scale solar electricity production.

Most of the emissions in the city of Palo Alto stem from transportation. However, the city has seen opportunities in the electric car sector as their low-hanging fruit in their path towards 100% RE. The city has charted its GHG emission horizon based on the increase in RE and energy efficiency. Palo Alto's embrace of RE projects and greater energy efficiency as resulted in significantly lower GHG emissions [see figure 5]

The city has taken several key initiatives to achieve a 50% renewable electricity supply through: Utilities Incentive Programs, Renewable Portfolio, Palo Alto Green (2003), City Climate Protection Plan, 10-year Energy Efficiency Plan (revised every 3 years by law), a Feed-in-Tariff Program, and a Carbon Neutral Portfolio Program.

4.2.3. Rhein Hunsrück (Germany)

The regional district of Rhein Hunsrück is located in Southwestern Germany and has a population of 104,000 people. In 1999 the region's politician, Bertman Fleck, started a campaign by promising to harness 370 Million Euro's spend annually on energy bills into money for local RE systems (Etcheverry, 2015). Thus, the district maintained the 370 Million Euros into producing power at the regional level. According to the Global 100% RE Campaign, this decision resulted in the generation of 65% of the region's electricity in 2010. Progressively in 2012 the region exceeded its 100% RE production and started to export the renewable electricity produced. Thus, creating economic value and jobs at the region (Couture, & Leidreiter, 2014).

Rhein Hunsrück started the transition towards sustainability over two decades ago (1999-2009), following the desire to become a role model for other districts by reaching 100% local energy from CO_2 neutral energy supply (Couture, T., & Leidreiter, A., 2014). The region estimates it will produce 828% of the district's power consumptions with renewables by 2050 (Go 100% RE, 2015). Various projects and initiatives have been taken by Rhein-Hunsrück. The overview of their achievements can be narrowed down to 2000 individual solar photovoltaic (PV) systems, a minimum of 100 wind turbines, and 17 biomass, combined heat and power (CHP) facilities. (Couture, & Leidreiter, 2014, p. 18). What made this possible was the combination of leadership, a broad pool of expertise, and the right political arena.

Strategies used by the district have included ensuring community "buy-in" to the energy transition by educating the younger generation early on, public campaigns about the benefits of the transition, electricity cost-savings, and opportunities for citizens to financially participation in the energy transition (Go 100% RE, 2015). According to Navigant Research (2013), the district has used aggressive energy efficiency programs that reduced their electricity load by 25% in 2014 through combination with the shift to local power supply generation from renewables. The district also benefits from having grid connections with all neighbouring districts, which from a technical perspective provide fewer challenges. The region is now looking into solutions for making its transportation to 100% RE and to re-investing 250 Million Euros for expenditures in RE systems that would create local jobs and innovation (Couture & Leidreiter, 2014, p. 22).

4.2.4. Main Findings and Discussion

4.2.4.1. There is no One Size Fit All Approach

Every community is different. However, it seems that there are certain principles and visions that can be applied everywhere. However, the initiatives taken by each of the communities analyzed shows that the path for achieving the 100% RE target is different. This path, drawn from the case

studies, could depend on the available local resources, climate of the region, degree of control over energy supply, local government, and their capacity and the involvement of the region's citizens, relationships among all stakeholders, and the development history in the region. The right political and community "buy-in" is vital to moving the RE plans forward.

4.2.4.2. Energy Efficiency Is Vital

Energy efficiency measures are a vital first step for reducing GHG emissions and planning for long term RE systems. It offers a cost-effective tool for achieving energy transformation (Maltini, 2014). Having energy efficiency measures as part of a comprehensive plan towards 100% RE is key and can be achieved through proactive local demand energy management.

Improvements in energy efficiency result in a reduction of investment in the conventional energy infrastructure and improved consumer welfare. Mark Rosalind, in his book titled Toward Sustainable Communities, acknowledges energy efficiency as the most cost-effective alternative to expanding energy supply (p. 113). According to Maltini, F. (2014), the most important sectors that energy savings can be applied to are buildings, industry, appliances, and transport (p. 207).

4.2.4.3. Set Targets for 100% Renewable and Nothing Less

The first case, Oxford County in Canada, described a municipality at its earliest stage of developing a plan towards 100% RE by 2050. The main driver for this target has been to understand that achieving this goal is possible. After that, setting the target and projecting the vision have been the key drivers towards this ultimate goal with acknowledgement of the challenges to be faced along the transition period.

As Bertram Fleck, the chief administrative officer of the district of Rhein-Hunsruck has discussed, "There are two types of leaders: those who look for all the reasons to be afraid of advancing RE and to put it off, and those who look for ways to get it done and figure out best practices as they go" (Presentation in Pathways to 100% RE conference available at http:// www.renewables100.org).

Oxford County has definitely proven to be a leader that is not afraid of facing challenges as they go along the 100% RE path. In the case of Palo Alto, harnessing the low-hanging fruit, the electricity sector, had opened up possibilities to bring changes to other sectors to become 100% RE as well. For example, by harnessing the power of the sun and increase in local electricity generation changes in the transportation system is also coming along. The city of Palo Alto has recently passed a new ordinance requiring all new homes to accommodate electric cars. This change would not have

happened if the city did not invest in the 100% renewable electricity systems. Therefore, setting the 100% RE target is essential in shaping the future actions of local governments.

4.2.4.4. Defining What 100% Renewable Energy Means and Engaging Local Citizens

It is important to define what 100% RE means. According to Droege, (2010), RE at full capacity will cover all electricity, thermal, transportation, and other energies embodied in goods and services. As we have seen in the cases above, Palo Alto, for example, has set the target to make its electricity sector 100% RE. Oxford County, however, has not yet defined what it means by 100% RE by 2050. It is best to clearly define the meaning of the goal so that planning can be attainable.

The district of Rhein-Hunsrück in Germany has clearly addressed the importance of the lifestyle and behavioural patterns of the consumers during the energy transition. They have identified that, by engaging citizens from an early age, they can achieve important lifestyle changes that would affect their choices toward energy consumption and production as they age.

4.2.4.5. Make an Economic Case for 100% Renewable Energy Community

There is an industry waiting to be evolved, said Oxford County's Chief Administrative Officer in an interview on October 2015. Communities should act quickly in order to benefit from the early beneficiary of this new market, waiting to be evolved through new economic cycles (Newman, Beatley & Boyer, 2009; Friedman, 2008). It is clear from all three case studies that jobs have been or will be created within the communities, as most of the money that was used to import energy is now being kept inside the communities. For example, the early successes of Rhein-Hunsrück demonstrate the significant environmental benefits, substantial economic benefits, and reduction in the region's reliance on imported energy while creating jobs and revenue for their district.

4.2.4.6. Effective Municipal Policy Framework is Key

If there is no strong backing from the Councils during the transition towards 100% renewable communities, the vision of 100% RE will just be a dream. As it has been seen in the case of Palo Alto, the city has supported the movement towards 100% renewable electricity by applying mandatory and voluntary initiatives. Roseland (2012) acknowledges that demand management has proved to be a smart strategy in a variety of contexts. Two keys to such conservation initiatives are both strong community support and strong administrative leadership within the community to implement policy frameworks that work for the community achieving its target.

4.3. Why Should Communities Plan for 100% Renewable Energy Now?

The fabric of our current cities and communities is dependent on conventional fuels. This results in cities, according to Stefan Lechtenbohmer, being not only the main driver of climate change, but also the bearer of the effects of a changing climate. According to Rae, & Bradley (2012), at the community level the increased levels of energy autonomy results in social, financial and environmental benefits. In addition, investments made today will determine the energy systems of tomorrow. RE resources offer many times more than the world's energy demand; its potential is enormous (Akella, Saini., & Sharma, 2009). RE technology can bring numerous opportunities to communities as detailed in the following sections.

4.3.1. Environmental Protection

RE usage to create electricity and other forms of energy supply reduces the environmental impact associated with fossil fuels used to provide communities with electricity, heating, and transportation fuel through the combustion of petroleum, natural gas, and coal. Some of these impacts include habitat destruction and damage to the ecosystem during the extraction phase (Finkelman, R. B., & Stracher, G. B., 2011), air pollution and acid rain

through “sulphur dioxide, nitrogen oxides, ozone, dust and aerosols, carbon dioxide, chlorofluorocarbons, steam-laden emissions and meteorological inversion” during combustion (Akella, A., Saini, R., & Sharma, M., 2009), and soil and water contamination resulting from spills or leakages during the extraction and transportation of fossil fuels (Vallero, D. A., & Letcher, T. M., 2013).

Generating energy through renewable technologies does not produce greenhouse gas emissions to the extent of conventional methods. It also reduces some types of air pollution that would otherwise be generated through the conventional production of energy. RE technologies produce GHG emissions only at the manufacturing stage. In addition, a study by the U.S. Department of Energy's National RE Laboratory explored the feasibility and environmental impacts associated with generating 80 percent of the country’s electricity from renewable sources by 2050 and found that global warming emissions from electricity production could be reduced by approximately 81 percent (National RE Laboratory, 2012, p. 271).

4.3.2. Improve Citizen’s and Ecosystem Health

Adoption of RE technology improves the public health at large. The combustion of fossil fuels affects human health in a variety of ways. These

effects might be as mild as an itchy eye, to as chronic as heart failure. These health effects have monetary value as well. For example, should people in Canada get affected by health issues associated with polluted air, soil or water from fossil fuel combustions, it would adversely affect the country's public funding for healthcare. Some of these issues are cardiovascular, nervous, urinary, digestive illnesses, premature mortality, and reduced life expectancy (Mabahwi, N. A. B., Leh, O. L. H., Omar, D., 2014).

Human health increases as the air pollution decreases. Ecosystems will improve as less waters are polluted for the extraction of fossil fuels. The increase in RE technology can also benefit agricultural productivity due to reductions in the acid rains (Partridge, I., & Gamkhar, S., 2012). It has been calculated by Jacobson, M. et al (2015) that health costs per person will decrease tremendously per year as all states and cities in the United States convert their all-purpose energy systems (electricity, transportation, heating and cooling, and industry) to renewably powered sources. These co-benefits arise from substituting RE generation technologies.

4.3.3. Provides Energy Security and Build Resilience

The adoption of RE sources that are available at the local level secure energy supply, increase energy independence, increase community resilience, and

increase the energy security (Valentine, S., 2011). The current challenges concerning the availability and accessibility of energy with depleting resources emphasizes the importance of adequate and affordable, while at the same time environmentally sustainable, energy services at the local level (Blum, H., & Legey, L., 2012). Bang, G., (2010) argues that to minimize the energy supply risk, domestic contributions should increase. The 100% RE systems in local communities mitigate the risk by cutting dependency on fossil fuel supplies.

Energy security, as the ability of an economy to provide sufficient, affordable and environmentally sustainable energy services , is one of the major challenges of the 21st century (Gouveia, Dias, Martins & Seixas, 2014). The environmental aspects of energy security are a rising concern as the combustion of fossil fuels to produce energy is the main cause of climate change and, thereby, extensive emissions of GHG. Energy insecurity due to resource scarcity and the rising prices of conventional energy sources are becoming major threats to the economy and political stability (Jacobson, M. et al, 2015). The continued reliance on fossil fuels and conventional energy technologies will adversely affect energy security (Valentine, S., 2011).

4.3.4. Creates Employment

The RE sector contributes to the development of a green economy. In Canada, despite less aggressive climate policies, employment in the RE sector will have a positive growth in the next decade (Demerse, C., 2011). According to the Clean Energy Canada (2014), each province has taken action towards reducing their fossil fuel reliance since 2009. For example, in April of 2011 the province of Manitoba allocated $30 million to support local clean-energy technology firms (Clean Energy Canada, 2014, p. 12). This investment turns into employment creation at the local level. According to Harden-Donahue & Peart. (2009); the average investments in RE create four times jobs in comparison to the same investment in fossil fuel economy (p.10)

Additionally, in a survey of clean-power investment and growth, there has been an accumulative national investment of $24 billion in renewables since 2009 (Clean Energy Canada, 2014, p. 4). Also, total direct clean energy jobs were 23,700 in 2012, which had outnumbered the total direct energy jobs in the oil sands industry. The available literature suggests that the deployment of renewable technology will result in significant job creation, which will result in more jobs per unit of installed capacity than the conventional technologies (Cameron, L., & van der Zwaan, B., 2015). Through the export and sales of clean and RE, local jobs can be created and local economies will be stimulated. This will happen by keeping the finance dollars, otherwise used to purchase energy, for the local communities' needs.

4.3.5. Democratizes Energy Systems

The analysis of eight city, region, national, and island cases done by Couture, T., & Leidreiter, A. (2014) on 100% RE resulted in findings that achieving 100% RE, contrary to many arguments, can actually generate significant cost savings (p. 44). Jurisdictions that achieved the 100% renewable targets managed to reduce their consumption of fossil fuels through substitutions with local RE resources. By reducing their dependency on importing energy, these places brought a wider range of benefits to their communities. In addition, many places saved through the reduction of subsidies used for end-user prices (consumption subsidies). These subsidies had been estimated as $530 Billion dollars in 2012, and savings achieved by many governments allowed for building economic and social resilience in their communities (Couture, & Leidreiter, 2014, p. 44).

The cost-effectiveness of RE generation systems at the local community level enables democratization of energy production by consumers. Particularly, as the cost of RE systems decreases, more consumers become engaged in their energy supply, mainly electricity (Riesz, J. et al., 2014). This allows the community members and stakeholders to take part in the energy systems and adopt an active role in energy production. RE technology offers opportunities to regain control over the energy production required for communities, helps

to stabilize energy prices, and increases the energy security within local communities (Roseland, 2012).

4.4. Why 100% Electricity Sector?

The electricity sector is of particular importance as it is the building block of our modern lifestyle and economy. The global temperature increase has a significant impact on the electricity demand and expansion of networks for supply (Ahmed, T., et al., 2012). This increase in demand would result in more GHG due to the production of electricity in many areas of the world as discussed earlier. The ability of local governments to provide affordable and reliable energy to meet society's need for electricity will be compromised if business as usual is the only method of providing the electricity needs (Mideska, & Kallbekken, 2010). As a result, the solution of alternative energy technologies, prior to significant increase in the energy prices and more damage to the Earth's climate, is a viable action.

According to the "Power for the Future: Electricity's Role in a Canadian Energy Strategy" (2013) report, electricity generation in Canada consists of 63% hydro, 15% nuclear, 15% coal, 5% natural gas, and 2% wind (p. 14). For the production of electricity from renewable resources, wind, geothermal, solar photovoltaic, tidal, wave, and hydropower have been identified as the primary technologies (Jacobson, M., 2009, p. 4).

In Canada, the main portion of the electricity system is generated through hydro, therefore, the decision to go 100% renewable electricity would only require 37% more renewable sources to be added to the current hydro system. Therefore, setting the target for 100% renewable electricity is the right path for Canada. This is particularly true considering the abundance of renewable resources available around the country.

Jacobson, M. (2009) proposed in his research that climate change, energy security, and air and water pollution can be addressed using three renewable sources of water, wind, and solar. Further, Jacobson, M. et al. (2015) provided a thorough analysis of 100% renewable roadmap for all sectors, should all of the energy sectors including electricity, heating, and transport were converted to one format: electricity. They calculated that all of the energy demands can be met through water, wind, and solar by gradual phasing out of the conventional fossil fuels by 2050 (Jacobson et al., M., 2015).

4.5. The Recommended Renewable Energy Framework for Canadian Municipalities (CEP phase II)

Jeremy Leggett, in his report published in 2014 on how to achieve 100% RE notes:

> "Our dependence upon fossil resources has built a system that lacks diversity and security, threatens the health of our citizens, jeopardizes the stability of the earth's climate, and robs future generations of clean air, clean water, and energy independence"

Therefore, it is the duty of decision makers and citizens today to transform the current energy systems to 100% RE systems. There is a lack of research in the scholarly articles regarding the development of RE community frameworks; however, discussing the issue with ten municipal staff members helped me to synthesize the recommendations summarized in the next section.

The following recommendations are specifically for communities who have already adopted a CEP and therefore are aware of their energy supply and their demand load for business as usual in different sectors. In addition, they should have an estimate of the growth within their communities over the coming years, and they must be willing to develop policy frameworks that would increase the implementation of RE targets in three gradual timeframes of 2020, 2030, and 2050. These communities should plan to have SMART implementation plans, meaning specific, measurable, achievable, realistic, and time-bound plans (Quest Conference in Vancouver, December 2014). In their second phase CEPs should have the council's approval for the specific timeframes and targets so they should be quantifiable and achievable based on

the communities' capacities.

4.5.1. Set 100% Renewable Energy Target for 2050

The first step required in achieving 100% RE is to set a political target that would bring commitment and provide understanding for all stakeholders regarding the long-term vision for the community. Providing a strong picture of the future and highlighting the benefits of RE systems will give the stakeholders a sense of ownership and commitment. Many regions around the world have achieved the 100% RE goal. The technologies and the knowledge required to make this transition exist. However, as pointed out by many, "the transition to 100 % RE is a political – not technical – decision" (100% RE- A global movement, p. 12).

4.5.2. Develop the required policy framework, regulation, and standards

This has been identified as an important step in many conversations with municipal staff. They believed setting a political target would drive the policy and standards required for implementing the targets. The reality is that…add please

4.5.3. Assess Renewable Energy Resources within the Municipal Boundaries

Calculating how much energy can be produced from a variety of RE sources is a necessary first step (Droege, 2009, p. 256). For many places in Canada, it is important to properly assess the heat demand for the residential and commercial sectors, as heat cannot be transported over long distances. (Genske et al., 2009, p. 256). It is also important to understand which type of RE option would be best suited for a particular area and what percentage of a mix would respond to the current and future demand.

Developing Integrated Community Energy Models (ICEMs) has been supported by scholars as a tool to accelerate the deployment of RE technologies (Webster et al., 2011). Therefore, using this mapping technique will greatly increase the use of community energy planning in a second phase for deployment of 100% renewable targets at community level. Mark Jacobson, a civil and environmental engineering professor at Stanford, created a roadmap for 100% RE Canada by 2050.

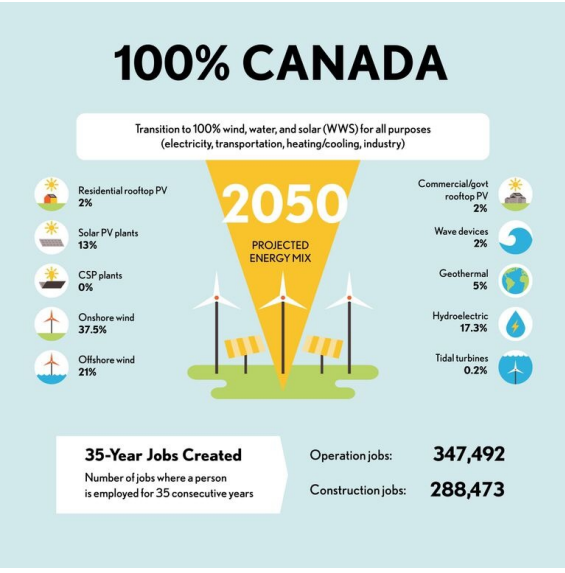


Figure 6. 100% Renewable Canada by 2050

Source: The solutions project organization

In this map (Figure 6), the

percentage of each source of wind, water, and solar is shown. Although a national, municipalities could still use this as a guideline to identify the resources available to them based on their geographic location.

4.5.4. Make Bold Energy Efficiency Targets

As discussed previously, addressing energy efficiency targets is critical in achieving 100% RE goals. Couture & Leidreiter (2014) made a recommendation for policy makers addressing energy efficiency as an important part of the transformation towards 100% renewable targets: they emphasis that 100% RE targets cannot be achieved unless it is accompanied by simultaneous improvement in the energy efficiency (p.49). This is particularly important, as it has been identified as the cheapest way to achieve RE's ultimate target.

4.5.5. Identify the Low-hanging Fruit in the Energy Sector of the Local Economy

The low-hanging fruit sector, as the sector that is the easiest to be transformed towards 100% RE, has been a great starting point for many of the communities that set 100% RE targets. Therefore, it is important to identify these sectors as an initial step. As mentioned earlier, in Canada only 37% of the electricity is from non-renewable resources. Therefore, pursuing 100% renewable electricity is the low-hanging fruit for the Canada that could set the

path to 100% RE systems.

4.5.6. Educate and Inform Citizens and Professional Stakeholders

Another municipal traditional function is to conduct active outreach with the public and professional stakeholders. Through this approach, cities and communities can support organizations with stakeholder meetings, educational and informational sessions to help individuals, or businesses to achieve energy targets. The 100% RE goal can also create a vision for key players to get inspired and take actions. Although this may not count as an aggressive move towards achieving the target, municipal staff has identified it as steady movement. Public awareness and education is critical to the long-term success of RE target implementation (Couture & Leidreiter, 2014, p. 51).

4.5.7. Use University Campuses, Hospitals, and Schools as Energy Hubs

The physical infrastructure and density of university campuses, hospitals, and schools are suitable for implementing infrastructures that increase the RE systems. For example, David MacMillan, a York University graduate, has demonstrated in his MES research how the York University Keele campus could expand its district energy system to provide heating and cooling for neighbouring communities. Hospitals have been identified as suitable locations for district energy systems. Another York University MES graduate

student, Mustafa Nazari, provided detailed information on a solar station for electric cars on York University's campus. Their research shows that universities are not only great for their academic research capacities, but also could be home to many RE infrastructures that can provide ongoing practical learning opportunities for communities willing to go for 100% RE targets.

4.5.8. Adopt an Integrated Approach

To accelerate the adoption of 100% RE, it is important to engage in an integrated approach where all aspects related to energy have been considered (e.g. policy, economic, and stakeholder involvement). Policy makers should increase coherence of their policies among all levels of government. This strengthens the approach to achieve 100% RE targets. Collaboration is required at all levels of government and society and it can be gained through the adoption of integrated approach. For example, City of Vancouver has integrated the 100% RE plan to all the city strategies considering the social, economic, and environmental pillars of their sustainability model.

4.5.9. Harness all Municipality-owned Assets

Facilities and buildings owned and operated by the municipality should be planned as net zero buildings, running on RE. High efficiency structures and the development of comprehensive RE infrastructure in existing city-owned

buildings demonstrate leadership taken by the municipality. It brings down the communities' GHG emissions, and serves as a model for local businesses and citizens to follow.

4.5.10. Use Innovative Techniques for Increase Green Funding

Communities are drivers of climate change mitigation in Canada. They are central for achieving the 100% RE goals and shifting towards sustainability. Cities can study trends of energy usage, use waste generated as an asset, move towards resource efficiency, and use different methods for increasing the funding required for RE deployment. For example, by investing the money otherwise spent outside for providing energy at the local level or applying for federal grants and other sources of financial assistance, cities can promote the deployment of RE systems within local communities.

Section 5: Conclusion

Climate change is no longer tomorrow's problem. The evidence available today indicates that the warming of the climate will have unprecedented effects on human life and the environment. The increasing frequency of extreme weather conditions has been felt by the recent events around the globe; floods, storms, wildfires, droughts, sea level rise, and hurricanes are a few examples. The energy supply sector is the main contributor to global GHG emissions, and human activities depend heavily on these energy systems.

In December 2015, the governments of more than 192 countries will gather in Paris for a two-week meeting of the UN Framework Convention on Climate Change (UNFCCC) conference. This event could have major implications for many countries and local governments' climate and energy policies.

Local governments are at the frontline of climate change impact such as environmental, social, and economical. They influence nearly 60% of energy use and more than 45% of greenhouse gas emissions nationally. As population is growing and urbanization is becoming a trend, energy consumption is on the rise as well. As a result, municipal governments are seeking solutions to maintain environmentally sustainable communities where they can provide reliable, secure, and affordable energy in a sustainable manner. Energy, however, has not been the focus of municipalities until recent events due to

changing climate events. These events and their impacts at the local level have shifted the view of many municipalities towards the important issue of sustainable energy systems.

Canada has been behind on national climate efforts, however, at the local level many municipalities have adopted community energy plans as a mitigation and adaptation tool to battle the changing climate. This tool defines community priorities around energy and focuses on improving energy efficiency, decreasing GHG emissions, increasing RE resources, achieving community resilience, and driving economic development. It provides a broad framework for local energy systems, and it helps communities understand their energy systems, the greenhouse gas emissions produced by each economic sector, and the local energy supply and demand for each. Although this approach is diverse in its size and scope, it presents a strategic solution to the problem of energy and GHG emissions at the local level.

Community energy plans (CEPs) are widely adopted in Canada as more than 170 local communities use them as their main climate change planning strategy. CEPs can unlock an untapped potential for communities to enable governments at local, provincial, or federal levels to achieve their energy objectives. However, having the CEPs does not guarantee the implementations of the energy targets or GHG emission targets assigned to

their local communities. The main barriers to using this framework at the local level are lack of internal alignment, lack of capacity, lack of funding, and lack of effective policy frameworks.

The six steps identified in chapter three are key to developing the policy frameworks starting with initiating the market analysis, surveying and interviewing to better solidify the findings at the initial stage, analysis of all the related data, writing the best practices document brief for identified policy tools suitable at the local level, development and integration of the policy framework with political buy-in or incentives, and implementing and monitoring progress and achievements to further re-frame the policy framework in order to accommodate the changes required to address the climate change.

Leadership, staff support, and political buy-in are critical elements for CEP implementation. It has been identified in this MRP that staff and financial capacity constraints can hold municipalities back from implementing their CEP targets. The capacity constraints, such as limited local government funding's, lack of expertise among local staff, and limited stakeholder support, are challenges faced by most municipalities. Therefore, integrating CEP into existing municipal plans and processes has been recommended here as a key point for local policy makers. This change can guarantee its

implementation even if political cycle changes happen at the local and federal level. In short, institutionalization of CEPs ensures its implementation in the long-term.

As the issue of climate change is no longer just a scientific warning, all people and all economic sectors that are dependent on conventional fuels will feel the changes that apply to the "business as usual" model of the energy systems in the coming years. Communities and cities as the heart of the energy changes play a key role in leading the way to low-carbon communities through a transition towards an energy revolution.

RE systems represent the best path for communities and cities around the world. To get to a RE future a collaborative approach, an effective policy framework, good planning, and an interdisciplinary viewpoint are all required. Energy targets must be bold to increase efficiency on one side and to increase the deployment of RE systems on the other. Deployment of these technologies brings forward local environmental protection, health improvements, energy security, employment, and a more democratized energy system that is not dependent on diminishable, dirty fuel sources. Therefore, the promotion of clean, low-carbon technologies is vital to the transition towards sustainable communities.

Small- to medium- sized municipalities could be the role models of energy transition towards 100% RE targets. Successful cases demonstrate that this target is not only achievable, but highly desirable. Technological advancement has made some of the RE systems comparable to the conventional methods of supplying energy, however, lack of political and socio-economical support can hinder the widespread implementation of these RE solutions.

Creating a vision for 100% renewable communities, designing effective policy frameworks at the local level, and collaborating with all of the stakeholders from the early stages of energy planning to project development and implementation are all vital for achieving RE societies.

Municipalities are key in the energy transition required to decrease GHGs and to increase clean energy technologies. They are the responsible agents for providing affordable energy to the citizens and, in case of a catastrophic event, they are on the front line to deal with the issues and costs. They are positioned to take advantage of the opportunities created by negative effects from increases in population in the urban areas, city design, and reliance on interconnected infrastructure systems. They can address the challenges by incorporating new technologies that are proven infrastructures of future cities such as district energy systems, combined heat and power, and solar ready buildings.

Municipalities, through the use of CEPs and policy tools, land use planning, density bonus, zoning by-law, local improvement charges and other tools available to them, can have adaptation and mitigation strategies suitable for their local communities. In order to achieve the goals of the future cities, continued work on the CEPs are required. Therefore, the second phase of CEPs should set the energy targets for achieving 100% RE by 2050.

In the absence of national or provincial guidelines, it is crucial that local community council's be on board with the use of CEPs as a tool to achieve energy targets and guide municipal decision making realizing the vision for 100% RE, such as in the case presented in Oxford County, Canada. A strong vision and a stronger leadership is necessary to overcome regulatory and other barriers that are present at the local level.

In addition, communities can address ambitious energy targets by starting with the lowest-hanging fruit in their energy sectors, such as the transformation of electricity sector in Canada through conservation and efficiency. To get from planning to implementation, teamwork and constant collaboration and participation of all stakeholders is required. Municipalities can use their roles as advocates, regulators, or facilitators to make this desirable energy transition probable by 2050. It is well established that

tackling the climate change issue at the local level does not have a "one-size" fits all approach. However, municipalities can develop energy policy tools that are best for their communities learning from the experience of other jurisdictions.

This can be reached by understanding the community's context, policy options available, key criteria required for the policies, measuring their effectiveness, and receiving feedback after their implementation. Through continuous effort at all levels of government and with use of good planning, effective policies, case studies, and forward-thinking council and municipal team leaders communities, can one-by-one change their energy systems to 100% renewables by setting targets and achieving them in different stages and timeframes (e.g. 2020, 2030, 2050) that would not only benefit the environment, but also the next generation of the human race.

References

Ahmed, T., Muttaqi, K., & Agalgaonkar, A. (2012). Climate change impacts on electricity demand in the State of New South Wales, Australia. Applied Energy, 98, 376-383. http://dx.doi.org/10.1016/j.apenergy.2012.03.059

Akella, A., Saini, R., & Sharma, M. (2009). Social, economical and environmental impacts of RE systems. RE, 34(2), 390-396. http://dx.doi.org/10.1016/j.renene.2008.05.002

Amato, A., Ruth, M., Kirshen, P., & Horwitz, J. (2005). Regional Energy Demand Responses To Climate Change: Methodology And Application To The Commonwealth Of Massachusetts. Climatic Change, 71(1-2), 175-201. http://dx.doi.org/10.1007/s10584-005-5931-2

Anderson, G., & Bell, M. (2010). Heat Waves in the United States: Mortality Risk during Heat Waves and Effect Modification by Heat Wave Characteristics in 43 U.S. Communities. Environ Health Perspect, 119(2), 210-218.

Auld, H., Maclver, D., 2007. Changing Weather Patterns, Uncertainty and InfrastructureRisks: Emerging Adaptation Requirements. Occasional Paper 9.Environment Canada, Toronto.

Bang, G. (2010). Energy security and climate change concerns: Triggers for energy policy change in the United States? Energy Policy, 38(4), 1645-1653. http://dx.doi.org/10.1016/j.enpol.2009.01.045

Baynham, M., Stevens, M., 2014. Are we planning effectively for climate change? An evaluation of official community plans in British Columbia. J. Environ. Plann. Manage. 57, 557–587.

BC, Climate Action for the 21st Century. (2015). Retrieved from http://www2.gov.bc.ca/assets/gov/...and.../climate_action_21st_century.pdf

Blum, H., & Legey, L. (2012). The challenging economics of energy security: Ensuring energy benefits in support to sustainable development. Energy Economics, 34(6), 1982-1989. http://dx.doi.org/10.1016/j.eneco.2012.08.013

Burch, S. (2010). Transforming barriers into enablers of action on climate change: Insights from three municipal case studies in British Columbia, Canada. Global Environmental Change, 20(2), 287-297.

Cameron, L., & van der Zwaan, B. (2015). Employment factors for wind and solar energy technologies: A literature review. Renewable and Sustainable Energy Reviews, 45, 160-172. http://dx.doi.org/10.1016/j.rser.2015.01.001

Canada. National Round Table on the Environment and the Economy (2011). Paying the Price: The Economic Impacts of Climate Change for Canada
Canada's Emissions Trend. (2014).

Carlet, F. (2014). Book Review: The Hidden Potential of Sustainable Neighborhoods: Lessons from Low-Carbon Communities. Journal Of Planning Literature, 29(3), 274-275. http://dx.doi.org/10.1177/0885412214531914

Carter, J., Cavan, G., Connelly, A., Guy, S., Handley, J., & Kazmierczak, A. (2015). Climate change and the city: Building capacity for urban adaptation. Progress In Planning, 95, 1-66. http://dx.doi.org/10.1016/j.progress.2013.08.001

Case Study: District Energy Systems in Eugene, Oregon (P, 23). Available at: http://www.districtenergy.org/assets/CDEA/Case-Studies/Eugene-OR-DE-SystemsBryant-thesisspring-2011.pdf

Changing Climate, Changing Communities (p. 10).

Chen, Y., Hobbs, B., Hugh Ellis, J., Crowley, C., & Joutz, F. (2015). Impacts of climate change on power sector NOx emissions: A long-run analysis of the US mid-atlantic region. Energy Policy, 84, 11-21. http://dx.doi.org/10.1016/j.enpol.2015.04.013

Choices in the stabilization of atmospheric CO2 concentrations. Nature 379,
Chu, S., & Majumdar, A. (2012). Opportunities and challenges for a sustainable energy future. Nature, 488(7411), 294-303. http://dx.doi.org/10.1038/nature11475

Clean Energy Canada. (2014). Tracking the Energy Revolution: Canada Edition 2014. Bowen Island, BC: Clean Energy Canada. Retrieved from: http://cleanenergycanada.org/wp-content/uploads/2014/12/Tracking-the-Energy-Revolution-Canada-.pdf

Climate Action Legislation 2015). Province of British Columbia. Retrieved 11 October 2015, from http://www2.gov.bc.ca/gov/content/environment/climate-change/policy-legislation-programs/legislation-regulations

Climate Change 2013: The Physical Science Basis. (2013).

Climate Change 2014: Mitigation of Climate Change. (2014). Retrieved from http://www.ipcc.ch/report/ar5/wg3/

Climate Change Impacts (2015) Province of British Columbia. Retrieved 5 October 2015, from http://www2.gov.bc.ca/gov/content/environment/climate-change/reports-data/climate-change-impacts
Climate Policy 3, 359–372.

CMC RESEARCH INSTITUTE. (2015).
Colwell, R. (1998). Global Climate Change and Infectious Diseases. Emerg. Infect. Dis., 4(3), 451-452. http://dx.doi.org/10.3201/eid0403.980327

Community Energy Plan. (2013). Retrieved from https://www.burlington.ca/en/live-and-play/community-energy-plan.asp
Corfee-Morlot, È., Kamal-Chaoui, L., Donovan, M., Cochran, I., Robert, A., & Teasdale, P. (2009). Cities, Climate Change and Multilevel Governance.

Corfee-Morlot, J., & Höhne, N. (2003). Climate change: long-term targets and short-term commitments. Global Environmental Change, 13(4), 277-293. http://dx.doi.org/10.1016/j.gloenvcha.2003.09.001

Ćosić, B., Krajačić, G., & Duić, N. (2012). A 100% RE system in the year 2050: The case of Macedonia. Energy, 48(1), 80-87. http://dx.doi.org/10.1016/j.energy.2012.06.078

Couture, T., & Leidreiter, A. (2014). How to Achieve 100% RE (pp. 22-24). World Future Council.

Couture, T., & Leidreiter, A. (2014). How to achieve 100% RE: Policy Handbook.

Demerse, C. (2011). Reducing Pollution, Creating Jobsææš: The employment effects of climate change and environmental policies (p. 25). Drayton Valley, AB: The Pembina Institute. Retrieved from: http://www.pembina.org/reports/reducing-pollution-creating-jobs.pdf

Donaldson, G.C., H. Rintamaki, and S. Nayha, 2001: Outdoor clothing: its relationship to geography, climate, behaviour and cold-related mortality in Europe. International Journal of Biometeorology, 45(1), 45-51.

Droege, P. (2009). 100% Renewable: Energy Autonomy in Action. London: Earthscan.

Droege, P. (2010). 100% RE and Beyond for Cities.

Ec.gc.ca,. (2015). About Canada's GHG Emissions Inventory - Climate Change - Environment Canada. Retrieved 13 October 2015, from https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=3E38F6D3-1#section1

Ellabban, O., Abu-Rub, H., & Blaabjerg, F. (2014). RE resources: Current status, future prospects and their enabling technology. Renewable And Sustainable Energy Reviews, 39, 748-764. http://dx.doi.org/10.1016/j.rser.2014.07.113

Energy supply. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

Engel, K.H., 2009. Whither subnational climate change initiatives in the wake of federal climate legislation? Publius: The Journal of Federalism 39 (3), 432–454.Environ. Change 16, 282–292.

Environment Canada. (2010). Retrieved from https://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=F93CD795-1

Environment Canada. (2013) (p. 16).

Environmental change. Global Environmental Change 20 (4), 550–557.

Etcheverry, J. (2011). New Climate Protection, Energy Security, and Employment Creation

Fankhauser, S., Gennaioli, C., & Collins, M. (2015). The political economy of passing

Climate change legislation: Evidence from a survey. Global Environmental Change, 35, 52-61. http://dx.doi.org/10.1016/j.gloenvcha.2015.08.008
Federation of Canadian Municipalities. (2009). Retrieved from https://www.fcm.ca/Documents/reports/PCP
Municipal_Resources_for_Adapting_to_Climate_Change_EN.pdf

Finkelman, R. B., & Stracher, G. B. (2011). Environmental and Health Impacts of Coal Fires. In G. B. Stracher, A. Prakash, & E. V. Sokol (Eds).,

"Coal and Peat Fires: A Global Perspective - Volume 1: Coal - Geology and Combustion" (115-125). Amsterdam, The Netherlands: Elsevier

Fraker, H. The hidden potential of sustainable neighborhoods.
Frappe-Seneclauze, T., Thibault, B., & Pond, E. (2014). Energy Labelling for New Homes (p. 17).

Friedman, T. (2008). Hot, flat, and crowded. New York: Farrar, Straus and Giroux.

Genske, D. D., & Porsche, L., Ruff, A., (2009). Urban Energy Potentials: A Step Towards the Use of 100% Renewable Energies., 100% Renewable: Energy Autonomy in Action (251-262). London: Earthscan.

Gielen, D., Ferroukhi, R., Kieffer, G., Taylor, M., Nagpal, D., & Khalid, A. (2014). Rethinking Energy: Towards a New Power System. Abu Dhabi, UAE: International RE Agency. Retrieved from: http://www.irena.org/rethinking/Rethinking_FullReport_web.pdf

Glave, J., Chapman, J., Duffy, R., & Beresford, C. (2013). A CANADIAN ENERGY STRATEGY: Why should local governments care?. Vancouver: Colombia Institute. Retrieved from http://columbiainstitute.ca/resources/canadian-energy-strategy-why-should-local-governments-care
Gouveia, J., Dias, L., Martins, I., & Seixas, J. (2014). Effects of renewables penetration on the security of Portuguese electricity supply. Applied Energy, 123, 438-447. http://dx.doi.org/10.1016/j.apenergy.2014.01.038

GRIMMOND, S. (2007). Urbanization and global environmental change: local effects of urban warming. The Geographical Journal, 173(1), 83-88. http://dx.doi.org/10.1111/j.1475-4959.2007.232_3.x

Gunderson, L. H., and C. S. Holling, editors. 2002. Panarchy: understanding transformations in human and natural systems. Island Press, Washington, D.C., USA.
H, A., & Mclver, D. (2005). Cities and Communities: The Changing Climate and Increasing Vulnerability of Infrastructure.

H. Lund, P.A. Østergaard. Sustainable towns: the case of Frederikshavn – 100% RE. W.W. Clark II (Ed.), Sustainable communities: toward energy independence and carbon neutral communities, Springer, New York (2009), pp. 155–168

Harper, M. (1993). Planning to make the future renewable. The role of local authorities in RE resource assessments. RE, 3(2-3), 217-220. http://dx.doi.org/10.1016/0960-1481(93)90025-c

Harden-Donahue, A., & Peart, A. (2009). Green, Decent and Public (p. 10). Retrieved from http://canadians.org/documents/climatejustice/green-decent-public.pdf

Harlan, S., & Ruddell, D. (2011). Climate change and health in cities: impacts of heat and air pollution and potential co-benefits from mitigation and adaptation. Current Opinion In Environmental Sustainability, 3(3), 126-134. http://dx.doi.org/10.1016/j.cosust.2011.01.001

Hein, L., van Koppen, K., de Groot, R., & van Ierland, E. (2006). Spatial scales, stakeholders and the valuation of ecosystem services. Ecological Economics, 57(2), 209-228. http://dx.doi.org/10.1016/j.ecolecon.2005.04.005

Hiremath, R., Shikha, S., & Ravindranath, N. (2007). Decentralized energy planning; modeling and application—a review. Renewable And Sustainable Energy Reviews, 11(5), 729-752. http://dx.doi.org/10.1016/j.rser.2005.07.005

Hoyer, K., & Holden, E. (2001). Housing as basis for sustainable consumption. IJSD, 4(1), 48. http://dx.doi.org/10.1504/ijsd.2001.001545
Hughes, S., & Sarzynski, A. (2015). Building capacity for climate change adaptation in urban areas: Editors' introduction. Urban Climate.

I.C.L.E.I,. Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation.
ideas, interests and institutions in healthcare resource allocation. Publ. Policy Adm. 29, 331–347.

IEA. (2014) International Energy Agency; Key World Energy Statistics pp. 6,24,28 Retreived from http://www.iea.org/publications/freepublications/

Intergovernmental Panel on Climate Change (IPCC), 2007. Summary for policymakers.In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, London, UK.

International RE Agency (IRENA). (2012). Evaluating Policies in Support of the Deployment of Renewable Power: IRENA Policy Brief. Abu Dhabi, UAE: IRENA. Retrieved from: http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID= 36&CatID=141 &SubcatID=25

IPCC, 2014: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[Internet] -, R. (2015). Go 100% RE : Our vision. Go100percent.org. Retrieved 17 October 2015, from http://www.go100percent.org/cms/index.php?id=3

[Internet] Bchydro.com,. (2015). Corporate Information. Retrieved 21 October 2015, from http://www.bchydro.com/quickfacts

[Internet] Cityofpaloalto.org,. (2015). Council Agendas - City of Palo Alto. Retrieved 18 October 2015, from http://www.cityofpaloalto.org/gov/depts/cou/council_agendas.asp

[Internet] Districtenergy.org,. (2015). What is District Energy? » District Energy. Retrieved 20 October 2015, from http://www.districtenergy.org/what-is-district-energy

[Internet] Engage.gov.bc.ca,. (2015). Climate Action Leadership |. Retrieved 20 October 2015, from https://engage.gov.bc.ca/climateleadership/

[Internet] Navigant Research,. (2013) . All Renewables, All the Time. Retrieved 18 October 2015, from https://www.navigantresearch.com/blog/all-renewables-all-the-time

[Internet] Quickfacts.census.gov,. (2015). Palo Alto (city) QuickFacts from the US Census Bureau. Retrieved 18 October 2015, from http://quickfacts.census.gov/qfd/states/06/0655282.html

[Internet] Smartenergyoxford.ca,. (2015). Smart Energy Oxford > Home. Retrieved 17 October 2015, from http://smartenergyoxford.ca

[Internet] Www12.statcan.gc.ca,. (2015). Census Profile. Retrieved 17 October 2015, from http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CD&Code1=3532&Geo2=PR&Code2=35&Data=Count&Sea

rchText=Oxford&SearchType=Begins&SearchPR=35&B1=All&Custom=&TABID=1

[Internet] Www2.gov.bc.ca,.. Climate Action Legislation - Province of British Columbia. Retrieved 20 October 2015, from http://www2.gov.bc.ca/gov/content/environment/climate-change/policy-legislation-programs/legislation-regulations

[Internet] Www3.epa.gov,. (2015). RE Certificates (RECs) | Green Power Partnership | US EPA. Retrieved 26 October 2015, from http://www3.epa.gov/greenpower/gpmarket/rec.htm
240–243.

Lorek, S., & Spangenberg, J. (2001). Indicators for environmentally sustainable household consumption. IJSD, 4(1), 101. http://dx.doi.org/10.1504/ijsd.2001.001549

Mabahwi, N. A. B., Leh, O. L. H., Omar, D. (2014). Human Health and Wellbeing: Human Health Effect of Air Pollution. Procedia - Social and Behavioural Sciences 153, 221-229. doi:10.1016/j.sbspro.2014.10.056

Maltini, F. (2014). Climate change and the complexity of solutions for securing energy supply: the global Energy [R]evolution. Ntp, 10(2), 100-141. http://dx.doi.org/10.4024/n08ma14a.ntp.010.02
Managing the Policy Process. Routledge, London/New York

Marić, I., Pucar, M., & Kovačević, B. (2015). Reducing the impact of climate change by applying information technologies and measures for improving energy efficiency in urban planning. Energy and Buildings. http://dx.doi.org/10.1016/j.enbuild.2015.04.044
Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C.von Stechoweds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Mideska, T. K., & Kallbekken, S. (2010). The impact of climate change on the electricity market: A review. Energy Policy 38 (7), 3579-3585. doi:10.1016/j.enpol.2010.02.035
Miller, N., Hayhoe, K., Jin, J., & Auffhammer, M. (2008). Climate, Extreme Heat, and Electricity Demand in California. J. Appl. Meteor. Climatol., 47(6), 1834-1844. http://dx.doi.org/10.1175/2007jamc1480.1

Moomaw, W., F. Yamba, M. Kamimoto, L. Maurice, J. Nyboer, K. Urama, T. Weir, 2011: Introduction. In IPCC Special Report on RE Sources and Climate

Change Mitigation [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P.
Myhrvold, N., & Caldeira, K. (2012). Greenhouse gases, climate change and the transition from coal to low-carbon electricity. Environ. Res. Lett., 7(1), 014019. http://dx.doi.org/10.1088/1748-9326/7/1/014019

National RE Laboratory. (2012). Renewable Electricity Futures Study.

Hand, M.M.; Baldwin, S.; DeMeo, E.; Reilly, J.M.; Mai, T.; Arent, D.; Porro, G.; Meshek, M.; Sandor, D. eds. 4 vols. NREL/TP-6A20-52409. Golden, CO: National RE Laboratory. p.271

National Report on Policies Supporting Community Energy Plan Implementation. (2015).

Newman, P., Beatley, T., & Boyer, H. (2009). Resilient cities. Washington, DC: Island Press.

Nrcan.gc.ca,. (2015). About RE | Natural Resources Canada. Retrieved 13 October 2015, from http://www.nrcan.gc.ca/energy/renewable-electricity/7295 NY, USA.

Oee.nrcan.gc.ca,. (2015). Report to Parliament Under the Energy Efficiency Act 2010-2011. Retrieved 16 October 2015, from http://oee.nrcan.gc.ca/publications/statistics/parliament10-11/chapter1.cfm?attr=0

Oke, T. (1981). Canyon geometry and the nocturnal urban heat island: Comparison of scale model and field observations. Journal Of Climatology, 1(3), 237-254. http://dx.doi.org/10.1002/joc.3370010304

Ostrom, E., 2010. Polycentric systems for coping with collective action and global
P. (2010). 100% RE and Beyond for Cities.
Pacala, S., Socolow, R., 2004. Stabilization wedges: solving the climate problem for

Parl.gc.ca,. (2015). Parliament of Canada - Home Page. Retrieved 20 October 2015, from http://www.parl.gc.ca/default.aspx?Language=E

Partridge, I., & Gamkhar, S. (2012). A methodology for estimating health benefits of electricity generation using renewable technologies. Environment International, 39(1), 103-110. http://dx.doi.org/10.1016/j.envint.2011.10.003

Pembina Institute,. (2004). Using Local Improvement Charges to Finance Building Energy Efficiency Improvements A Concept Report (pp. 6, 8, 22). Retrieved from http://www.pembina.org/pub/1706

Pitt, D. (2010). Harnessing community energy: the keys to climate mitigation policy adoption in US municipalities. Local Environment, 15(8), 717-729. http://dx.doi.org/10.1080/13549839.2010.509388

Power for the Future: Electricity's Role in a Canadian Energy Strategy. (2013) (p. 14).

President’s Council of Economic Advisers and the U.S. Department of Energy’s Office of

Electricity Delivery and Energy Reliability,. (2013). Economic Benefits of Increasing Electric Grid Resilience to Weather Outage.

Rae, C., & Bradley, F. (2012). Energy autonomy in sustainable communities—A review of key issues. Renewable And Sustainable Energy Reviews, 16(9), 6497-6506. http://dx.doi.org/10.1016/j.rser.2012.08.002

Rae, C., & Bradley, F. (2012). Energy autonomy in sustainable communities—A review of key issues. Renewable And Sustainable Energy Reviews, 16(9), 6497-6506. http://dx.doi.org/10.1016/j.rser.2012.08.002

RE Policy Network for the 21st Century (REN21). (2014). Renewables 2014: Global Status Report. Paris, France: REN21 Secretariat. Retrieved from: http://www.ren21.net/Portals/0/documents/Resources/GSR/2014/GSR2014_full%20report_low%20res.pdf

Riesz, J., Hindsberger, M., Gilmore, J., & Riedy, C. (2014). Perfect Storm or Perfect Opportunity? Future Scenarios for the Electricity Sector. In F. P. Sioshansi (Ed.), "Distributed Generation and its Implications for the Utility Industry" (453-474). Waltham, MA, USA: Academic Press.

Rocca, M., Brown, P., MacDonald, L., & Carrico, C. (2014). Climate change impacts on fire regimes and key ecosystem services in Rocky Mountain forests. Forest Ecology And Management, 327, 290-305. http://dx.doi.org/10.1016/j.foreco.2014.04.005

Roseland, M (2012). Toward sustainable communities.

Schneider, S. (2004). Abrupt non-linear climate change, irreversibility and surprise. Global Environmental Change, 14(3), 245-258. http://dx.doi.org/10.1016/j.gloenvcha.2004.04.008

Simon, C. (2007). Alternative energy. Lanham, Md.: Rowman & Littlefield Publishers.

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. Global Environmental Change, 16(3), 282-292.

Smit, B., Pilifosova, O., 2003. From adaptation to adaptive capacity and vulnerability reduction. In: Smith, J.B., Klein, R.J.T., Huq, S. (Eds.), Climate Change, Adaptive Capacity and Development. Potsdam Institute for Climate Impact Research,Potsdam, pp. 1–20.

Smit, B., Wandel, J., 2006. Adaptation, adaptive capacity and vulnerability. Global

Smith, N., Mitton, C., Davidson, A., Williams, I., 2014. A politics of priority setting:

Solomon, B., & Krishna, K. (2011). The coming sustainable energy transition: History, strategies, and outlook. Energy Policy, 39(11), 7422-7431. http://dx.doi.org/10.1016/j.enpol.2011.09.009

Solutions, T. (2015). RE Systems. Rdn.bc.ca. Retrieved 21 October 2015, from http://www.rdn.bc.ca/cms.asp?wpID=2434

St. Denis, G., & Parker, P. (2009). Community energy planning in Canada: The role of RE. Renewable And Sustainable Energy Reviews, 13(8), 2088-2095. http://dx.doi.org/10.1016/j.rser.2008.09.030

Steffen, W., Crutzen, P., & McNeill, J. (2007). The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature. AMBIO: A Journal Of The Human Environment, 36(8), 614-621. http://dx.doi.org/10.1579/0044-7447(2007)36[614:taahno]2.0.co;2

Strategies for Latin and North America Based on RE Collaboration. Latin American Policy, 2(1), 43-57. http://dx.doi.org/10.1111/j.2041-7373.2010.00031.x

Sustainable Development Officer, Environment Canada. (2010).
the next 50 years with current technologies. Science 305, 968–972.

Three resources of energy consumption had been found as major problematic areas: transportation, housing, and food (Holden, 2001; Lorek and Spangenberg, 2001; Aall and Norland, 2002).

Tozer, L. (2013). Community energy plans in Canadian cities: success and barriers in implementation. Local Environment, 18(1), 20-35. http://dx.doi.org/10.1080/13549839.2012.716406

Uddin, N., & Taplin, R. (2015). Regional cooperation in widening energy access and also mitigating climate change: Current programs and future potential. Global Environmental Change. http://dx.doi.org/10.1016/j.gloenvcha.2015.05.006

UNFPA Technical Division,. (2012). Population Matters for Sustainable Development. Retrieved from http://www.unfpa.org/publications/population-matters-sustainable-development

United Nation's Environmental Program. (2014).

United Nation's Environmental Program. (2014). Retrieved from http://www.unep.org/energy/districtenergyincities

United Nations, Department of Economic and Social Affairs, Population Division (2014). World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

Valentine, S. (2011). Emerging symbiosis: RE and energy security. Renewable And Sustainable Energy Reviews, 15(9), 4572-4578. http://dx.doi.org/10.1016/j.rser.2011.07.095

Vallero, D. A., & Letcher, T. M. (2013). Spills. In D. A. Vallero & T. M. Letcher (Eds)., "Unravelling Environmental Disasters" (131-162). Amsterdam, The Netherlands: Elsevier.

Verbong, G., & Loorbach, D. (2012). Governing the energy transition. New York: Routledge.

Vogel, B., & Henstra, D. (2015). Studying local climate adaptation: A heuristic research framework for comparative policy analysis. Global Environmental Change, 31, 110-120. http://dx.doi.org/10.1016/j.gloenvcha.2015.01.001

Warren, F.J. and Egginton, P.A. (2008). Chapter 2: Background Information – From Impacts to Adaptation: Canada in a Changing Climate 2007, edited by D.S. Lemmen, F.J.

Warren, J. Lacroix and E. Bush; Government of Canada, Ottawa, ON, p. 27-56

Webster, J., Korteling, B., Gilmour, B., Margerm, K., & Beaton, J. (2011). Integrated Community Energy Modelling: developing map-based models to support energy and emissions planning in Canadian communities.

Weisser, D. (2007). A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies. Energy, 32(9), 1543-1559. http://dx.doi.org/10.1016/j.energy.2007.01.008

Wigley, T.M.L., Richels, R., Edmonds, J.A., 1996. Economic and environmental

Wilhelm, M., & Ritz, B. (2004). MOTOR-VEHICLE RELATED AIR POLLUTION AND ADVERSE BIRTH OUTCOMES IN LOS ANGELES COUNTY, CALIFORNIA, 1994-2000. Epidemiology, 15(4), S52. http://dx.doi.org/10.1097/00001648-200407000-00125

Wu, X., Ramesh, M., Howlett, M., Fritzen, S., 2010. The Public Policy Primer:

Zalasiewicz, J., Williams, M., Haywood, A., & Ellis, M. (2011). The Anthropocene: a new epoch of geological time?. Philosophical Transactions Of The Royal Society A: Mathematical, Physical And Engineering Sciences, 369(1938), 835-841. http://dx.doi.org/10.1098/rsta.2010.0339

Zhang, Z. (2006). Toward an effective implementation of clean development mechanism projects in China. Energy Policy, 34(18), 3691-3701. http://dx.doi.org/10.1016/j.enpol.2005.08.014

Appendix A - Small to mid-sized communities in the study area

The following detailed table shows the communities in the BC Hydro area with a population less than 75,000, their average annual growth rate between the 2006 and 2011 census years, their 2011 population, and the annual GWh of community electricity consumption attributed by the 2010 Community Energy & Emissions Inventory (CEEI) data.

Note: in some cases electricity data is withheld from CEEI, e.g. where there are privacy concerns. This sometimes happens with large industry for communities, and occasionally with other electricity data types.

Local government name	Local government type	Average annual growth, 06-11	2011	GWh
1.100 Mile House	District	0.02%	1,886	31
2.Alberni-Clayoquot	Regional District Unincorporated Areas	-0.32%	9,815	132
3.Alert Bay	Village	-0.48%	445	6
4.Anmore	Village	3.44%	2,092	12
5.Armstrong	City	2.70%	4,815	43
6.Ashcroft	Village	-0.44%	1,628	16
7.Barriere	District	4.76%	1,773	20
8.Belcarra	Village	-0.94%	644	6
9.Bowen	Island Municipality	0.24%	3,402	41
10.Bulkley-Nechako	Regional District Unincorporated Areas	0.07%	19,637	163
11.Burns Lake	Village	-0.74%	2,029	28
12.Cache Creek	Village	0.06%	1,040	15
13.Campbell River	City	1.10%	31,186	321
14.Canal Flats	Village	0.42%	715	8
15.Capital	Regional District Unincorporated Areas	0.69%	24,735	283
16.Cariboo	Regional District Unincorporated Areas	-0.29%	39,422	327
17.Central Coast	Regional District	0.10%	3,206	32
18.Central Kootenay	Regional District Unincorporated Areas	0.29%	30,360	352
19.Central Okanagan	Regional District Unincorporated Areas	1.70%	14,727	126
20.Central Saanich	District	0.24%	15,936	157
21.Chase	Village	0.72%	2,495	20
22.Chetwynd	District	0.02%	2,635	554
23.Clearwater	District	0.96%	2,331	29
24.Clinton	Village	1.28%	636	6
25.Coldstream	District	1.78%	10,314	65
26.Columbia Shuswap	Regional District Unincorporated Areas	-0.64%	19,767	261
27.Colwood	City	1.92%	16,093	123
28.Comox	Town	2.00%	13,627	104
29.Comox Valley	Regional District Unincorporated Areas	0.09%	22,414	230
30.Courtenay	City	1.88%	24,099	236
31.Cowichan Valley	Regional District Unincorporated Areas	1.08%	35,698	348
32.Cranbrook	City	1.08%	19,319	170

33.Cumberland	Village	4.60%	3,398	27
34.Dawson Creek	City	1.08%	11,583	116
35.Duncan	City	-0.22%	4,932	60
36.East Kootenay	Regional District Unincorporated Areas	-0.82%	15,629	289
37.Elkford	District	0.48%	2,523	19
38.Enderby	City	0.74%	2,932	25
39.Esquimalt	District Municipality	-0.74%	16,209	121
40.Fernie	City	1.10%	4,448	46
41.Fort St. James	District	5.06%	1,691	17
42.Fort St. John	City	1.38%	18,609	175
43.Fraser Lake	Village	0.98%	1,167	11
44.Fraser Valley	Regional District Unincorporated Areas	0.09%	16,633	178
45.Fraser-Fort George	Regional District Unincorporated Areas	-0.37%	14,792	770
46.Gibsons	Town	1.22%	4,437	50
47.Gold River	Village	-1.40%	1,267	18
48.Golden	Town	-0.58%	3,701	63
49.Granisle	Village	-3.36%	303	5
50.Harrison Hot Springs	Village	-1.34%	1,468	17
51.Hazelton	Village	-1.56%	270	8
52.Highlands	District	2.28%	2,120	21
53.Hope	District	-0.70%	5,969	59
54.Houston	District	-0.10%	3,147	32
55.Hudson's Hope	District	-0.84%	970	6
56.Invermere	District	-0.32%	2,955	38
57.Kent	District	3.90%	5,664	56
58.Kimberley	City	1.68%	6,652	59
59.Kitimat	District	-1.46%	8,335	80
60.Kitimat-Stikine	Regional District Unincorporated Areas	-0.78%	16,110	146
61.Ladysmith	Town	1.02%	7,921	70
62.Lake Country	District	4.38%	11,708	104
63.Lake Cowichan	Town	-0.26%	2,974	32
64.Langford	City	6.02%	29,228	261
65.Lantzville	District	-0.32%	3,601	30
66.Lillooet	District	-0.02%	2,322	24

67.Lions Bay	Village	-0.16%	1,318	16
68.Logan Lake	District	-0.82%	2,073	13
69.Lumby	Village	1.18%	1,731	20
70.Lytton	Village	-0.60%	228	2
71.Mackenzie	District	-4.54%	3,507	33
72.Masset	Village	-1.20%	884	13
73.McBride	Village	-2.24%	586	11
74.Merritt	City	0.32%	7,113	80
75.Metchosin	District	0.04%	4,803	47
76.Mission	District	1.12%	36,426	245
77.Mount Waddington	Regional District Unincorporated Areas	-0.97%	3,743	51
78.Nakusp	Village	0.60%	1,569	23
79.Nanaimo	Regional District Unincorporated Areas	0.92%	38,499	414
80.New Denver	Village	-0.32%	504	8
81.New Hazelton	District	1.24%	666	8
82.North Cowichan	District	0.90%	28,807	281
83.North Okanagan	Regional District Unincorporated Areas	0.06%	18,240	154
84.North Saanich	District	0.50%	11,089	148
85.Northern Rockies	Regional Municipality	-2.50%	4,987	71
86.Oak Bay	District	0.12%	18,015	127
87.Parksville	City	1.80%	11,977	128
88.Peace River	Regional District Unincorporated Areas	-0.17%	21,464	456
89.Peachland	District	1.30%	5,200	34
90.Pemberton	Village	1.62%	2,369	30
91.Pitt Meadows	City	2.70%	17,736	155
92.Port Alberni	City	0.22%	17,743	173
93.Port Alice	Village	-0.38%	805	9
94.Port Clements	Village	-2.82%	378	5
95.Port Edward	District	-1.14%	544	10
96.Port Hardy	District	0.98%	4,008	64
97.Port McNeill	Town	-0.90%	2,505	32
98.Pouce Coupe	Village	-0.02%	738	5
99.Powell River	Regional District Unincorporated Areas	0.30%	6,741	59
100.Powell River	City	0.32%	13,165	116

101.Prince George	City	0.28%	71,974	1414
102.Prince Rupert	City	-0.48%	12,508	140
103.Qualicum Beach	Town	0.44%	8,687	82
104.Queen Charlotte	Village	-0.08%	944	12
105.Quesnel	City	1.46%	10,007	111
106.Radium Hot Springs	Village	1.14%	777	11
107.Revelstoke	City	-0.26%	7,139	91
108.Salmon Arm	City	1.82%	17,464	149
109.Sayward	Village	-1.40%	317	4
110.Sechelt	District	1.98%	9,291	101
111.Sechelt Band	Indian Government District	?	828	11
112.Sicamous	District Municipality	-1.76%	2,441	43
113.Sidney	Town	-0.24%	11,178	116
114.Silverton	Village	1.08%	195	3
115.Skeena-Queen Charlotte	Regional District Unincorporated Areas	-2.22%	3,526	35
116.Smithers	Town	0.72%	5,404	59
117.Sooke	District	3.58%	11,435	102
118.Spallumcheen	Township	0.38%	5,055	63
119.Sparwood	District	0.28%	3,667	34
120.Squamish	District	2.96%	17,158	172
121.Squamish-Lillooet	Regional District Unincorporated Areas	-0.04%	6,498	91
122.Stewart	District	-0.08%	494	8
123.Strathcona	Regional District Unincorporated Areas	-0.48%	10,041	116
124.Sun Peaks Mountain	Village	-2.58%	371	22
125.Sunshine Coast	Regional District Unincorporated Areas	-0.31%	14,891	157
126.Tahsis	Village	-2.74%	316	7
127.Taylor	District Municipality	-0.16%	1,373	27
128.Telkwa	Village	0.84%	1,350	7
129.Terrace	City	0.30%	11,486	117
130.Thompson-Nicola	Regional District Unincorporated Areas	0.33%	23,107	440
131.Tofino	District	2.68%	1,876	38
132.Tumbler Ridge	District	2.08%	2,710	41
133.Ucluelet	District	1.88%	1,627	33
134.Valemount	Village	0.04%	1,020	17

135.Vanderhoof	District	2.04%	4,480	49
136.Vernon	City	1.20%	38,150	346
137.View Royal	Town	1.40%	9,381	82
138.Wells	District	0.76%	245	3
139.West Kelowna	District	2.70%	30,892	214
140.Whistler	Resort Municipality	1.24%	9,824	417
141.White Rock	City	0.62%	19,339	118
142.Williams Lake	City	0.16%	10,832	122
143.Zeballos	Village	-6.78%	125	1
TOTAL			**1,305,173**	**15,562**

Appendix B - Local Government Survey

Local Government Survey – planning & policy measures for energy sustainability

Community Energy and Emissions Plan Status

2. Did your Council adopt the Community Energy & Emissions Plan?

- ☐ Did your Council adopt the Community Energy & Emissions Plan? Yes
- ☐ No
- ☐ Unsure

3. Please indicate which of the following planning & policy measures for energy sustainability your community has adopted and/or would be interested in receiving free support to develop & adopt.

	Already adopted. No further support needed.	**Already adopted, but need further support.**	**Not adopted, but interested in receiving support.**	**Not adopted and no interest in receiving support.**
Workshops - energy efficiency for builders/ developers	☐ *Please indicate which of the following planning & policy measures for energy sustainability your community has adopted and/or would be interested in receiving free support to develop & adopt. Workshops - energy efficiency for builders/ developers Already adopted. No further support needed.	☐ Workshops - energy efficiency for builders/ developers Already adopted, but need further support.	☐ Workshops - energy efficiency for builders/ developers Not adopted, but interested in receiving support.	☐ Workshops - energy efficiency for builders/ developers Not adopted and no interest in receiving support.
Sustainability Checklist - for new buildings / developments	☐ Sustainability Checklist - for new buildings / developments Already adopted. No further support needed.	☐ Sustainability Checklist - for new buildings / developments Already adopted, but need further support.	☐ Sustainability Checklist - for new buildings / developments Not adopted, but interested in receiving support.	☐ Sustainability Checklist - for new buildings / developments Not adopted and no interest in receiving support.
Zoning Bylaw - review to remove barriers and identify opportunities to improve energy efficiency in buildings	☐ Zoning Bylaw - review to remove barriers and identify opportunities to improve energy efficiency in buildings Already adopted. No further support needed.	☐ Zoning Bylaw - review to remove barriers and identify opportunities to improve energy efficiency in buildings Already adopted, but need further support.	☐ Zoning Bylaw - review to remove barriers and identify opportunities to improve energy efficiency in buildings Not adopted, but interested in receiving support.	☐ Zoning Bylaw - review to remove barriers and identify opportunities to improve energy efficiency in buildings Not adopted and no interest in receiving support.

	Already adopted. No further support needed.	Already adopted, but need further support.	Not adopted, but interested in receiving support.	Not adopted and no interest in receiving support.
Fee Rebates - for building / development permits for energy efficient building standards above building code	☐ Fee Rebates - for building / development permits for energy efficient building standards above building code Already adopted. No further support needed.	☐ Fee Rebates - for building / development permits for energy efficient building standards above building code Already adopted, but need further support.	☐ Fee Rebates - for building / development permits for energy efficient building standards above building code Not adopted, but interested in receiving support.	☐ Fee Rebates - for building / development permits for energy efficient building standards above building code Not adopted and no interest in receiving support.
Development Cost Charge - reductions for developments with energy efficient buildings above building code	☐ Development Cost Charge - reductions for developments with energy efficient buildings above building code Already adopted. No further support needed.	☐ Development Cost Charge - reductions for developments with energy efficient buildings above building code Already adopted, but need further support.	☐ Development Cost Charge - reductions for developments with energy efficient buildings above building code Not adopted, but interested in receiving support.	☐ Development Cost Charge - reductions for developments with energy efficient buildings above building code Not adopted and no interest in receiving support.
Variable Development Cost Charges - to encourage infill development	☐ Variable Development Cost Charges - to encourage infill development Already adopted. No further support needed.	☐ Variable Development Cost Charges - to encourage infill development Already adopted, but need further support.	☐ Variable Development Cost Charges - to encourage infill development Not adopted, but interested in receiving support.	☐ Variable Development Cost Charges - to encourage infill development Not adopted and no interest in receiving support.
Development Permit Area - to encourage reduced energy consumption	☐ Development Permit Area - to encourage reduced energy consumption Already adopted. No further support needed.	☐ Development Permit Area - to encourage reduced energy consumption Already adopted, but need further support.	☐ Development Permit Area - to encourage reduced energy consumption Not adopted, but interested in receiving support.	☐ Development Permit Area - to encourage reduced energy consumption Not adopted and no interest in receiving support.
Development Permit Area - for on-site RE	☐ Development Permit Area - for on-site RE Already adopted. No further support needed.	☐ Development Permit Area - for on-site RE Already adopted, but need further support.	☐ Development Permit Area - for on-site RE Not adopted, but interested in receiving support.	☐ Development Permit Area - for on-site RE Not adopted and no interest in receiving support.
Density Bonus Bylaw - for energy efficiency (single family homes or higher density)	☐ Density Bonus Bylaw - for energy efficiency (single family homes or higher density) Already adopted. No further support needed.	☐ Density Bonus Bylaw - for energy efficiency (single family homes or higher density) Already adopted, but need further support.	☐ Density Bonus Bylaw - for energy efficiency (single family homes or higher density) Not adopted, but interested in receiving support.	☐ Density Bonus Bylaw - for energy efficiency (single family homes or higher density) Not adopted and no interest in receiving support.
Rezoning Policy - to Guide Staff/Council Decisions (promoting energy efficient buildings)	☐ Rezoning Policy - to Guide Staff/Council Decisions (promoting energy efficient buildings) Already adopted. No further support needed.	☐ Rezoning Policy - to Guide Staff/Council Decisions (promoting energy efficient buildings) Already adopted, but need further support.	☐ Rezoning Policy - to Guide Staff/Council Decisions (promoting energy efficient buildings) Not adopted, but interested in receiving support.	☐ Rezoning Policy - to Guide Staff/Council Decisions (promoting energy efficient buildings) Not adopted and no interest in receiving support.
Tax Exemption Bylaw - for energy efficient buildings	☐ Tax Exemption Bylaw - for energy efficient buildings Already adopted. No further support needed.	☐ Tax Exemption Bylaw - for energy efficient buildings Already adopted, but need further support.	☐ Tax Exemption Bylaw - for energy efficient buildings Not adopted, but interested in receiving support.	☐ Tax Exemption Bylaw - for energy efficient buildings Not adopted and no interest in receiving support.

	Already adopted. No further support needed.	Already adopted, but need further support.	Not adopted, but interested in receiving support.	Not adopted and no interest in receiving support.
Verification Checklist - for building code compliance	Verification Checklist - for building code compliance Already adopted. No further support needed.	Verification Checklist - for building code compliance Already adopted, but need further support.	Verification Checklist - for building code compliance Not adopted, but interested in receiving support.	Verification Checklist - for building code compliance Not adopted and no interest in receiving support.
Solar Panel Permit Cost Reductions (local government permits)	Solar Panel Permit Cost Reductions (local government permits) Already adopted. No further support needed.	Solar Panel Permit Cost Reductions (local government permits) Already adopted, but need further support.	Solar Panel Permit Cost Reductions (local government permits) Not adopted, but interested in receiving support.	Solar Panel Permit Cost Reductions (local government permits) Not adopted and no interest in receiving support.
Solar Hot Water Ready Bylaw Adoption	Solar Hot Water Ready Bylaw Adoption Already adopted. No further support needed.	Solar Hot Water Ready Bylaw Adoption Already adopted, but need further support.	Solar Hot Water Ready Bylaw Adoption Not adopted, but interested in receiving support.	Solar Hot Water Ready Bylaw Adoption Not adopted and no interest in receiving support.
Best practice language on energy for official land use policies, e.g. OCP's, Local Area Plans, other	Best practice language on energy for official land use policies, e.g. OCP's, Local Area Plans, other Already adopted. No further support needed.	Best practice language on energy for official land use policies, e.g. OCP's, Local Area Plans, other Already adopted, but need further support.	Best practice language on energy for official land use policies, e.g. OCP's, Local Area Plans, other Not adopted, but interested in receiving support.	Best practice language on energy for official land use policies, e.g. OCP's, Local Area Plans, other Not adopted and no interest in receiving support.
Energy benchmarking or labelling as a condition for obtaining a building permit	Energy benchmarking or labelling as a condition for obtaining a building permit Already adopted. No further support needed.	Energy benchmarking or labelling as a condition for obtaining a building permit Already adopted, but need further support.	Energy benchmarking or labelling as a condition for obtaining a building permit Not adopted, but interested in receiving support.	Energy benchmarking or labelling as a condition for obtaining a building permit Not adopted and no interest in receiving support.

Other (please specify)

Please indicate whether or not you would interested in receiving free support to include energy sustainability measures in each of the planning documents below and when you expect to conduct the update. If you are not interested in receiving support on a particular planning document, please leave it blank.

4. Official Community Plan

- Official Community Plan Interested in free support to include energy sustainability
- Update currently in process
- Planned update to start in (please indicate year in text box below – if unsure then leave blank):

Year (please specify)

5. Local Area Plan

☐ Local Area Plan Interested in free support to include energy sustainability

☐ Update currently in process

☐ Planned update to start in (please indicate year in text box below – if unsure then leave blank):

Year (please specify)

6. Zoning Bylaw

☐ Zoning Bylaw Interested in free support to include energy sustainability

☐ Update currently in process

☐ Planned update to start in (please indicate year in text box below – if unsure then leave blank):

Year (please specify)

7. Subdivision Servicing Bylaw

☐ Subdivision Servicing Bylaw Interested in free support to include energy sustainability

☐ Update currently in process

☐ Planned update to start in (please indicate year in text box below – if unsure then leave blank):

Year (please specify)

8. Are there any other plans, policies or bylaws you are developing or plan to develop for which you would be interested in receiving free support to include energy sustainability considerations? Please indicate the policy and anticipated start date (list only those for which you are interested in receiving support).

9. Do you have any other comments or questions?

Appendix C - Sustainability Checklist Municipality Survey Questionnaire

1. Is the checklist primarily used to support council rezoning decisions/staff recommendations? Does it have any other uses?
2. In your opinion, does it adequately support decision making for Council? For staff?
3. Who fills it out – developer, staff or both working together?
4. Is it considered easy to use (by developers, by staff)?
5. Is it generally resulting in more sustainable development?
6. With respect to measures affecting energy efficiency, RE, shifts in transportation mode – is it effective?
7. What changes/improvements might help make it more effective? (process or content or both?)
8. If you were to rate its effectiveness on a scale of 1 to 5 (one = least effective, five = most effective), how would you rate the checklist?

Appendix D - City of Duncan Sustainability Checklist

* As the complete checklist is not yet shared with the public, this page is taken for the purpose of this MRP only.

Note to Applicant: ONLY FILL OUT THE COLUMN THAT IS APPLICABLE TO THE DEVELOPMENT FOR WHICH THIS CHECKLIST APPLIES.

	Features	Multi-Family Residential	Commercial/ Office	Mixed Use	Possible Points	Additional Notes/Comments
PRIORITY #1: A CARBON NEUTRAL COMMUNITY, APPROACHING ZERO-WASTE THAT HAS AFFORDABLE AND SAFE PUBLIC AND ACTIVE TRANSPORTATION OPTIONS. **Key Areas: Energy & GHG Emissions, Waste Reduction, Transportation and Mobility**						
	Energy Conservation, GHG Emissions and Waste Reduction					
1.1	Provides onsite renewable energy generation such as solar energy or geothermal heating.				3	
1.2	PowerSmart and CFC-reducing **HVAC systems** are used throughout the building.				2	
	Meets a new home energy labeling program standard (i.e. ASHRAE, EnerGuide, EnergyStar). Please provide detail in comment box.				4	
1.3	Includes a passive **Heat Recovery Ventilator** (HRV, for 2 points) or an active Heat Recovery Ventilator/**Energy Recovery Ventilator** (HRV or ERV, 4 points) either centrally or in each unit.				4	
1.4	The building is built to be '**Solar Ready**'.				2	
1.5	Includes the installation of an active solar hot water system sized for a minimum of 30% **Domestic Hot Water.**				2	
1.6	The development maintains an existing building.				2	
1.7	The development uses at least: i) 15% recycled or reused content in building materials; OR ii) 25% recycled or reused content in building materials.				2 3	
1.8	A comprehensive recycling program is utilized during construction: i) 25% of construction and demolition debris; OR ii) 50% of construction and demolition debris.				2 4	

Appendix E - Oxford County's Growing Stronger….together

Whereas the environmental implications of continued fossil fuel use and the growing impacts of climate change are well documented and recently recognized by G7 Leaders; And whereas significant reduction in fossil fuel dependency represents, as it does for much of the world, an enormous challenge to Oxford;

And whereas Oxford has begun to address the challenge of energy sustainability through critical first steps that include energy management and conservation strategies;

And whereas Oxford has a history of environmental courage and leadership;

And whereas Oxford is poised to adopt by the Fall of 2015 its first Community Sustainability Plan which includes, among other goals, significant advancement in the role of RE in Oxford with similarly significant reductions in fossil fuel reliance;

And whereas leading municipalities around the world are considering or have committed to achieving 100% RE by 2050;

And whereas the continued advancements of RE and energy storage technologies demonstrate strong potential for achieving 100% RE by 2050;

And whereas Oxford residents and businesses already demonstrate significant leadership in the advancement of RE technologies and their applications;

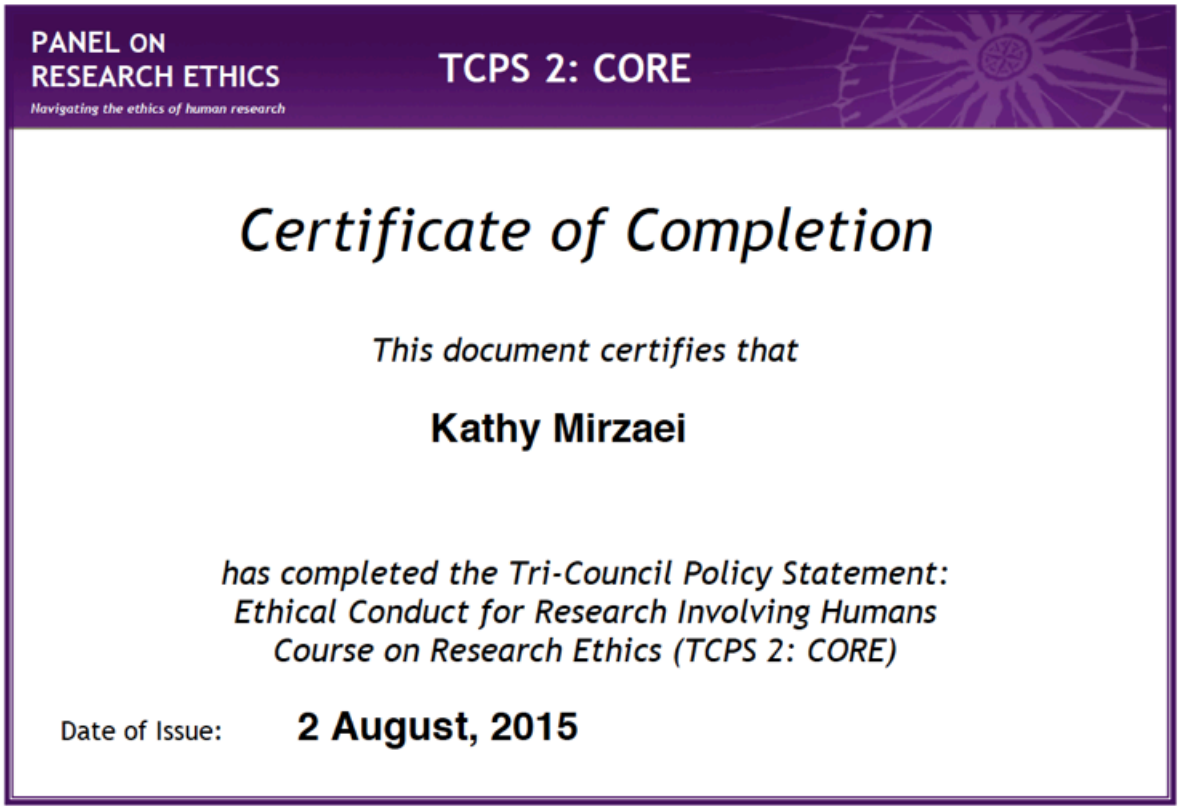
And whereas Oxford has the opportunity to be the first Ontario municipality to commit to achieving 100% RE by 2050;

And whereas being the first Ontario municipality to commit to achieving 100% RE by 2050 is expected to catalyze environmental change in Oxford, create opportunity for RE investment in Oxford, and position Oxford as a RE centre of excellence and home for RE education, research and development;

Therefore be it resolved that the County of Oxford hereby commits to the achievement of 100% RE by 2050.

Adopted by Oxford County Council at its June 24, 2015 Regular Meeting

Appendix F - Certificate of Completion on Ethical Conduct in research



PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Kathy Mirzaei

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue: **2 August, 2015**