

**Turning Point for Transformation?
Investigating a Local Decarbonization Initiative
in Waterloo Region, Canada**

by

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A thesis

presented to the University of Waterloo

**in fulfilment of the
thesis requirement for the degree of**

Master of Environmental Studies

in

Sustainability Management

Waterloo, Ontario, Canada, 2017

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Canada is a world leader - in burning fossil fuels. Canadians produce more tonnes of CO₂ per capita than almost any nation on earth. Canada's GHG emissions are part of a global problem. There is international consensus that a rapid transition to a low carbon economy within a few short decades is essential to maintain global environmental and economic integrity. The 2015 agreement in Paris set a new high watermark of this consensus and produced unprecedented international commitments to take urgent action to reduce GHG emissions. However, decades of incremental, piecemeal action at the international level have left an 'ingenuity gap' between the worsening impacts of climate change and the development of solutions to address those impacts.

Fortunately, local level actors demonstrate promising potential for leadership on decarbonization. Cross sectoral collaboration, a flourishing array of processes and a plethora of technological solutions all add to the great potential of these ascendant local level actors. However, tensions arising in the local decarbonization space prevent local actors from harnessing their full potential as proponents of deep decarbonization. Local actors must develop the capacity to address and ultimately resolve these tensions to take the transformative action required for deep decarbonization in their communities. To that end, local actors are developing and testing governance tools that hold promise for this endeavour, such as arenas and experiments. These tools have yet to be tested in North America's highly carbonized communities but the Decarbonize Waterloo Region forum has opened an opportunity to investigate their potential in a Canadian municipality. In November 2016, local actors in this Canadian community took the first steps toward decarbonizing its energy systems at the Decarbonize Waterloo Region forum. The forum was initiated by local scholars with the goal of developing a vision, scenarios and pathways to 100% local decarbonized energy systems by 2050.

The author of this thesis seized that opportunity to investigate the nascent stages of Waterloo Region's decarbonization process, in the spirit of a growing scholarly movement calling for more direct and active engagement in the development of local decarbonization processes. This research project aimed to join the community in the search for practical local solutions for deep decarbonization; to facilitate the initiation of local spaces for change; and to contribute to the growing critical body of literature on deliberate transformation.

This investigation was pursued by means of participation in the November forum, and administration of a post forum survey to all willing participants. Forum participants were also invited to take part in post forum focus groups to generate ideas on how to use governance tools like arenas and experiments locally to help trigger deep decarbonization. This research revealed that Waterloo Region reflects a picture of local potential and tensions like that which emerges in the literature. The paper also contributes practical ideas for applying arenas and experiments as governance tools to tip this Canadian community toward deep decarbonization, including a proposal for three potential experiments to be implemented in the Region.

Keywords: deep decarbonization; local; transformation; governance; experiments; arenas; Waterloo Region; participatory action research

Acknowledgements

Foremost I am grateful to my thesis advisor Dr. Sarah Burch. Her guidance in this thesis process has been invaluable to me and I thank her for all the times that she has gently but adamantly ‘leaned on the rudder’ to steer me in the right direction. In addition to her guidance and support in this project, I am indebted to Dr. Burch for her excellent mentorship as I re-entered the world of scholars after a considerable absence. Her generous support in so many forms has opened multiple doors, facilitated instrumental connections and helped me to balance graduate studies and family commitments. I am excited to continuing to work with her.

I am also very grateful to my committee member Dr. Paul Parker and my thesis reader Dr. Sean Geobey. Their thorough and straightforward feedback was greatly appreciated and contributed to substantial improvements in the quality and comprehensiveness of my thesis. I thoroughly enjoyed the time I spent with them in the revision and defence process. Their deep and determined questioning challenged me and contributed significantly to my growth as a scholar.

This thesis is the product of a participatory action research project that would not have been possible without the passionate and inspired leadership of Dr. Heather Douglas. Together with the sharp-witted and cool-headed Nigel Moore, she organized the Decarbonize Waterloo Region forum, a truly remarkable gathering that called us all to strive for a new level of transformative change. I am grateful for the opportunity to work with and learn from over fifty of the most talented and committed people in our community, who invested the time and energy to participate in the forum, as well as the survey and focus groups that I organized. I look forward to continuing to work with them to realize the bold vision of deep decarbonization of energy systems in our shared home, Waterloo Region.

I am sincerely grateful for the financial support of the Energy Council of Canada, which provided funding for this research project. I appreciate their contribution to my work, and their visionary leadership in this important and growing field of energy transformation.

Finally, I pay tribute to the bedrock of my support, through this and all my endeavours, my family. My partner Melody inspired me by example to pursue a career in scholarship at a time in life when many people are settling into a familiar vocational groove (and those could be good, bad or indifferent grooves). I am feeling good in the new groove that I am carving for myself with her support as she takes a turn as the ‘designated earner’ after pursuing two degrees of her own. I cannot begin to fully express all the ways that my children inspire me. Their earnest questions challenge me and their pursuit of personal excellence motivates me. I am immeasurably proud and honoured to be their dad. I will dedicate the rest of my life to creating a better world for them by investigating and instigating transformative change with my fellow advocates who seek to build more sustainable communities.

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Chapter One: Investigating a Local Decarbonization Initiative

1.1 Introduction

Canada is a world leader - in burning fossil fuels. Each Canadian produces more tonnes of CO₂ per capita than almost any nation on earth. Canada's GHG emissions are part of a global problem and there is ample evidence that the international community must act now to maintain a "safe operating space for humanity" (Rockström et al., 2009). There is international consensus that a rapid transition to a low carbon economy within a few short decades is essential to maintain global environmental and economic integrity (Bataille et al., 2016; Carney, 2015; Meadowcroft, 2016). The 2015 agreement in Paris set a new high watermark of this consensus and produced unprecedented international commitments to take urgent action to reduce GHG emissions. However, decades of incremental, piecemeal action at the international level have left an 'ingenuity gap' between the worsening impacts of climate change and the development of solutions to address those impacts (Westley et al., 2011). Even with the unprecedented commitments made in Paris, international actors face a daunting challenge to fill this ominous gap.

In this context, the local level is emerging as a promising new locus of climate action (Betsill & Bulkeley, 2007; Okereke et al., 2013). A growing body of research and practice shows that global citizens are most strongly motivated to address climate change when it is framed at the local scale – where people live, and do business (Potvin et al., 2017; Schweizer et al., 2013). Consequently, local government climate leadership and collaboration has matured significantly in the past decade (Kinley, 2016). Though the potential of the emerging local locus is widely lauded, scholars investigating this trend warn that much of the climate action emerging at the

local level is of the same incremental and piecemeal nature that has allowed the ingenuity gap to widen at the international level (Castán Broto & Bulkeley, 2013). Scholars attribute this collective shortcoming to the paucity of tools and resources available to the local actors who choose to take on the complex and arduous task of decarbonization (Hughes, 2016; Loorbach & Rotmans, 2010).

Fortunately, some communities are creating spaces where local actors can collaboratively articulate a transformative vision for deep decarbonization and test practical tools to make those visions a reality. Transition scholars are working with communities to create transition arenas as spaces where local actors can collaborate to forge transformative visions for decarbonized communities (Frantzeskaki et al., 2012; Nevens et al., 2013). Within these arenas, experiments are emerging as an important and effective tool for translating long term visions into practical, manageable action that local actors can initiate in the near-term (Karvonen et al., 2013; Luederitz et al., 2016). There is a growing base of literature on arenas and experiments, internationally, and an expanding number of practical examples of this approach being implemented in Europe.

In the context of the global ingenuity gap and the ascendance of local level actors in the realm of climate governance, local decarbonization efforts take on increasing political, practical and scholarly importance. Learning how to ramp up local climate action from incremental mitigation to transformative, deep decarbonization shows promise as the best hope for protecting “a safe operating space for humanity” that Rockström describes. As the climate consequences of carbonized energy systems continue to rapidly unfold, communities must urgently generate, implement and disseminate innovative and effective solutions to fill the global ingenuity gap. Decarbonize Waterloo Region presents an ideal opportunity for transition researchers to immerse themselves in an investigation of a local process in its early stages to glean practical lessons for

other communities in Canada and beyond. This learning endeavour can also contribute significant insights to the growing body of international literature dedicated to deep local decarbonization.

1.2 Context: A Canadian Community Exploring Deep Decarbonization

In Canada, with its high per capita emissions, precious few communities have articulated a transformative vision for deep decarbonization of local energy systems. The City of Vancouver and Oxford Country are the only Canadian municipalities thus far to have made an official commitment to complete decarbonization of energy systems. In November 2016, local actors in another Canadian community took the first steps toward decarbonizing its energy systems at the Decarbonize Waterloo Region forum. The forum was initiated by a local scholar, Professor Heather Douglas at the University of Waterloo, with the goal of developing a vision, scenarios and pathways to 100% local decarbonized energy systems by 2050. The forum assembled 50 local experts and practitioners from government, the civil sector, business and academia. This diverse set of participants explored the emerging panoply of technical and financial innovations in the field of local energy solutions. As will be described in detail later, the forum generated many ideas on how to move toward 100% decarbonization. However, despite two days of concerted and collaborative effort, there is still much work to be done to construct comprehensive scenarios and pathways to decarbonization in Waterloo Region. Much hard work lies ahead for these frontrunners in this Canadian community. The organizers of the Decarbonize Waterloo Region forum set lofty goals, and as will be elaborated later, some progress was made toward these goals. Other goals were stymied, but some interesting outcomes and insights emerged, making this a rich opportunity for learning.

1.3 Research Objectives and Key Terms

The primary goal of this research project is to seize the learning opportunity in Waterloo Region. That broad goal encompasses three more specific objectives:

1. Understand and frame the local Decarbonize Waterloo Region initiative in the evolving context of local level decarbonization efforts around the world;
2. Investigate the November 2016 forum to glean lessons on ramping up local efforts from incremental mitigation to transformative deep decarbonization;
3. Build on the November 2016 forum and help to initiate local spaces in which diverse local actors can co-create practical solutions for transformative deep decarbonization using emerging governance tools, specifically transition arenas and experiments.

These three objectives are in turn pursued through a review of the international literature and a two-pronged local investigation. The two-pronged investigation is framed around two central questions and conveyed in two manuscripts. The following section provides concise definitions of some of the key terms used in this thesis.

Governance

Defining governance is a remarkable challenge. Robichau asserts that, “As with many debated topics, the source of confusion in governance begins with its definition. Over the last several decades, governance has been given multiple meanings and special significance beyond the standard dictionary definition. This array of governance usages creates additional obstacles for researchers” (Robichau, 2011). For the sake of simplicity and after an extensive search, this definition, offered by Graham et al (2013) has been chosen as the one that strikes a good balance between comprehensive and concise: “governance is a process whereby societies or organizations make their important decisions, determine whom they involve in the process and

how they render account. Since a process is hard to observe, students of governance tend to focus our attention on the governance system or framework upon which the process rests - that is, the agreements, procedures, conventions or policies that define who gets power, how decisions are taken and how accountability is rendered” (Graham et al., 2003, p. 1).

Transformation

Avelino et al define transformation as “an irreversible, persistent adjustment in societal values, outlooks and behaviours of sufficient ‘width and depth’ to alter any preceding situation” (Avelino et al., 2013, p. 2). In more specific terms of energy systems, McCormick et al assert that “decarbonization...involves no less than a transition from long established systems (technologies, infrastructures, practices, lifestyles, values, and policies) to very different ones... ‘old’ systems are often embedded, physically and culturally, in built infrastructure, urban form, systems of provision (energy, water, food, transport, and information), and urban lifestyles, creating dependencies that are hard to overcome” (McCormick et al., 2014, p. 12). Burch et al assert that transformations “may only be fully evident in hind-sight, making challenging the task of identifying the ‘seeds’ of such transformation and the key enabling conditions” (Burch et al., 2014, p. 477)

Transition Arena

Jhagroe and Loorbach offer this definition of transition arenas:

“A transition arena can be defined as: an innovative participatory process of envisioning, searching, learning and agenda-building aimed at social learning as a means to achieve (sustainable) social change. It is a particular site in which the practice of managing transitions takes place. These arenas should be understood as a model that can be

connected to a specific sector (mobility, or health), or to a region” (Jhagroe & Loorbach, 2015, p. 68).

Experiments

Luederitz et al provide a useful and comprehensive definition of experiments, saying that they, “often focus on defined small-scale settings, specific to a particular location and socio- cultural context. Following the notion of experimentation, the intention is to create positive outcomes that are replicable, transferable, and scalable to society at large. Experiments focus, for example, on socio-technical innovations (e.g. in the energy or food sector), on networks (e.g. political and technical coalitions), or on small spatial or organizational units (e.g. a neighborhood or a building). In addition to having real-world impacts, such experiments are research endeavors to the extent that they produce evidence regarding both the persistent unsustainability of dominant regimes and the possible solutions to given sustainability problems.” (Luederitz et al., 2016, p. 2).

1.4 Seizing a Propitious Opportunity to Investigate Local Decarbonization

This section elaborates on how the Decarbonize Waterloo Region forum was developed, and how this participatory action research study evolved to seize that propitious opportunity to pursue engaged scholarship in a local deep decarbonization process in its nascent stages.

Methodological issues concerning the specific data collection strategies are elaborated in chapter 3 (post-forum surveys), and chapter 4 (focus groups). The Decarbonize Waterloo Region forum was initiated as a participatory process, with the goal of bringing together the pluralistic knowledge and capacities of many different local actors. As will be elaborated, there is room for improvement about making this ongoing process more participatory and inclusive. The process

was initiated in early 2016 by Dr. Heather Douglas, a professor in the Philosophy Department at the University of Waterloo, who sought out a broad range of experts from the local civil sector, academia, all levels of government, energy sector leaders as well as local entrepreneurs. These actors were convened for a two-day invitation-only forum, hosted at the Balsillie School of International Affairs in Waterloo. Of course, the focus on experts and the invitation-only approach limited the inclusiveness of this process, but it was done intentionally and aligns with proven approaches documented in transition management literature. For example, Wittmayer and Schapke provide a succinct summary of several the engagement of ‘frontrunners’ in the transition process, drawing on several leading transition scholars.

“At the outset of a transition management process, researchers carry out system and actor analyses to learn about them and their challenges. The focus is on ‘frontrunners’, persons who already address issues in their sector or community (through action or deliberation) and can therefore be considered as having a sense of problem ownership. Research participants are selected on the basis of knowledge, competencies and worldviews, rather than on hierarchical power, representativeness or authority”
(Wittmayer & Schapke, 2014).

Dr. Douglas approached local government and civil sector leaders who had developed and implemented the Waterloo Region Climate Action Plan (2013) to assist in the development of the list of participants. These local leaders had already done significant groundwork to engage local expertise and build partnerships. Led by local civil sector organizations like Sustainable Waterloo Region and REEP Green Solutions, they called together many actors to create the Climate Action Waterloo Region plan that was launched in 2013. This plan is unique in Canada in that it was initiated and is still led by civil sector actors. The plan is implemented by a joint

management team and three committees that include diverse stakeholders from all sectors. The goals of the plan are relatively modest, compared to the broader goal of decarbonization, but the Plan’s unique governance structure and the connections that it has created set the table for deeper decarbonization.

Based largely on the counsel of these local leaders, Dr. Douglas developed an invitation list which is broken down below by the sectors that she identified as crucial for engagement in early local dialogue about deep decarbonization. Beside the breakdown of invitees is the breakdown of how many people from each sector ultimately attended the forum in November.

Figure 1: Participants at Decarbonize Waterloo Region

Invitees by Sector	Participants by Sector
10 from civil society;	7 from civil society;
31 from academia and academic institutions;	19 from academia and academic institutions;
16 from local government;	9 from local government;
2 from First Nations;	0 from First Nations;
10 elected officials;	0 elected officials;
8 from local utilities;	1 from local utilities;
33 from business – including energy tech, architects, banks, builders and industry	11 from business – including energy tech, architects, banks, builders and industry plus two facilitators and the author = 50

The composition of participants could be the subject of a chapter itself, but a brief analysis is all that space permits here. Clearly there is a heavy emphasis on the academic sector on the invitation list and consequently the academic sector had the largest representation at the

forum. The civil sector and local government sector were not as well represented as the academic, but many of those invited attended. It is interesting to note that although the business sector had the largest number of invitees, only one-third attended. Unfortunately, there was low attendance from the local utilities (only 1 of 8 invitees) and no elected officials attended. Although no-one from the First Nations sector attended, only 2 were invited. The composition of both the invitee list and the participant list must be analyzed and addressed in future local decarbonization work. Ideas about how to make the ongoing work toward local deep decarbonization more inclusive will be discussed more fully in Chapter 5.

Forum Agenda and Outcomes

On November 17 and 18, 2016, over 50 participants gathered for the two-day workshop. The forum organizer, Dr. Douglas, also engaged Nigel Moore of the Waterloo Institute on Renewable Energy (WISE) as a co-facilitator for the forum. The co-facilitators articulated ambitious goals: namely, the development of scenarios for fully decarbonized local energy systems and pathways to achieve those scenarios. The scenarios were focused on the three energy-use sectors with the highest GHG emissions, as identified in the Waterloo Region Climate Action Plan – transportation, residential and industrial/commercial. Scenarios were also to be developed for the transformation of three broad energy source categories, including electricity, fuels and thermal energy. The forum intentionally excluded agriculture and waste because in the local context these represent relatively small proportions of total emissions. In addition to the development of scenarios and pathways, the Decarbonize Waterloo Region forum also included the development of policy recommendations for federal, provincial and municipal governments. Participants at the forum sought to quantify the complexity of the carbon challenge in their own Canadian municipality and devise specific strategies that might

trigger and accelerate the transformation of local energy systems to achieve a zero-carbon local economy.

The author chose Participatory Action Research (PAR) as the methodology to investigate this local decarbonization initiative because it shares a transformational orientation and objective (MacDonald, 2012). Wittmayer and Schapke identify PAR as a new frontier for sustainability research and a promising tool for the collaborative production of knowledge (Wittmayer & Schapke, 2014). A handful of sustainability scholars are exploring the potential of this malleable methodology in sustainability and transitions literature. Wiek et al contend that, “Transformational sustainability research foresees a new role for scientists [who] need to immerse themselves into decision processes that are embedded in societal transition processes and build socially robust knowledge” (Wiek et al., 2012, p. 7). The role of the ‘immersed’ scholar (the author of this thesis) was disclosed and explained to participants by means of a letter in advance of the forum, in addition to in-person introductory remarks at the forum reiterating this role. Throughout the two-day forum, the scholar took part in discussions and took notes about how the process was unfolding. This participatory observation, in addition to a post-forum survey administered by the immersed scholar, provided rich insights on the governance of a local decarbonization process in its nascent stages. The survey process and the insights it generated are described in detail in chapter three.

The first day of the forum included several presentations by local experts on emerging tools that organizers evaluated as promising for the decarbonization of the Region. These included social innovations like coordinated neighbourhood retrofits for district energy, financial innovations such as impact investment and technical innovations such as geothermal energy systems. A list of policy recommendations for federal, provincial and local governments was

also generated by forum participants in a session designed specifically for that purpose on day two. This discussion included early ideas on how to coordinate policies across the jurisdictions to promote a rapid local transition to decarbonized energy systems. Another session on day two of the forum was dedicated to the articulation of co-benefits that will accrue from efforts to decarbonize the Region's energy systems (in addition to the direct impact of reducing local GHG emissions). The long list included social, economic and environmental co-benefits.

The most challenging part of the forum was the development of scenarios for local deep decarbonization and pathways to realize those scenarios by 2050. Participants looked at the total energy system of the region quantitatively, using charts prepared before the forum which outlined the energy expended annually in the Region (demand) and the various sources of that energy (supply). Facilitators divided up the expertise in the room to focus on demand sectors (residential, businesses, transportation) or sectors of possible renewable energy supply (electricity, biofuels, thermal energy). The 'demand' groups were asked to determine how to reduce and meet the overall demand in their sector (and what kinds of energy will be needed), and the 'supply' groups to determine how renewable energy production could be maximized, including storage options. The groups then shared their ideas, compared supply and demand, and thought about how to meet the shortfalls in various sectors.

Once the groups had developed several potential scenarios in their respective sectors, the next task was to find the 'pathways' to the decarbonized future scenarios. Participants were asked to consider the following questions in the development of those pathways:

- 1) What is the path to that future? Where do we need to be by 2020? 2025? 2035?

What is the infrastructure investment timeline?

2) Which policies (including financial ones) at the municipal, provincial, and federal levels would help us along the timelines? Which policies are inhibitors currently?

3) What are the additional benefits of pursuing this pathway?

Two days of collaborative work and dialogue by local experts generated several partial scenarios and ideas for pathways toward meeting future energy challenges without fossil fuels. However, the facilitators reported in the white paper that they wrote on the outcomes of the forum that, “We found that the decarbonization challenge presented exciting opportunities for the region, but that we could not yet see how we would meet the full extent of the challenge”¹. Fortunately, in the process of developing partial scenarios for local decarbonization, forum participants also generated many ideas about the significant challenges that must be overcome to develop clear and comprehensive pathways to deep decarbonization in Waterloo Region. In the white paper, the co-facilitators (Heather Douglas and Nigel Moore) synthesized those ideas to identify four concrete challenges for moving toward 100% decarbonization. The White Paper was drafted and revised in consultation with the forum participants via email. This is how they framed those challenges:

“Challenge 1: Dramatically reducing energy needs of the built environment

Overall energy demand by must be reduced by at least 50% by 2050 to have any chance to end reliance on fossil fuels. Buildings of all types must become far more efficient in their use of energy, through both retrofits and better new buildings.

Challenge 2: Maximizing local renewable power generation

Renewable energy production must be maximized within the region, which primarily means using solar energy (particularly photovoltaic, but also solar thermal) and sustainable biomass sources.

¹ Quoted from an unpublished white paper authored by Heather Douglas and Nigel Moore

Our region does not have strong small hydro potential or strong wind potential for substantial production, although some potential might exist locations.

Challenge 3: Eliminating fossil fuels based transportation

Elimination of fossil fuels for transportation will entail a major shift in what powers our mobility. Fossil fuel powered cars must be phased out as the current fleet reaches the end of its life. In addition to a complete shift from gas-powered to electrically-powered vehicles (whether EVs or hydrogen-powered cars—where the hydrogen is produced with renewable electricity), we need to reduce energy demand for transportation, e.g. through significant increases in ridership for public transportation, increasing car-sharing (particularly with autonomous vehicles), and/or greater use of active transportation (biking or walking).

Challenge 4: Replacing natural gas as a source of energy for heating

We need to figure out how to replace natural gas for the thermal needs of the region. Simply replacing it with electricity will overload our electrical grid—especially with the likely electrification of the transportation fleet. We must assess the geothermal and solar thermal energy (including seasonal storage cycles) potential for the region. We can then assess how to best retrofit our existing building and housing stock to make use of these sources”².

Though the development of scenarios and pathways was difficult and left incomplete at the end of the November forum, the process of working on them helped to identify the four challenges outlined above. The identification of these challenges created an opportunity for the immersed researcher to initiate further participatory action research as part of the local decarbonization process. These challenge areas were recognized by the researcher as the

² Excerpt from an unpublished white paper authored by Heather Douglas and Nigel Moore

potential seeds of local transition arenas, in which transition experiments can be conducted. The development of that next step in participatory action research is elaborated in chapter four. The next section provides a road map of how those chapters will be laid out.

1.5 Thesis Road Map

1.5.1 Literature Review: Placing the Local Initiative in a Global Context

The literature review precedes the manuscripts to provide a solid grounding of this local decarbonization initiative in the global context. It also provides explication of the key concepts and developments in the rapidly expanding international field of local climate action that have been identified as significant to the work in Waterloo Region. The review outlines the global climate consequences unsustainable trajectories created by current carbonized energy systems and the concomitant imperative to pursue transformative action that results in deep decarbonization of those energy systems. Following is an outline of the evolutionary shift to a local locus of climate action in the wake of decades of incremental and piecemeal action that has resulted in an ‘ingenuity gap’ between climate action and the rapidly compounding effects of climate change.

The explication of this emerging local locus explores the rapidly expanding potential of local actors in this space, but also the tensions that arise within it. It also outlines the emerging cast of characters at the local level, the evolution of processes employed by these actors to develop and implement climate action, and the range of innovative solutions being developed. The evolution of transition arenas and experiments is noted as particularly salient in bringing about deep decarbonization. The emerging role of scholars as active, engaged participants in the development of arenas and experiments and catalysts for the shift from incremental to transformative action is also highlighted in the review.

The review concludes with a summary of the current gaps in the international body of literature. International scholarship is only beginning to explore the application of arenas and experiments in the pursuit of decarbonization, especially in the context of North American communities with their highly-carbonized energy systems.

1.5.2 Manuscript One: Insights from the Forum

The local investigation applies and builds on the concepts and developments laid out in the literature review using participatory action research in a two-pronged approach. The first prong focuses on the central question: *“What governance insights emerged from the Decarbonize Waterloo Region forum about moving from incremental piecemeal mitigation to transformative action for deep decarbonization at the local level?”* This question was investigated through participation in the November 2016 forum, and administration and analysis of a post-forum survey.

1.5.3 Manuscript Two: Local Spaces, Practical Tools

The second prong of the investigation focused on the central question: *How can arenas and experiments be used strategically to advance the transformative goal of decarbonizing energy systems in the Canadian community of Waterloo Region by 2050?*

This investigation was pursued through post-forum focus groups which engaged the forum participants who opted to discuss next steps in the implementation of local decarbonization. These focus groups centred around the potential transition arenas that were articulated following the November forum, and possible experiments that could be initiated in those arenas as practical starting places for deep decarbonization. This approach was designed to move beyond observing

and studying the local decarbonization process to take an active role and “initiate spaces for transformative change” in the community (Wittmayer & Schapke, 2014).

1.5.4 Missing from the Map; Yet to be Drawn

Like any road map, certain features are chosen as the focus because including every detail of a landscape would create a cluttered and confusing picture and reduce the map’s utility. The challenge of decarbonization, even at the local level, is incredibly complex and encompasses nearly every aspect of human society. Growing, manufacturing and building the food, products and infrastructure that make up communities generates significant carbon emissions, as does the waste that is generated by daily human activity. This is further complicated by a global economy in which high demand for goods in wealthy countries drives up emissions in the (often poorer) countries where those goods are manufactured. This thesis, and the Decarbonize Waterloo Region process, focuses solely on energy systems because these systems alone present a challenging picture to navigate. This does not negate the importance of addressing the many other sources of emissions. Out of necessity, it leaves those essential tasks for others to investigate and implement.

Many features have yet to be built on this road map as well. This thesis is a description and analysis of the early steps to decarbonization in Waterloo Region and thus the picture it presents reflects the vision, opinions and actions of the ‘frontrunners’ who participated in the November 2016 forum. Local decarbonization must start somewhere, and this work can present a relatively clear picture of those starting places. However, an attempt is also made here to propose starting places for expanding this local decarbonization effort. The routes that these frontrunners will take to engage many other local actors, navigate barriers and create new opportunities cannot be predicted with any degree of certainty. Like a road map, this work includes some ‘dotted lines’

to suggest proposed future routes to decarbonization, acknowledging that uncertainty. Future works will have to present a more definitive map of how the local routes to decarbonization are ultimately laid out.

This research project can help to inform and equip local leaders to act now and to plan for transitions that will benefit the region both economically and environmentally for many decades to come. The forum will build on existing leadership in Waterloo Region on energy system issues, and provide the scaffolding for future efforts in energy planning. Meeting the challenge of decarbonization presents possible opportunities to make positive impacts on local quality of life, energy self-sufficiency, pollution reduction and economic competitiveness in Waterloo Region. Moreover, analysis and dissemination of the lessons from the Decarbonize WR process can help to broaden positive environmental, social and economic impacts to other Canadian communities who seek to decarbonize their own local energy systems (Markard et al., 2012; Pohl et al., 2010).

Disclaimer: The author is currently engaged in the implementation of Climate Action Waterloo Region, the plan to reduce local greenhouse gas emissions by 6% from 2010 levels by the year 2020. In that capacity, I serve as the vice-chair of the committee that engages Industrial/Commercial/Institutional (ICI) actors in the implementation of the Plan. I developed and implemented this research project (my thesis) independently as a graduate student at University of Waterloo under the guidance of my academic supervisor, Dr. Sarah Burch.

Chapter Two: Reviewing the Literature on Local Decarbonization

2.1 Introduction

This chapter examines current sustainability transitions, innovation and governance literatures with the goal of situating the Decarbonize Waterloo Region initiative within the global context of climate change and decarbonization initiatives, particularly at the local level. Like Decarbonize Waterloo Region, this review focuses on efforts to decarbonize energy systems, to the exclusion of other GHG reduction initiatives and concerns. Scholarly output in the field of decarbonization has burgeoned worldwide over the past fifteen years. A key theme of that literature is the growing potential of local actors as active and effective proponents of decarbonization. This chapter surveys that growing array of academic output to identify tensions within it, and puts forth propositions regarding how those tensions can be addressed and potentially resolved to fully realize the potential of local actors. These propositions will be further probed in the subsequent chapters that investigate the insights that emerged from the November 2016 Decarbonize Waterloo Region forum and propose next steps for that local decarbonization process.

This chapter begins by providing support from sustainability literature for the bedrock premise that current fossil fuel based energy systems represent an unsustainable development trajectory. Flowing from that argument is the contention that deep decarbonization is imperative to avoid catastrophic and irreversible environmental and societal consequences (Rockström et al., 2009; Steffen et al., 2015). The emerging and expanding role of local actors in the pursuit of this imperative decarbonization is an important focus of this early section and scholars provide ample evidence of the ascendant potential of local level actors, who operate at the level where people live, work and can see the direct impact of climate change (Betsill & Bulkeley, 2007;

Bulkeley & Betsill, 2013; Hawkins & Wang, 2012). The literature also outlines the expanding capacities of local level actors including: the advent of new technological and financial innovations (Loftus et al., 2015; Schot & Geels, 2008); the proliferation of local level collaborations across public, private and civil sectors (Loorbach & Wijsman, 2013; Seyfang & Haxeltine, 2012; Widerberg & Stripple, 2016); and the development of local participatory processes to generate visions, pathways and scenarios for decarbonization has also garnered significant scholarly attention (Loftus et al., 2015; Robinson et al, 2011).

The potential of local actors as effective catalysts and drivers of deep decarbonization is becoming clear, but harnessing local level potential is not simple. Deeper exploration of the emerging literature on local decarbonization reveals several tensions between the potential and predicaments that arise in this expanding space. First, as so many new actors from across sectors seek to collaborate and meet the challenge of local decarbonization, scholars point to tensions that arise about who is in charge (or should be) in this fast-growing field (Bulkeley & Betsill, 2005; Hughes, 2016; Meadowcroft, 2007). Second, there is tension between the drive by some local actors to develop targets and pathways to decarbonization, and contentions in the literature that such approaches do not account for the complex and emergent nature of the future (Wiek et al, 2012). Third, scholars also identify a tension between the incremental approaches often chosen by local actors with limited resources and the transformative action required to bring about deep decarbonization (Lo, 2014; Meadowcroft, 2016; Rockström et al., 2017). Growing numbers of scholars assert that incremental action alone is not only an inadequate response, but a counterproductive focus that can lead to infrastructure lock-in and hamstring future efforts toward deep decarbonization (Bataille et al., 2016; Seto et al., 2016; Westley et al., 2011). Finally, scholars name the tension between the emphasis on technological or the political aspects

of decarbonization. Though many scholars extol the myriad innovative technological and financial solutions that local actors can access, the literature shows that these innovations can be stifled in the context of resilient incumbent regimes that resist change (Geels, 2014; Moloney & Horne, 2015; Patterson et al., 2015). Those regimes include the infrastructure and institutions that constitute current fossil fuel based energy systems, and the less tangible but equally resilient and pervasive set of narratives and values that underpin the way of life that is powered by fossil fuels (Burch, 2016; O'Brien, 2012; Schweizer et al., 2013).

While the need for deep decarbonization is clear, and the potential of local actors as contributors to decarbonization is promising, the many tensions articulated by scholars must be addressed for that potential to be fully realized. The next section of the chapter puts forth several propositions that have been gleaned from the literature for addressing and ultimately resolving these tensions, especially from a governance standpoint. Patterson's contention that local actors must pursue "incremental change with a transformative agenda" is presented as a foundation point and several insights from other authors are built upon this. Transition arenas and experiments are presented as promising practical methods that local actors are employing, particularly in Europe, to resolve the identified tensions and achieve greater potential as proponents of decarbonization. The chapter concludes by revealing opportunities to explore salient gaps in theoretical and practical work toward resolving the identified tensions in local decarbonization initiatives, especially in North American communities. This provides a segue to the subsequent chapters which explore that gap via the investigation of the Decarbonize Waterloo Region initiative.

2.2 Unsustainable Trajectories and a Growing Ingenuity Gap

Local decarbonization takes place in the context of, and is motivated by, ominous developments on the global scale. Global emissions of greenhouse gases (GHG) have pushed atmospheric concentrations of carbon dioxide consistently above 400 parts per million (ppm) – a level unprecedented over the course of human history, and clearly linked to the escalating consumption of fossil fuels. Level (i.e. not increasing) flows of greenhouse gases, however, will still lead to an increasing stock of carbon in the atmosphere (especially if the capacity of oceans and terrestrial ecosystems to absorb carbon reaches its threshold), and ultimately produce dangerous shifts in the global climate (Rogelj et al., 2015).

Rockstrom et al put forth the argument that a ‘safe operating pace for humanity’ must be preserved, and that crossing certain biophysical thresholds could have disastrous consequences for the planet and the humans that inhabit it (Rockström et al., 2009). Steffen and colleagues further argue that several of these identified thresholds have already been crossed, and others are in danger of being transgressed (Steffen et al., 2015). Adding further urgency to the need for action is the fact that many experts have expressed concern for over a decade that crossing these thresholds holds the prospect of triggering abrupt changes in the planet’s climate systems (Folke et al., 2002). Biermann et al warn that, “Human societies must now change course and steer away from critical tipping points in the Earth system that might lead to rapid and irreversible change (Biermann et al., 2012, p. 1306). Finally, Jakob and Hilaire claim that large portions of current fossil fuel reserves on earth are un-burnable if this safe operating space for humanity is to be preserved (Jakob & Hilaire, 2015).

The latter assertion that fossil fuel reserves are un-burnable has also recently gained considerable attention and credibility beyond sustainability circles in the fields of economics and

finance. Perhaps most famously, Bank of England Governor Mark Carney said in a 2015 speech that, “Climate change is the tragedy of the horizon. We don’t need an army of actuaries to tell us that the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – imposing a cost on future generations.” He emphasized the urgency of action as well, asserting that climate change is a threat to “financial resilience and longer-term prosperity. While there is still time to act, the window of opportunity is finite and shrinking” (Carney, 2015). These concerns have also motivated widespread investment in energy alternatives by business leaders around the world, including the launch of the Breakthrough Energy Coalition, Mission Innovation, the International Solar Alliance (Ivanova, 2016). These cumulative global shifts in mindset and rhetoric are setting the stage for a more transformative orientation in thought and action toward the need to decarbonize.

This confluence of knowledge from diverse fields of endeavour and influence has supported the emergence of an unprecedented international consensus on the imperative to reduce greenhouse gas emissions on a global scale. The most significant manifestation of this consensus to date is the Paris Agreement in 2015 (Kinley, 2016). Alongside the unprecedented consensus around the need for change is a pervasive argument in the literature that this change must happen rapidly to avoid breaching the thresholds described by climate scientists and scholars. Growing numbers of scholars argue that incremental action is not sufficient to avert the consequences of the unsustainable trajectories outlined above (Meadowcroft, 2016; Rogelj et al., 2015). Bataille also notes that deep decarbonization can’t be done in the same way as marginal or incremental mitigation or adaptation work – it is not only ineffective, but also counter-productive (Bataille et al., 2016).

Implementing deep and rapid decarbonization will necessarily be a transformative process that brings about fundamental change at many levels. As McCormick et al (2014) claim, “decarbonization...involves no less than a transition from long established systems (technologies, infrastructures, practices, lifestyles, values, and policies) to very different ones... ‘old’ systems are often embedded, physically and culturally, in built infrastructure, urban form, systems of provision (energy, water, food, transport, and information), and urban lifestyles, creating dependencies that are hard to overcome.” (McCormick et al., 2014, p. 12).

Notwithstanding the strong evidence, articulated urgency and unprecedented commitment, deep decarbonization is tremendously difficult and the need for transformative action remains contested. The international consensus articulated in the 2015 Paris Agreement is relatively new, and some very powerful actors (both state and non-state) still demonstrate ambivalent commitment to action. For example, Griffin and colleagues investigated this ambivalence and found that papers published on the carbon bubble had limited and short term effects on the stock prices of fossil fuel companies (Griffin et al., 2015). At the extreme end, the US has recently initiated its removal from the Paris Agreement. Costanza writes that “the election of US President Trump is a double-edged development with uncertain potential.” The author says on one hand that “The current US administration poses a threat to the climate, the environment, equity and sustainability.” but also posits that “Should the administration fail, this could provide the necessary push for change.” (Costanza, 2017, p. 3). Even though 195 of the world’s countries remain in the Agreement, Rockström et al point out that even among these states, “alarming inconsistencies remain between science-based targets and national commitments.” (Rockström et al., 2017).

2.3 The Local Level: Potential and Tensions

In the context of the ambivalence around the transformation imperative, scholars have identified a growing ‘ingenuity gap.’ The problem of climate change is deepening and worsening much faster than efforts to address it (Westley et al., 2011). While action at the state level remains slow and piecemeal in many cases (Terhalle & Depledge, 2013) a shift of global proportions is taking place. In the past two decades, the growing body of literature on local sustainability transitions indicates that cities have moved from being seen as ‘part of the problem’ to being a key players in the solution (Betsill & Bulkeley, 2007). The focus on cities began to take shape with Agenda 21 at the 1992 Earth Summit and has evolved over recent decades to the point where thousands of cities have climate action plans (Bulkeley & Betsill, 2005). A milestone in this evolution was the meeting of over a thousand city mayors at the COP 21 Summit in Paris in 2015 (Ivanova, 2016). A resurgence of local commitment to action also followed President Trump’s announcement that the US would withdraw from Paris. This resurgence is most strongly evident in thriving local coalitions like the US Climate Mayors. The locus for climate action is clearly moving beyond state actors and international treaties, as growing number of communities around the world are taking collaborative local action on mitigation, adaptation and transformation. This abundance of local level action is accruing global impact (Hughes, 2016).

In this era when the local level is the ascendant locus of climate action, the lessons learned at the community level have global implications and applications. At the local scale, the challenge of decarbonization becomes perhaps more manageable and comprehensible in size and scope, but the problems are still very complex, pervasive and deeply embedded in the fabric of each Canadian community. Life in Canada runs on carbon and Canadians are among the highest

emitters per capita on earth (Burck et al., 2015). Because of the scale of the changes needed to carbonized energy systems, even at the local level, incremental action is not sufficient.

Transformation requires system innovation (Smith et al., 2010; Westley et al., 2011).

As suggested in the preceding section, the potential of local actors as effective catalysts and drivers of decarbonization is becoming clear, but harnessing local potential is not simple.

Tensions are evident in the literature that explores and elucidates this fast-emerging potential.

2.3.1 Proliferating Local Actors – But Who’s in Charge?

In the context of the ascendancy of local level climate action, many new actors are entering the fray to take on new roles, forge new collaborative partnerships and develop new governance models (Bulkeley & Castán Broto, 2013; Loorbach & Wijsman, 2013). As these many actors enter the ascendant space of local decarbonization, scholars point to tensions that arise about who is in charge (or should be) in this fast-growing field. The proliferation of actors is a boon to local decarbonization efforts in many ways.

Municipal governments are of course among these new actors stepping forward in local transition processes, as mentioned earlier. Scholars have captured the many entry points of municipal governments into the arena of transition, from infrastructure decisions (Creutzig et al., 2016), to adaptation, mitigation, climate action planning and increasingly more transformative action. The past decade has also seen a proliferation of networks that connect municipal level governments around the world. Consequently scholars write extensively on the expansion of such Transnational Municipal Networks or TMNs (Fünfgeld, 2015; Hayes & Knox-hayes, 2014).

This proliferation of new actors goes well beyond municipal governments. As Castán-Broto and Bulkeley note:

“The literature on global environmental governance now makes clear that non-state actors...are increasingly involved in responding to climate change.

Moreover, the boundaries between the public and private actors are increasingly blurred, as private organisations take on roles traditionally regarded as the province of the state, while public authorities are engaged in forms of activity often regarded as a private domain, such as intervening in carbon markets or promoting the energy economy.” (Castán Broto & Bulkeley, 2013, p. 93)

The desire for tangible, local action has fuelled growing interest as well as financial investment in clean technology solutions and the entrepreneurs who create them (Klewitz & Hansen, 2014; Loorbach & Wijsman, 2013). Actors in the civil sector have also become key players in local climate action (Hawkins & Wang, 2012; Sheppard et al., 2011). Some authors hail the ‘third sector’ as the key to successful local climate change action (Hale, 2010). Similarly scholars have become more involved in local climate action, and an expanding cadre of authors write prolifically, urging more academics to become engaged in local decarbonization (Trencher et al., 2014; Wiek & Lang, 2016; Wittmayer & Schapke, 2014)

This proliferation of actors, however, has the potential to be confusing and adds further layers of complexity to an already complex space. Meadowcroft captures this potential confusion in his work which asks the question “Who’s in charge here?” and explores some ideas regarding how power can be shared among actors in a radically ‘decentred’ societal context (Meadowcroft, 2007, p. 299). Other authors such as Stirling contend that “diversity is rarely an unqualified good. Under any perspective, it presents challenges...and possible tensions with

equity, co-ordination, coherence and accountability” (Stirling, 2011, p. 86). The answer to Meadowcroft’s question about who’s in charge is not a simple one, and it will be further investigated in subsequent sections of this thesis.

2.3.2 Are Pathways and Targets the Right Approach in a Complex, Emergent Future?

Tackling the complex issue of local decarbonization is no small feat for the proliferating array of actors working in the local decarbonization space. Consequently, these actors have developed and implemented an expanding array of new processes to facilitate that challenging work. However, there is tension between the drive by some local actors to develop targets and pathways to decarbonization, and contentions in the literature that such approaches do not account for the complex and emergent nature of the future.

Visioning processes have been employed around the world to engage actors across a variety of sectors in transition work (McCormick et al., 2014; Talwar et al., 2011). Particularly because transitions take place over decades, the technique of collaboratively generating future scenarios and pathways to realize them can be very helpful to create practical visions for deep decarbonization (Bataille et al., 2016). Examples of participatory scenario building processes abound in the literature (Johnson et al., 2012; Olabisi et al., 2010). Backcasting is also a popular approach for developing goals or targets for decarbonization and then determining how those goals can be met in within the timeline set out for the target. Participatory backcasting is being used in communities across Europe (Carlsson-Kanyama et al., 2008), and use of this technique is also growing in Canada (Cameron & Potvin, 2016). More recently, some communities have begun to set ambitious targets for deep decarbonization and generating proposed pathways and scenarios to achieve these targets (Burch et al., 2014; Frantzeskaki et al., 2012).

During this expansion of local level processes to create visions, targets, pathways and scenarios, scholars warn about the limitations of these approaches in the context of a complex, uncertain and emergent future. Rockström et al caution that “scenarios often struggle to capture transformative change and the dynamics associated with it: disruption, innovation, and nonlinear change in human behavior.” (Rockström et al., 2017). Other authors express concern that the inevitable uncertainty of a decarbonized future necessitates prudence about creating blueprints and targets which have many built-in assumptions about how the future will evolve (Cameron & Potvin, 2016; McCormick et al., 2014).

2.3.3 Incremental or Transformative Action: Will Slow and Steady Win the Race?

Scholars laud the flourishing array of local action on decarbonization, but also identify a tension between the incremental approaches often chosen by local actors with limited resources and the transformative action required to bring about deep decarbonization. As mentioned, a growing body of scholarship critiques incremental action at the local level. Some scholars assert that incremental action alone is not only an inadequate response, but a counterproductive focus that can lead to infrastructure lock-in and hamstring future efforts toward deep decarbonization (Bataille et al., 2016; Seto et al., 2016; Westley et al., 2011). Lo is particularly scathing, claiming that “the gulf between radical rhetoric and ambitious goals on the one hand, and weak responses on the other, has become apparent.” Lo continues, “cities present themselves as wanting to show leadership on climate change based on scientific consensus and economic co-benefits (suggesting ethical, environmental, and economic concerns), but their actual actions (via policy priorities and distribution of responsibility between public and private sectors) do little to prevent the climate catastrophes of carbon-centered economies.” (Lo, 2014).

While the charge of ‘weak responses’ at local level must be tempered by recognition of the fact that local level actors are still early in their efforts to develop capacity and consensus, the promise of local actors as collaborators in the achievement of deep decarbonization is clear. To be successful local actors need to develop approaches that can be implemented practically at the local level now, and hold promise for triggering transformative change over the longer term.

2.3.4 Innovative Local Solutions: We Have the Technology – But What About the Politics?

Finally, as myriad innovative technological and financial solutions become accessible to local actors, research shows that these innovations can be stifled in the context of resilient incumbent regimes that resist change. To close the ingenuity gap and transform energy systems, viable alternatives to current energy systems must be developed. A growing panoply of technical, financial and social innovations in the field of local energy solutions has emerged in the past decade (Meadowcroft, 2016) making it increasingly feasible for communities to take steps toward decarbonization. The rapidly decreasing cost of solar energy, the proliferation of electric vehicles and the popularization of green bonds are but a few examples. However, decarbonization is not simply a technical matter of ‘fuel switching’ or even energy system innovation, but rather a “social, economic and deeply political” process (Burch, 2010). As Meadowcroft points out, “more needs to be done to grasp the politics of these [transition] processes. What works and what does not work is being sorted out in the world of practical politics.” (Meadowcroft, 2011, p. 70). Current energy systems are deeply embedded, not just in the infrastructure of communities, but also in the political and social structures. Therefore, changing those systems involves challenging the status quo (Luederitz et al., 2016) and shifting the values systems. Burch captures this profound facet of energy transitions, proclaiming that,

“transformative shifts thus require communities to be imaginative, radical and ambitious, pursuing sustainability as a complex set of value propositions about what defines a “good life” (Burch, 2016, p. 4).

2.4 Transformative Action at the Local Level: Governance Approaches

2.4.1 Incremental to Transformative: Governance Solutions

The diversity of local actors responding to the call for decarbonization with an expanding array of participatory processes and technological innovation represents enormous potential for transformation. However, this crescendo of potential generates profound tensions about who’s in charge and how local actors can ramp up from incremental to transformative action in the deeply political present, and into the complex and uncertain future. Finding ways to resolve these tensions between the potential and the predicaments is the key to enabling local level actors to take the imaginative, radical and ambitious action for transformative change that facilitates rapid, deep decarbonization. A large and expanding body of literature points to the importance of innovative governance approaches for the resolution of the tensions arising at the leading edges of local decarbonization.

Patterson et al (2015) shed some light in this regard, asserting that, “governance for transformation entails a dual focus on high-level, longer-term transformation combined with an honest recognition of the realities of near-term incrementalism at the same time.” They propose pursuing a strategy of “incremental change with a transformative agenda.” And a focus on governance efforts that “orient incremental efforts (such as policy change) within a broader narrative of transformative change.” (Patterson et al., 2015). Patterson and fellow authors present a very appealing and eloquent argument that fits well in the context of local actors with

limited resources who seek to take urgent action on a complex problem. Patterson et al also contend that it is “important to critically reflect on the *relationship between* incremental change and longer-term transformation.” The authors raise several salient questions including, “Is it possible to pursue incremental change with a transformative agenda through situating incremental efforts (such as policy change) within a broader transformations narrative?” and “Can incremental reforms with a general commitment to sustainability actually lead to systemic transformations?” (Patterson et al., 2015, p. 12).

Their arguments and questions bear exploration at the practical level of communities that are pursuing decarbonization. This section draws on current literature to set out a series of propositions about how this appealing idea of pursuing incremental change with a transformative agenda is already being put into practice by local actors to resolve the tensions identified in this review. These propositions are not presented as facile recipes for success, but rather are intended to elucidate governance approaches that have begun to show promise and are worthy of further testing and investigation. The three propositions for governance approaches are presented here in very broad strokes and elaborated further below:

1. Establish innovative spaces for co-creation of transformative visions and actions among diverse local actors, such as transition arenas;
2. Implement transition experiments as practical starting places for action that match the capacities of local actors and facilitate learning by doing;
3. Use experiments strategically to challenge narratives practically and politically.

The following section will elaborate on each of these three governance approaches.

2.4.2 Innovative spaces for co-creation of transformative visions and actions

Establishing innovative spaces for co-creation of transformative visions and actions is the first governance approach to be discussed. Establishing these spaces is proposed to address the tension between the proliferation of actors and concerns about who is ‘in charge’ in the expanding field of urban decarbonization. In broad strokes, these spaces can be designed to move beyond command and control approaches where government actors have traditionally taken the lead and other actors, if engaged at all, follow government’s lead. These scholars argue that that the ‘command and control’ approach to governance is ineffective in energy transitions and that one does not simply fix dysfunctional systems with sweeping top-down action. Scholars are both investigating and instigating a more polycentric approach in local decarbonization, where actors from many sectors pursue more radical and creative actions. Jhagroe and Loorbach urge local actors to begin “thinking beyond existing paradigms of democratic institutions and deliberative democracy...to create more diverse and open processes and democratize dominant conception of decision-making itself.” They further argue that such processes, “can potentially be highly democratic exactly because it is not firmly rooted in institutionalized democracy” (Jhagroe & Loorbach, 2015, p. 66).

Loorbach and others call the growing throng of local actors ‘frontrunners’. Frontrunners are the pioneers from across sectors who come together to develop new polycentric spaces for dialogue and action on decarbonization (Loorbach & Wijsman, 2013; Nevens et al., 2013; Trencher et al., 2014). These new polycentric spaces for co-creation of transformative visions are initiated by bringing these frontrunners together (Loorbach, 2010). Instead of sorting out ‘who’s in charge’, actors in this polycentric space can focus their efforts on co-creating a common vision for deep decarbonization. It is this shared vision that then provides cohesiveness

and direction rather than a single leader in charge (Frantzeskaki & Tefrati, 2016). Furthermore, the diverse actors bring a breadth of expertise and divergent ways of thinking to the complex problems of deep decarbonization (Stirling, 2011). The heterogeneous array of expertise and thinking styles can also help to supplant the traditional command and control approach that tends to reinforce incumbent patterns of thought and action, thus reducing regime resilience and promoting creative and radical thinking (Westley et al., 2011).

The co-creation of a common vision and agenda also helps to resolve the tension between incremental and transformative action. The vision developed in this co-creative space can facilitate the orientation of all local incremental actions into the context of, and in service to, the broader transformative vision. A practical manifestation of this approach that has been implemented by local actors is the creation of Transition Arenas. The actors who develop the arena are selected from across all societal sectors, based on their competencies, interests and backgrounds. They should also reflect a diversity of niche players and regime players. Different forms of this process have been used across Europe and especially the Netherlands (Loorbach & Rotmans, 2010). Moving the shared agenda forward often involves the development and implementation of transition experiments, which are described in the subsequent section.

2.4.3 Transition Experiments: Practical Starting Places for Transformative Visions

The development of spaces for co-creation of a vision is key to ramping up incremental mitigation to transformative, deep decarbonization, but implementing that vision is the next challenge. Sustainability scholars are increasingly recognizing experiments as a tool with diverse potential to address multiple tensions in the local decarbonization space. Luederitz et al provide a useful and comprehensive definition of experiments, saying that they,

“often focus on defined small-scale settings, specific to a particular location and socio-cultural context. Following the notion of experimentation, the intention is to create positive outcomes that are replicable, transferable, and scalable to society at large. Experiments focus, for example, on socio-technical innovations (e.g. in the energy or food sector), on networks (e.g. political and technical coalitions), or on small spatial or organizational units (e.g. a neighborhood or a building). In addition to having real-world impacts, such experiments are research endeavors to the extent that they produce evidence regarding both the persistent unsustainability of dominant regimes and the possible solutions to given sustainability problems.” (Luederitz et al., 2016, p. 2).

Castán Broto and Bulkeley present their analysis of 627 urban climate change experiments in a sample of 100 global cities as strong empirical evidence of “experimentation as a key tool to open up new political spaces for governing climate change in the city” (Castán Broto & Bulkeley, 2013, p. 92). In another collaborative work, these two authors further assert that experiments show promise as a special class of incremental effort with transformative potential. (Bulkeley & Castán Broto, 2013). Karvonen et al add that experiments are useful for “reframing the emphasis of sustainability from distant targets and government policies to concrete and achievable actions that can be undertaken by a wide variety of urban stakeholders” (Karvonen et al., 2013, p. 3). This reframing power makes experiments particularly useful as tools for resolving several of the tensions identified above. Experiments provide local actors with a practical and manageable starting place for carrying out the transformative vision that they develop in the arena.

Whole new models are being developed to foster experimentation at the local level. Prominent examples in the literature include two closely related models known as Urban Transition Labs and Urban Living Labs. The multi-partner European research project Governing Urban Sustainability Transitions (GUST), for instance, is developing the concept of Urban Living Labs as experimental sites that design, test, and share lessons about both social and technical innovation (Bulkeley et al., 2015). The Urban Transition Lab (UTL) has been used in several communities across Europe. The model explained by Nevens et al, that offers this definition: “Urban Transition Labs (UTL) are settings in which real life trajectories of sustainable development in cities are deployed and at the same time carefully observed; in a co-creative collaboration between actors and researchers (transdisciplinary research).” (Nevens et al., 2013, p. 111). They further state that UTLs incorporate “emergence and serendipity”, as well as “reflection, re-consideration and learning.” And that, “this learning aspect is not merely ‘a phase’ in the trajectory but a continuous aspect; as a cyclical and constant structural flow of the process design as well as substance (Nevens et al., 2013, p. 119). Loorbach and Rotmans are among the leading proponents of a ‘learning by doing’ approach that acknowledges the reality that decarbonization processes are not linear, but rather build on a series of processes in a cyclical fashion. (Loorbach & Rotmans, 2010). This constant, reflexive learning enables local actors to ‘course correct’ and change their approaches along the way, since the process of decarbonization is “emergent rather than pre-given.” (Bulkeley et al., 2016). Rooting this nimble, reflexive approach in the context of a broader transformative vision, co-created in the arena makes experiments an even more formidable tool for resolving tensions. They can inform and build on a transformative vision while incorporating a complex and emergent future.

Another model of experimentation gaining popularity is the Urban Living Lab model. The Governance of Urban Sustainability Transitions (GUST) project describes what Urban Living Labs ‘look like’ in practice, saying: “ULLs can be buildings, streets, neighbourhoods or districts within cities. They can be designated to host a multitude of social or technical experiments to inform urban policy, planning, and in particular politics.” (Voytenko et al., 2016). Nystrom et al also investigate Urban Living Labs, and their analysis uncovers the importance of a co-creative approach in experimentation. This approach of co-creative testing, design and development of experiments helps to address the tension regarding who’s in charge. As Nystrom asserts, “In living labs, users shape the innovation in their daily real-life environments, whereas in traditional innovation networks or labs the users are observed and their insights are captured and interpreted by experts. The users not only act as sources of information, but they are also testers, developers, and designers of innovation on an equal basis with the others in the living lab..” (Nyström et al., 2014, P. 483).

Finally, in addition to their power as practical starting places and tools for learning by doing, scholars present growing evidence of even greater transformative potential for experiments. For instance, Karvonen et al (2013) remark that, “When they work, experiments re-write a local or regional development narrative.” The authors offer well-known success stories, such as the High Line in New York City, the bus rapid transit system in Curitiba, and the progressive planning agendas in the Swedish city of Malmö and the German city of Freiburg as evidence of this power (Karvonen et al., 2013). Intentionally tapping into this potential to change narratives is crucial for resolving the tension between the technological and political focus of decarbonization. Experiments are about learning by doing, and as Karvonen asserts, they can also be about *transforming* by doing, as will be discussed in the next section.

2.4.4 Challenging Narratives

The power to change narratives makes experiments particularly potent tools in the deeply political space of local decarbonization. Potvin et al emphasize the need to tap into wider public narratives to achieve the unprecedented depth and breadth of change involved in transformative shifts (Potvin et al., 2017). However, Lo's indictment of the widening gap between rhetoric and action on decarbonization at the local level warns against a reliance on rhetoric alone to challenge these narratives. Experiments can provide an avenue for local actors to concretely and constructively challenge narratives by advancing new ways of *thinking* about energy systems through demonstrating new ways of *doing* energy (Avelino & Wittmayer, 2015). Additionally, when experiments are intentionally aligned with a transformative vision that is co-created by local actors in an arena they allow local actors to move beyond the hyperlocal, short term innovation of pilot projects to take a more long-term, transformative orientation (van Buuren & Loorbach, 2009).

New ways of 'thinking and doing' energy will inevitably run up against regime resistance so the frontrunners who design and implement experiments must do so in such a way that they balance between "cooperation and contestation" as Haxeltine et al claim (Haxeltine et al., 2016). Diverse strategies for engaging potential winners and losers is a key part of the development of these spaces so that the vision for transformation can expand beyond the frontrunners who develop it. That includes engagement of the incumbents who control and maintain the existing energy systems as well as political systems (Avelino & Wittmayer, 2015). Determining exactly what these strategies will be is the challenge of the frontrunners in each community, but the basic premise remains that experiments cannot be about "innovating in isolation" with a small cadre of consensus (van Buuren & Loorbach, 2009). The broader aim of system entrepreneurs is always

“reduce the resilience of dominant institutional systems and position viable shadow alternatives” (Westley et al., 2011, p. 762). Therefore, experiments oriented within arenas are imbued with great potential for resolving the tension between the technological and political focus of decarbonization, because they can give local actors the ability to use technological innovation as a political tool.

Furthermore, as McCormick et al state, “In the urban context, disruptive changes in attitudes, behaviors, and values (such as valuing public space, taking public transport or walking, buying local food, saving energy, and so on) can interact in complex ways with technological developments (such as renewable energy, electric cars, 3D printing, and so on) to produce rapid shifts in patterns of production and consumption.” (McCormick et al., 2014, p. 13). Local actors can both precipitate and capitalize on these interactions.

In exploring the tensions between creating visions/targets and the complex, emergent nature of the future, many scholars argue that decarbonization cannot be planned, but local actors must create conditions that facilitate long term transformation (Voss & Bournemann, 2011). Other authors pick up on this theme, calling for advocates of transformative change to not only scale up practical solutions, but also to scale deep (Moore & Riddell, 2015). Scaling deep involves delving into the values and culture that undergird current energy systems. Getting at this deep level is what unlocks the political will to make the transformative changes to energy systems. Experiments may not always be successful, but over time the learning and narrative changes that they foster can help communities to tip toward sustainability (Westley et al., 2011).

2.5 Opportunities to Explore Gaps in the Literature

This review reveals that efforts to bring about deep decarbonization at the local level are receiving a great deal of attention in sustainability literature. In that literature, many tensions are surfacing regarding how the myriad local actors need to go about the complex and difficult task of making deep decarbonization of communities a reality. Scholars have begun to both observe and suggest solutions for resolving these tensions. Their collective investigation has produced creative theoretical insights, such as Patterson's proposal to explore the relationship between incremental and transformational action (Patterson et al., 2015). However, many gaps remain to be fully explored in the expanding body of work on local decarbonization. In particular, Patterson et al (2015) point out that, "despite receiving growing attention in recent years, the governance and politics aspects of transformations remain arguably under-developed in the global sustainability literature." (Patterson et al., 2015, p. 2).

As outlined in this review, governance tools like transition arenas and experiments are being developed and tested, particularly in Europe. However, there remains a paucity of academic investigation into how the governance of decarbonization at the local level is being worked out by the many diverse local actors who are realizing and developing their potential. That is especially the case in North America, where local energy systems remain highly reliant on fossil fuels (Markard et al., 2012). Interestingly, a growing number of scholars are urging their fellow academics to become more engaged not only in the investigation but also the implementation of local decarbonization governance. Wiek et al (2012) implore sustainability scientists to demonstrate "a greater willingness to join ...communities to work on practical solutions" and "immerse themselves into decision processes that are embedded in societal transition processes and build socially robust knowledge" (Wiek et al., 2012, p. 7). Wittmayer and Schapke

articulate an even bolder vision of the roles that scholars can play in exploring the gaps in learning and action on local decarbonization. They call for academics to be deeply and actively engaged in the co-creative endeavour of shaping governance tools like Arenas and Experiments. They contend that “action researchers can initiate these spaces and can be seen as an integral part of the process unfolding within them...rather than by remaining an outside observer.” Furthermore, they claim that, “creating and maintaining such spaces is a core activity of researchers.” (Wittmayer & Schapke, 2014, p. 484).

In the context of the emerging tensions in the milieu of deep local decarbonization, an opportunity has arisen to explore the gaps in current understanding in a Canadian community that is just beginning to articulate a vision for deep decarbonization of local energy systems by 2050. Waterloo Region is a Canadian municipality that reflects the diversity of local level potential elaborated earlier in this review. The region has a global reputation as a technology hub, and cross sectoral cadre of local leaders created a Climate Action Plan to reduce GHG emissions by 6% between 2013 and 2020. In November 2016, local scholars convened a forum called Decarbonize Waterloo Region with the goal of ramping up local efforts to reflect a much deeper decarbonization trajectory by 2050. This emerging endeavour presented an ideal context for local academics to explore the tensions elaborated in this literature review and investigate how they might be addressed and resolved in the context of a North American community. The next section outlines how that study was undertaken. The following two chapters will look at how the question of governance for transformation is unfolding in a Canadian community in the Decarbonize Waterloo Region process. Those chapters will present and analyze the result of a participatory action research project that was undertaken in the spirit of the call for scholars to become more actively engaged in local decarbonization endeavours. It is inspired by the

literature put forward here that calls for more sophisticated, practical and radical transition governance approaches to bring about deep decarbonization at the local level, especially in North America. Its objective is to help fill in the gaps in academic understanding that beckon to be explored and to contribute to practical understandings that local level actors can use to advance deep decarbonization in the pivotal decades ahead.

Chapter Three: Decarbonizing Waterloo Region - Primed with Potential, Fraught with Tension, Tipping Toward Transformation?

3.1 Introduction

Decarbonize Waterloo Region is a Canadian urban decarbonization initiative taking shape in the context of an international landscape in profound flux. Advocates for deep decarbonization of global energy systems to “protect a safe operating space for humanity” have garnered unprecedented consensus and commitment from powerful actors around the world (Rockström et al., 2009, p. 472). This growing global climate consensus culminated in the historic CO₂ emission reduction agreements at COP21 in 2015. However, less than two years hence, this consensus is proving to be fragile at many levels. The new American administration is rolling back its commitments to international and domestic climate action, a development that is bound to have profound and pervasive global impact (Costanza, 2017). The current Canadian government’s rhetoric on emission reductions in its recently released federal climate action plan is strong, but approval of large oil pipeline projects indicates ambivalence (Burch, 2016). In Ontario, pioneering provincial efforts to promote renewable energy have generated controversy and a high level of public resistance (McRobert et al., 2016).

Notwithstanding this ambivalence, scholars present growing evidence that decarbonization of energy systems is both imperative and urgent to avoid pervasive, profound and irreversible climate impacts at the global level (Biermann et al., 2012; Burck et al., 2015; Jakob & Hilaire, 2015; Rockström et al., 2009). There is also fast-growing support for the contention that deep decarbonization is the only means to avoid lock-in to unsustainable trajectories (Bataille et al., 2016; Rogelj et al., 2015; Steffen et al., 2015). Sustainability scholars point to decades of climate action by state actors at the international level and lament progress that is slow, incremental and piecemeal (Burch et al., 2014; Terhalle & Depledge, 2013). Calls for transformative action to

fill the growing ingenuity gap between the worsening effects of climate change and innovative, transformative action to address it have thus far produced ambivalent responses at the state level (Rockström et al., 2017; Westley et al., 2011).

Simultaneously, a profound shift in global climate governance dynamics is also taking place. The locus for climate action is moving beyond state actors and international treaties as growing numbers of communities around the world are taking collaborative local action on mitigation, adaptation and transformation (Okereke et al., 2013). This abundance of local level action has global impact and implications (Broto, 2017; Hughes, 2016). In the context of burgeoning local level climate action, many actors are entering the fray to take on new roles, forge novel collaborative partnerships and develop innovative governance models and tools (Loorbach & Wijsman, 2013; Seyfang et al., 2013; Trencher et al., 2014). In the context of this fragile global consensus and the ascendance of local level actors in the realm of climate governance, local decarbonization efforts like Decarbonize Waterloo Region take on increasing political, practical and scholarly importance. This chapter looks at the potential and tensions as they are manifesting in Waterloo Region and considers how local actors can help their community to tip toward transformation and deep decarbonization.

Waterloo Region is a southern Ontario municipality that has garnered an international reputation for technological and social innovation. The current Waterloo Region Climate Action Plan's goal to reduce local GHG emissions by 6% from 2010 levels by 2020 is, however, reflective of the incremental mitigation work that many communities are undertaking in the face of worsening climate change impacts (Castán Broto & Bulkeley, 2013). In a global context where local actors are newcomers to the climate action milieu, still struggling to define roles and muster resources, the current local Plan is a respectable starting place. The collaborative

development and adoption of a local climate action plan puts the Region ahead of many comparable municipalities around the globe. Nevertheless, even if every city on the planet created a similar climate action plan, the impact would not be sufficient to fill the ingenuity gap between worsening climate impacts and humanity's implementation of solutions (Bataille et al., 2016; Westley et al., 2011).

Local actors in Waterloo Region are beginning to recognize this gap and in November 2016, a forum took place that served as the genesis of the Decarbonize Waterloo Region process. The two-day forum was organized by scholars from the University of Waterloo who invited civil and public sector stakeholders, entrepreneurs, elected officials and fellow scholars to collaborate in a significant intensification of local decarbonization efforts. In contrast to the region's relatively modest target, the Decarbonize Waterloo Region initiative articulates the transformative goal of *eliminating* fossil fuels from local energy systems by 2050. Avelino et al define transformation as "an irreversible, persistent adjustment in societal values, outlooks and behaviours of sufficient 'width and depth' to alter any preceding situation" (Avelino et al., 2013, p. 2). In more specific terms of energy systems, McCormick et al assert that "decarbonization... involves no less than a transition from long established systems (technologies, infrastructures, practices, lifestyles, values, and policies) to very different ones... 'old' systems are often embedded, physically and culturally, in built infrastructure, urban form, systems of provision (energy, water, food, transport, and information), and urban lifestyles, creating dependencies that are hard to overcome" (McCormick et al., 2014, p. 12). Burch et al assert that transformations "may only be fully evident in hind-sight, making challenging the task of identifying the 'seeds' of such transformation and the key enabling conditions" (Burch et al., 2014, p. 477)

The participants who convened to pursue a transformative vision at the Decarbonize Waterloo Region forum constitute a small, select group of frontrunners. Many key decision makers in the Region were not present at the forum, but the participants who attended do possess formidable expertise, experience, connections and insights. Engaging energy incumbents and local democratic institutions in transformative goal and actions will present complex challenges. Even more broadly speaking, the question of how this emerging collective will engage the public in the decarbonization vision developed at the forum has yet to be addressed. It is not a foregone conclusion that the vision of deep local decarbonization will gain traction beyond the forum. Public engagement in the established ethos of caution that generated modest local 6% GHG reduction targets is further confounded by a wider provincial context of pervasive and vocal public resistance to renewable energy initiatives.

3.2 Local Decarbonization: Potential and Tensions in the Literature

This exploration into the decarbonization process in Waterloo Region builds on the flourishing body of literature concerning decarbonization at the local level. In the face of state-level ambivalence, communities around the world are struggling to fill the ingenuity gap. Literature on this shift to a local locus of climate action is abundant (Bulkeley & Betsill, 2013; Castán Broto & Bulkeley, 2013; Widerberg & Stripple, 2016). The local locus of decarbonization is a growing field that is at once primed with potential, and fraught with tension. This review of the literature provides a concise overview of how these tensions are manifesting in the local decarbonization space.

Leading authors assert that local climate action has quickly moved beyond the formal policy channels of municipal governments to include private sector and civil sector actors, as well as scholars (Bulkeley & Betsill, 2013). Further, scholars note that the local decarbonization space is increasingly polycentric in nature (Meadowcroft, 2007). Burch contends that transformative processes are “complex and emergent, and thus beyond traditional control and management” (Burch et al., 2014, p. 476). No one actor in such a process can steer transformation – contrarily, a plethora of actors exert influence in many different directions. Navigating this new space presents challenges but also opportunities to expand and reimagine democratic processes to support transformative system entrepreneurship (Jhagroe & Loorbach, 2015).

This expanding, polycentric array of local actors has also developed a concomitantly broad range of processes to facilitate decarbonization efforts. Local actors are co-creating visions, pathways and scenarios for decarbonization and setting increasingly ambitious targets for emissions reductions (Hughes, 2016). However, scholars warn about the limitations of these approaches in the context of a complex, uncertain and emergent future. Rockström et al caution that “scenarios often struggle to capture transformative change and the dynamics associated with it: disruption, innovation, and nonlinear change in human behavior.” (Rockström et al., 2017, p. 1269). Other authors express concern that the inevitable uncertainty of a decarbonized future necessitates prudence about creating blueprints and targets which have many built in, and potentially erroneous, assumptions about how the future will evolve (Cameron & Potvin, 2016; McCormick et al., 2014).

In addition to processes, communities are utilizing an increasing array of technical, social and financial innovations to decarbonize energy systems. Adoption of electric vehicles,

neighbourhood energy systems and green bonds (to name just a few such developments) allow communities to develop innovative decarbonization solutions at the local level on an unprecedented scale (Avelino, 2011; Bulkeley & Castán Broto, 2013; Widerberg & Stripple, 2016). Despite this flourishing innovative potential, local decarbonization is not a simple matter of fuel switching. Local energy systems are highly carbonized, particularly in Canada, which has among the highest per capita GHG emissions in the world (Burck et al., 2015). As a result, the ‘good life’ to which people in North America have become accustomed is inextricably intertwined with these fossil fuel burning energy systems (Burch, 2016). Volumes have been written in the literature about the resilience of these systems and the regime resistance that confounds efforts to change them (Geels, 2014; Geels, 2011; Meadowcroft, 2011; Schot & Geels, 2008). In this challenging context, local actors who seek to use their expanding innovative potential also need to learn how to navigate the deeply political space of local decarbonization (Burch, 2010). Scholars emphasize that in addition to technical and social innovation, system entrepreneurship is an essential aptitude for local actors who pursue deep decarbonization of local energy systems (Avelino et al., 2013; Olsson et al., 2014). Such system level innovation involves questioning and challenging the narratives of development that support the powerful status quo of carbonized energy systems (Luederitz et al., 2016). System entrepreneurs must find ways to reduce the resilience of dominant institutions (Westley et al., 2011) and change the conversation about carbon in public discourse at the community level (Cameron & Potvin, 2016; Potvin et al., 2017; Schweizer et al., 2013).

As local actors become ever more engaged in decarbonization initiatives, there is also an opportunity to probe the relationship between incremental and transformative action. Patterson et al. (2016) argue that “governance for transformation entails a dual focus on high-level, longer-

term transformation combined with an honest recognition of the realities of near-term incrementalism at the same time.” They propose pursuing a strategy of “incremental change with a transformative agenda” (Patterson et al., 2015, p. 12). This points to the need for more powerful and sophisticated governance tools in the milieu of local decarbonization, a theme which will be explored in subsequent sections.

Many authors speak to the deep and rich potential of the local decarbonization space, fraught with tensions as it is. Importantly, O’Brien identifies “the need to develop a critical body of literature on deliberate transformation” (O’Brien, 2012, p. 667). To build that critical body of literature, scholars need to engage in action research rooted ‘on the ground’ in communities around the world (Wittmayer & Schapke, 2014). Markard points specifically to a need for more exploration of transformative initiatives in the North American context (Markard et al., 2012). This research project focuses on the nascent stages of a local level initiative that seeks deliberate transformation in a Canadian context, to contribute knowledge to that critical body of literature. The project also seeks to translate that knowledge into broader and deeper action – both in Waterloo Region and other Canadian communities.

This brief review of the literature paints a picture of potential and tension at the local level. Exciting *technological* solutions can be stymied by innovation-stifling attitudes in this deeply *political* milieu; the expanding *collaboration* among diverse actors is also a space of intense *contestation*; the local actors who propound *bold visions* for deep decarbonization must confront the daunting *complexity* of systems and the *uncertainty* of the future; and the small *incremental* steps of which local actors are capable seem inadequate in light of the *transformative* leap required. The need for sophisticated governance approaches that help to harness local potential, resolve the tensions and facilitate deep decarbonization is clear. The

early steps taken toward deep decarbonization in Waterloo Region present a propitious opportunity to investigate the potential and tensions elucidated in the literature as well as the governance approaches that can be employed for deep local decarbonization. This chapter presents the empirical data from observations at the forum and a post-forum survey to elucidate insights emerging from this local decarbonization initiative.

3.3 Methods: Participatory Action Research on Local Transformations

The Decarbonize Waterloo Region forum was designed to bring together diverse stakeholders to discuss and pursue the transformative goal of deep decarbonization of Waterloo Region's energy systems. Participatory Action Research (PAR) was chosen as the methodology for this research project because it shares a transformational orientation and objective (MacDonald, 2012). Wittmayer and Schapke identify PAR as a new frontier for sustainability research and a promising tool for the collaborative production of knowledge (Wittmayer & Schapke, 2014).

A handful of sustainability scholars are exploring the potential of this malleable methodology in sustainability and transitions literature. Wiek et al (2012) lament that, "Sustainability science seems to be still largely 'trapped' in the safe space of descriptive-analytical knowledge production" and call on sustainability scholars to display "a greater willingness to join ...communities to work on practical [sustainability] solutions" (Wiek et al., 2012, p. 6). On a more hopeful note, Wiek et al also contend that "Transformational sustainability research foresees a new role for scientists [who] need to immerse themselves into decision processes that are embedded in societal transition processes and build socially robust knowledge" (Wiek et al., 2012, p. 7).

In pursuit of transformative potential, a participatory action research approach was taken to the study of the Decarbonize Waterloo Region forum, beginning in the planning stages. In advance of the forum, the author developed a quantitative, visual picture of energy use and sources in Waterloo Region to help forum participants understand local energy systems (see Figure 1).

The next logical step in the research project was to engage directly in the transformative efforts of the forum as both a participant and a scholar analyzing the process. The role of the ‘immersed’ scholar was disclosed and explained to participants by means of a letter in advance of the forum, in addition to in-person introductory remarks at the forum reiterating this role. Throughout the two-day forum, the scholar took part in discussions and took notes about how the process was unfolding.

Immediately after the forum, a 12-question survey was sent electronically to all forum participants. It asked questions about their experience in the forum process: what worked well, what didn’t work well, stakeholder interactions and contributions to the process, and what lessons can be learned as the decarbonization process moves forward. A survey was chosen as a time efficient method to elicit feedback from many busy participants, with an awareness of potential disadvantages of this method from the perspective of dialogue. The collaborative production of knowledge that Wittmayer and Schapke espouse is limited with surveys, since there is no opportunity for dialogue. Dialogue was integrated into this research project in the post-forum focus groups, which were conducted in the project’s other data collection process. Those methods and findings are outlined in a subsequent manuscript. One advantage of the survey method was that participants shared quite openly about their hopes and fears for local decarbonization in the anonymized survey responses.

Survey participants were recruited by means of an invitation at the forum and a follow up letter. Participation in the survey was optional. Thirty-five out of fifty participants responded to the survey, yielding a 70% response rate. Survey respondents reflected a reasonable cross-section of the sectors represented at the forum, including civil sector (6), private sector (5) and local government (3). The largest portion of respondents were scholars from the two local universities (18). This roughly reflected the same proportion from each sector that was present at the forum, but with an even greater percentage of the overall composition from the academic sector.

The survey questions were designed to have meaning and relevance to local stakeholders while also yielding insights salient to the expanding literature on urban sustainability transitions. Some questions were crafted to probe for more specific responses. For example: “Were any key stakeholders missing from the forum process?” and “Were there any MVPs in the forum process who had an extraordinarily positive contribution or influence?” In the spirit of PAR, some questions were deliberately left open ended to capture learning that might emerge from the forum that was not uncovered in the literature review. Open-ended questions included “What surprised you about the forum?” and “How did your attitude toward decarbonization change as a result of participating?” These open-ended questions yielded some of the richest and most interesting responses, which are outlined below.

The data analysis strategy was developed based on the literature review. Four key themes were gleaned from the review regarding the juxtaposition of expanding potential and opposing tension emerging in the field of local level decarbonization. The data yielded from the surveys was then coded and categorized according to how it reflected each of these four themes of juxtaposed potential/tension and presented in the findings (Section 4 below).

3.4 Findings: Potential and Tensions at the Decarbonize Waterloo Region Forum

Observations from discussion at the Decarbonize Waterloo Region forum and the follow-up survey supplied rich insights into the challenges that arise when local actors seek to take transformative action for decarbonization. The findings from the forum reflect the tensions articulated by scholars in literature and demonstrate that the emerging local decarbonization space in Waterloo Region is equally fraught with both potential and tensions.

3.4.1 Making beautiful music together – or preaching to the choir?

Participants expressed excitement and hope about the potential for collaboration among the diverse experts around the vision for local decarbonization. At the same time, many recognized the tensions that would arise as that vision is brought forward to the wider community for implementation. Several facets of the tension between collaboration and contestation became abundantly clear. Several survey respondents lauded the collaborative and respectful discussion, with one asserting that the “tone of conversation was very supportive of everyone.” However, other survey respondents problematized this dynamic, claiming that, “It would have been good to have more dissenting views in the room.” Another respondent lamented that the forum, “Lacked naysayers to challenge us further.”

Another facet of this tension arose around the composition of the group. Seven survey respondents articulated a strong appreciation for the “excellent mix of people, mix of disciplines” and the growing potential for polycentric leadership on decarbonization in Waterloo Region. However, it was also recognized by some that the group of fifty forum participants “was still an elitist cohort – not representative of the general populace.” Other survey respondents also noted

as missing, “ordinary citizens who will be affected by changes - especially those on the lower income spectrum.”

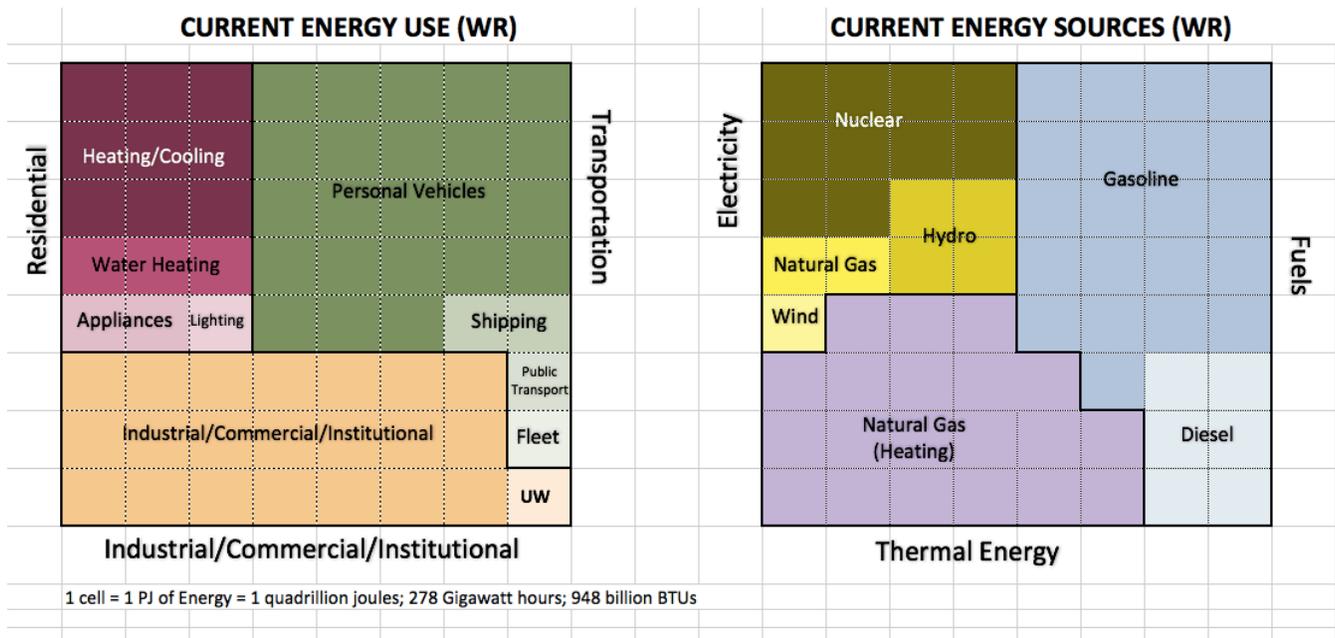
A final facet of this tension which emerged was the ascendance of new actors at the forum, juxtaposed with the comparative paucity of energy and power incumbents in attendance. A prime example was the noted contribution of participants from the private sector. The post-forum survey asked forum participants to identify ‘MVPs’ – a participant who made an extraordinarily positive contribution to the forum. Interestingly, over half of the respondents who identified a specific individual as an MVP named entrepreneurs, though they only a handful attended the forum. The input of these entrepreneurs was characterized by fellow forum participants as practical, helpful, and visionary. Conversely, ten participants expressed disappointment with the low representation from energy incumbents like electrical and gas utilities and energy intensive industries. The fact that no elected leaders attended was noted with dismay by some, who lamented the lack of “people with decision power”, and warned that it was “All well for those in the room to say what should be done, but no one with the ability to make real change was there.” Interestingly, several respondents expressed relief at the “lack of political or ideological agenda” at the forum, but others noted that without the incumbents on board, it will be very difficult to move innovative solutions forward.

3.4.2 A Clear, Bold Vision meets Daunting Complexity

Five participants specifically expressed excitement that a bold vision for decarbonization was articulated and clarified at the forum, an equal number said that they felt overwhelmed by the sheer scale complexity creating a decarbonized future in the Region. This formed the crux of another tension. One respondent made a particularly powerful statement about the vision for

deep decarbonization: “I have to say how thrilled I am that we had a forum called *Decarbonizing Waterloo Region* - I think that in itself is an incredibly important step forward in articulating what we need to do.” However, deeper consideration of this bold vision involved confronting some massive and daunting numbers. Statistics on local energy use and sources compiled for the forum made it clear that Waterloo Region’s energy systems are very carbon intensive. Over 77% of combined energy consumed in the residential, transportation and commercial/industrial sectors come from burning fossil fuels (see Figure 1 below). In preparation for the forum, statistics on present and future (2050 projections) energy use and sources for the Region were compiled into a series of diagrams and displayed in terms of petajoules. These diagrams provoked a great deal of discussion at the forum (as well as surprise and dismay). Survey responses revealed that many participants found this visualization very helpful for conceptualizing the challenge of decarbonization. The magnitude and concomitant difficulty of the task was noted by many participants. One participant said poignantly that this realization left her “more grief soaked” than before participating in the forum.

Figure 2: Current Energy Use and Sources in Waterloo Region in petajoules



This tension between bold vision and overwhelming complexity played out throughout the forum. As mentioned in the introduction, despite two days of concerted and collaborative effort, there is still much work to be done to construct comprehensive scenarios and pathways to decarbonization in Waterloo Region. Many participants noted that it was difficult to get their head around the problem – one survey respondent said: “I knew it would be complex – but not this complex.” Another respondent posited that, “In retrospect, consensus on a way forward may not even be possible in two days, given the magnitude of the goal and the many different directions you could go.”

It is important to note that despite the widespread sentiments of feeling overwhelmed, participants expressed a sense of hope and desire for ongoing engagement in local decarbonization. Surveys showed clearly that participants were willing to stay involved in a variety of ways. In addition, 100% of survey respondents expressed willingness to take part in follow up focus groups to explore next steps in the decarbonization process.

3.4.3 Saved by technology but stymied by politics?

The forum showcased several technological solutions for decarbonization that were very well received, but there was also an undercurrent of concern that none of these innovative solutions will take hold without strong political will and public support. This tension between the technological and political aspects of decarbonization was captured well by one respondent who warned that, “lots of good ideas [were] generated, but there is also a very strong uphill battle.” Early on day one of the forum, a panel of local experts presented several technical presentations on concrete potential solutions for decarbonizing the region. These included presentations on geothermal energy, hydrogen vehicles, neighbourhood heating systems and other innovative ideas. These presentations were regarded as very useful and enlightening, as summarized by one respondent who appreciated that the, “technical presentations provided a toolbox of possible solutions for us to draw on, and showcased efforts specific to the region.” Many other respondents expressed interest and excitement about the growing array of innovative technological solutions emerging at the local level.

The other side of this technological/political tension was equally prominent at the forum. In a group discussion early on day one, a local entrepreneur denounced stifling local attitudes that he had encountered towards decarbonization, proclaiming, “I’m sick and tired of being told it can’t be done here. I see so many things happening in other places.” In the surveys, another respondent expressed similar concerns about gaining political and public support for decarbonization, saying “it’s still a matter of convincing local folks that we really need to do this!” Still another respondent asserted that the forum should have included more “discussion of how to build popular support that endures the political winds of change.”

Another section of the forum agenda focused specifically on this political aspect, generating ideas for policy change at the local, provincial and federal levels. Participants applauded this work, but also cautioned that, “While good energy was put into the list of desired policies, there wasn't discussion around the fact that without developing and demonstrating popular support for the policies, policy makers will have difficulty implementing them.” One respondent had some interesting ideas about how to address the technological/political tension. That respondent reported that the forum, “showed me that the focus may not need to be on technologies so much as culture change. I am wondering what that forum might look like. Perhaps after seeing what comes out of the Community Energy Investment Strategy, if some decisions are made locally about what needs to be done, a forum about how to bring our community along with it would be a good thing to do.”

In an informal plenary session during the forum, one participant congratulated the organizers for starting “an adult conversation” about energy realities and the potential for innovation. The participant remarked that often discussions about energy get bogged down in political or ideological debates and consequently fail to articulate the concrete challenges and opportunities that lie ahead. Survey responses reflected that many participants shared the sentiment that this forum set the stage for ongoing constructive dialogue.

3.4.4 Incremental steps or transformative leap?

One of the most challenging dynamics that emerged from the forum was the tension between the transformative potential of the emerging vision for decarbonization and the relatively small, incremental steps that local actors have the capacity to take. The current Climate Action Plan became a focus of discussion while policy options were being generated. There were

some strong concerns among participants that current incremental steps are inadequate. Several expressed concern and disappointment with the progress toward the Plan's incremental goal of 6% reductions in greenhouse gas emissions by 2020 in the region. One survey respondent said it was, "great that our [policy] recommendations are in alignment with a document that has been approved by all 3 municipalities and the region [Climate Action Plan], but not so great that things seem to be in the same place as 3 years ago." Another respondent was more critical, warning that, "If we are content to leave this in the hands of policy makers without the development of concrete steps that stakeholders need to take, we will likely be in the same situation in another 3 years." [referring to the three years between the adoption of the current Climate Action Plan in 2013 and the forum in 2016].

Conversely, eight survey respondents expressed a desire to ramp up local efforts significantly saying that the forum reminded them "that there are a multitude of systems that need to fundamentally shift. It showed the importance of acting now to lay a foundation for future, deeper change." Another participant shared in a forum plenary session that "people go where systems led them – we have to change those systems." Finally, another survey respondent expressed appreciation for the panel presenter (an academic) who "inspired us to be bold." This respondent also conveyed that the forum was "a reminder that we need to *stop* burning fossil fuels - i.e. just making something a bit more efficient or cleaner isn't going to get us where we need to be."

One of the most poignant expressions of the tension between transformative vision and incremental actions was by a participant who wisely observed, "I'm not sure how the way forward should be mapped out, other than to note that it is already being mapped out with each decision we take, for our businesses, for our travel, and for our homes." This gives important

insight into how each of these incremental actions and decisions contribute to and map out the systems that need to be transformed in decarbonization. Along this same line, another respondent expressed concern that, “So many small steps lead to big change - I don't know if we've captured those yet.” This raises interesting questions about how to move deep decarbonization forward – and the danger of losing focus on the important small steps as local actors concentrate on making the big leap of transformation. In this regard, another survey respondent expressed apprehension about how to move the transformative vision of decarbonization forward, saying, “I was surprised/disappointed by how little consensus there was in the first and best steps to take.”

This is a somber and unsettling note on which to close these findings from the Decarbonize Waterloo Region forum, but it reflects the reality of moving forward on this complex and challenging undertaking. The next section begins the discussion of how local actors can seize the opportunity in this time and space, that is so fraught with both potential and tension, to tip it toward transformation.

3.5 Resolving Tensions to Harness Potential: Local Governance Tools

3.5.1 Governance for Transformation

The central question to consider now is: How can the local actors in Waterloo Region tip that community toward transformation and create the conditions that will bring their vision for deep decarbonization of local energy systems to fruition? This section explores how innovative ideas established in the literature, and emerging in practice in Europe, can be synthesized with the insights from the Decarbonize Waterloo Region forum to harness potential and resolve tensions in the unique context of this Canadian community.

That unique context includes the Climate Action Plan that was developed by local actors in 2013 and is half way through its implementation. This Plan is a starting place, but as established in the literature review, the Plan's incremental approach fits a common pattern among local level responses that will not make an adequate contribution to altering current unsustainable trajectories of GHG emissions, even at the local level. Scholars increasingly attribute this gap between aspiration and action not to the lack of desire or ability among local actors, but to the lack of local governance tools that have the power to resolve the tensions and harness the potential emerging in the local decarbonization space. The development of some powerful and sophisticated governance tools in Waterloo Region could help to trigger transformation.

Recall from the literature review that Patterson et al (2015) present a depiction of governance that fits well in the context of local actors with limited resources who seek to take urgent action on a complex problem. The authors assert that, "governance for transformation entails a dual focus on high-level, longer-term transformation combined with an honest recognition of the realities of near-term incrementalism at the same time." They propose pursuing a strategy of "incremental change with a transformative agenda." These authors further contend that it is "important to critically reflect on the *relationship between* incremental change and longer-term transformation." The authors raise several salient questions including, "Is it possible to pursue incremental change with a transformative agenda through situating incremental efforts (such as policy change) within a broader transformations narrative?" and "Can incremental reforms with a general commitment to sustainability actually lead to systemic transformations?" (Patterson et al., 2015, p. 12).

Building on this line of thinking, addressing the respective tensions in Waterloo Region is not about prioritizing one side of the tension and problematizing the other - for example, focusing on the political over the technological, or vice versa. Conversely, resolving the tensions involves exploring the *relationship between* the two sides of the various tensions. Rather than making a choice between incremental and transformative action, effective governance for deep decarbonization involves exploring how incremental actions can be employed to serve and advance a transformative vision for deep decarbonization. These same kinds of questions can help to address the other tensions that are emerging in Waterloo Region and other local decarbonization spaces. For example: How can exciting *technological* innovations be used strategically to change innovation-stifling attitudes in the deeply *political* milieu of local decarbonization? How can the *collaborative* space that was created at the forum be expanded to include the '*dissenting voices*' that might help to generate robust decarbonization solutions that actually gain traction with a skeptical public? How can local actors be equipped to implement the *bold vision* for deep decarbonization in systems that are *complex* and a future that is *uncertain*? These are the questions that need to be addressed next in the effort to decarbonize Waterloo Region.

To effectively address these fascinating but challenging questions, local actors need to develop sophisticated governance tools. This section presents two powerful tools that can be developed locally to advance that pursuit.

3.5.2 Fostering and Expanding Spaces for Transformation: Arenas

The participants at the Decarbonize Waterloo Region forum lauded the space that was created there for collaboration among the diverse actors who gathered in November 2016. That

space had been fostered for several years already by the local advocates who drove the collaborative, cross sectoral process to create the 2013-2020 Climate Action Plan. Going forward, this nascent space needs to be further developed into an even more sophisticated governance tool that can support and catalyze deep local decarbonization. Development of this space as a tool can take inspiration from transition arenas, a governance tool that is already being used successfully in several communities in Europe. As Loorbach and Rotmans say:

“A transition arena can be defined as: “an innovative participatory process of envisioning, searching, learning and agenda-building aimed at social learning as a means to achieve (sustainable) social change. It is a particular site in which the practice of managing transitions takes place. These arenas should be understood as a model that can be connected to a specific sector (mobility, or health), or to a region.”

(Loorbach & Rotmans, 2010)

The literature and the findings from the participant surveys both present some interesting insights about how these spaces can be shaped and established in Waterloo Region. Jhagroe and Loorbach emphasize that this space must be developed outside of traditional governance institutions so that actors can be radical and creative (Jhagroe & Loorbach, 2015). Participants at the forum noted in the survey that the space must be expanded beyond the “elitist cohort” that gathered in November 2016 to be informed by and engaged with the end users of local energy systems. The survey responses also reflected a push to include more “dissenting voices” and “naysayers” into the dialogue with a view to generating robust solutions that can “withstand the political winds of change.” Finally, this space must also engage the incumbents who were under-represented at the forum, especially elected leaders and energy providers. The actors who

develop the arena are selected from across all societal sectors, based on their competencies, interests and backgrounds. Loorbach and Rotmans assert that arenas should also reflect a diversity of niche players and regime players. (Loorbach & Rotmans, 2010). The ultimate goal for the development of the arenas is to create a ‘home’ for the transformative vision for decarbonization where that vision can be not only articulated but also contested and even renegotiated as the complexities and uncertainties of the future unfold.

These arenas also need to be focused and grounded in the unique realities of the region and shaped around specific local challenges. As mentioned in the introduction, discussion at the forum identified several major challenges which must be addressed by 2050 if full decarbonization is to be achieved in the Region. The forum facilitators later synthesized them into four distinct challenges:

Challenge 1: Dramatically reducing energy needs of the built environment

Challenge 2: Maximizing local renewable power generation

Challenge 3: Eliminating fossil fuels-based transportation

Challenge 4: Replacing natural gas as a source of energy for heating

While these challenges are undoubtedly daunting, they can serve as action-oriented focal points around which to organize four local transition arenas. These four challenges and the arenas that can be shaped around them will be discussed in greater detail in chapter four.

3.5.3 Creating Practical and Strategic Starting Places: Experiments

After establishing the arenas as a ‘home’ where the transformative vision for deep decarbonization in Waterloo Region can be articulated and contested, the next important step is to implement that vision. In this respect, experiments present interesting possibilities as a

powerful governance tool. Waterloo Region has already garnered a reputation as a hub of technological innovation in North America, and that innovative spirit has the potential to be harnessed more strategically to catalyze deep decarbonization using experiments. Experiments could be employed in the four proposed transition arenas to address tensions, harness potential and advance deep decarbonization locally. As established in the literature review, experiments possess several characteristics that contribute to their power as governance tools for transformation.

Firstly, experiments can provide practical starting places for action. As mentioned, survey respondents lauded the local experts and the many innovative energy solutions that they presented at the forum. However, participants also noted that it was very difficult to determine how this array of innovative alternatives might fit together into a big picture of decarbonization. The “many different directions” of innovation that were presented and discussed at the forum created a very complex puzzle. This likely contributed to the failure to develop concrete scenarios and pathways forward for decarbonization. As Karvonen claims, experiments are useful for “reframing the emphasis of sustainability from distant targets and government policies to concrete and achievable actions that can be undertaken by a wide variety of urban stakeholders.” (Karvonen et al., 2013, p. 3). Thus, experiments can help to resolve the tension between the bold vision and the complexity that overwhelmed participants at the forum by providing concrete, practical starting places for action.

Experiments can also be used as a manifestation of Patterson’s idea to employ incremental action with a with transformative agenda. To achieve this, experiments must be used strategically. As van Buuren and Loorbach say, local actors can use experiments as more than simple pilot projects, but rather tools for “learning by doing” (van Buuren & Loorbach,

2009). Experiments can be designed to serve and advance and inform the transformative vision that has its home in the arenas. The ‘learning by doing’ approach also feeds back into the vision to inform it and change it according to what is being learned in the experimental spaces. The vision for decarbonization must not become a stagnant blueprint frozen in the context of 2018, but rather a living vision that is reflexive and responsive to the realities that unfold in 2021, 2037 and beyond.

Experiments also have power as political tools, as demonstrated by Karvonen et al (2013) who contend that, “When they work, experiments re-write a local or regional development narrative.” Karvonen et al offer well-known success stories, such as the High Line in New York City, the bus rapid transit system in Curitiba, and the progressive planning agendas in the Swedish city of Malmö and the German city of Freiburg as evidence of this power (Karvonen et al., 2013, p. 3). In this way, experiments can use technological innovations to have political impact. Instead of using rhetoric, experiments can practically demonstrate the potential of technological innovations (like district heating, smart grids, thermal solar, electric vehicles, etc.) and help to change how people think about the viability and co-benefits of innovative technological solutions to decarbonization. In so doing, they can help communities to challenge and ultimately transform narratives that say “it can’t be done here” like the one lamented by the entrepreneur at the forum.

There is great potential to use experiments strategically in each arena by designing experiments intentionally to challenge specific narratives that currently stifle innovation that could contribute to deep decarbonization. Incorporating intentional narrative challenges into every incremental action can leverage the power of experiments in the political space of deep decarbonization. It can also provide entry points to engage incumbents and the “dissenting

voices” who may be very skeptical about the possibilities for deep decarbonization. It is difficult to maintain the position that decarbonization “can’t be done here” in the face of real life examples of success stories that have had a positive impact on the community. Waterloo Region needs to find its own narrative changing experiments. These real-life stories can help to change the conversation as Potvin says (Potvin et al., 2017) and do so practically and constructively. Changing the narratives is about scaling deep, as Moore et al, assert that “...durable change has been achieved only when people's hearts and minds, their values and cultural practices, and the quality of relationships they have, are transformed” (Moore et al., 2015, p. 74). Burch echoes this profound reality of deep decarbonization, proclaiming that, “transformative shifts thus require communities to be imaginative, radical and ambitious, pursuing sustainability as a complex set of value propositions about what defines a “good life” (Burch, 2016). Successfully scaling deep and redefining a “good life” in a decarbonized Waterloo Region will help tip toward transformation. A subsequent chapter will explore ideas for experiments that were generated by Decarbonize Waterloo Region forum participants in follow up focus groups.

3.6 Conclusion: Laying a Foundation for the Future

3.6.1 Key Findings

The survey responses revealed that Waterloo Region reflects a picture of local potential and tensions like that which emerges in the literature. Survey respondents articulated that they were excited about the growing array of technical solutions for decarbonization, but equally concerned about the political barriers that stand in the way of widespread local adoption of those technical solutions. The respondents also lauded the collaborative space that was fostered at the forum, but also felt that there must be ongoing efforts to engage energy and political incumbents

and dissenting voices who might contest the radical changes required for deep decarbonization. The bold vision for 100% decarbonization by 2050 was described as inspiring by many participants but many also expressed consternation about the complexity and scale of achieving that bold vision. Finally, the current local approach of an incremental 6% reduction target by 2020 was criticized as inadequate, but participants also acknowledged that the task of discerning concrete next steps in a more transformative approach felt unfinished at the end of the forum.

In addition to the familiar pattern of potential and tension, there was also unexpected candor from the survey respondents, especially to the questions about “what surprised you at the forum” and “what changed about your attitude since participating in the forum.” Responses to these open-ended questions yielded an uncommon glimpse into the thoughts, hopes and fears of the local proponents of deep decarbonization. A collective desire to move forward and continue developing and implementing deep decarbonization was also expressed in the surveys, but it was tempered with an uneasy uncertainty about what the next steps should be.

Nevertheless, the Decarbonize Waterloo Region forum succeeded in facilitating a productive conversation about innovative energy options and fostering collective desire to advance a transformative vision for local decarbonization – among fifty local leaders. Analysis of the expanding literature participation in the forum provided important insights about how to develop and mobilize the governance tools required to accomplish this complex, challenging and urgent endeavour. Experiments in arenas hold promise as governance tools that can help to resolve the tension that emerged at the forum and harnesses the potential that is evident in Waterloo Region.

3.6.2 Engaging Governance Tools to Scale Deep

Going forward, it will be imperative to ensure that the work of decarbonizing Waterloo Region builds upon the Climate Action Plan, and engages all the actors who developed it, including local energy incumbents. Equally importantly, decarbonization initiatives must also be integrally connected to other emerging local energy and climate action initiatives, such as the Community Energy Investment Strategy (CEIS) spearheaded by the Region of Waterloo. Interestingly, an early key message in the development of the CEIS highlights the fact that 87% of local dollars spent on energy currently leave the Region. Re-imagining the ‘good life’ that Burch evokes in which much more of that energy and the concomitant economic benefits, are generated within Waterloo Region is a propitious entry point for expanding dialogue about local deep decarbonization.

Above all, more work must also be done to determine how to engage the broader public in the vision and implementation of decarbonization. As one participant warned, there must be more “discussion of how to build popular support that endures the political winds of change.” Building that support will involve expanding the spaces of collaboration beyond the “elitist cohort” to embrace and integrate the “dissenting voices” that will challenge decarbonization front-runners to be both more innovative and more practical.

3.6.3 Further research and investigation

There is a great deal more to investigate than could not be included in these few pages. Deep decarbonization is a multi-level governance issue that implicates all levels of government. The actors within Waterloo Region have neither the jurisdiction nor the resources to accomplish this complex, long-term transformation on their own. The role of other levels of government and

other outside actors in decarbonization must therefore be a central consideration of ongoing research and action. Questions of justice and equity must also be core considerations. For that reason, it is crucial to invest energy in the expansion of local decarbonization dialogue and action beyond the “elitist cohort” that gathered at the November forum. There are many aspects of diversity that also must be considered to make local decarbonization a more democratic process of co-production, including education level, socio-economic status, culture, urban/rural, among others. Waterloo Region is a very diverse community and the full picture of that diversity should be reflected in the decarbonization process.

There will undoubtedly be winners and losers in the process of deep decarbonization and transforming energy systems will have massive social and economic impacts that must be carefully investigated throughout the process. There is also more participatory action research to do in Waterloo Region on the roles that each of these actors can play in mobilizing transformative potential at the local level. Local scholars have shown their potential to act as provocateurs of discussion and action on more transformative goals like deep decarbonization. Entrepreneurs show emerging promise as passionate advocates of innovation and dismantling negative narratives. The local civil sector has already shown its potential to bring many actors together and achieve consensus on the Climate Action Plan. Local government are also recognized as key leaders. The decarbonization space created in Decarbonize Waterloo Region has expanded beyond them, but it still includes them. The emerging polycentric approach also provides an opportunity to learn how to make the most out of each actor’s strengths.

3.6.4 Scaling Deep to Lay a Foundation for the Future

Moving into an uncertain future the local actors in Waterloo Region need to create conditions that can facilitate deep decarbonization. They can do so by moving forward boldly to harness this potential, creatively to resolve the tensions, prudently to overcome the barriers, and reflexively to respond to the complex and uncertain future as it unfolds. This participatory action research project captured insights from the frontrunners building a vision for deep decarbonization in this Canadian community. In the surveys these frontrunners shared their input on the forum, but they also shared hopes and fears that they might not have shared in a forum or even a focus group. This space of hopes and fears is the space in which the good life is reimagined and where the narratives, political will and public opinion are generated, stymied or unlocked. To help communities to scale deep and tip toward transformations, researchers must pursue more and better ways to creatively explore and understand this space.

The insights from the early work toward decarbonization in Waterloo Region need to be shared with other communities who are pursuing deep decarbonization. It is awe inspiring to think that this Canadian community might be tipping toward transformation. It is an exciting time in an exciting space and there is urgency. The lessons learned and the actions taken at the community level have global impact like never before in history. As the participant at the forum said, local actors in Waterloo Region must start “acting now to lay a foundation for the future” and make the vision of a decarbonized good life a reality for coming generations.

This chapter synthesized observation and interaction with the local frontrunners at the Decarbonize Waterloo Region forum with the latest literature to produce some theoretical insights on governance for deep decarbonization in a Canadian community. The next chapter will build on these insights with more in depth input from local frontrunners to suggest how this

theoretical knowledge might be mobilized and out into practice to tip Waterloo Region toward transformation and take the first steps toward 100% decarbonization.

Chapter Four: Exploring Arenas and Experiments as Governance Tools to Tip Toward Transformation in a Canadian Community

4.1 Introduction

In Canada, annual emissions per capita are equivalent in mass to a family of elephants (over 14 metric tons), putting Canadians among the highest emitters per capita on earth (Burck et al., 2015). Of course, Canada's emissions are part of a larger problem. The International Panel on Climate Change (IPCC) has made it clear that the international community must urgently reduce greenhouse gas (GHG) emissions to avoid pervasive, profound and irreversible climate impacts at the global level (Biermann et al., 2012; Burck et al., 2015; Jakob & Hilaire, 2015; Rockström et al., 2009). Elephantine per capita emissions make deep decarbonization even more imperative, and difficult, for communities in Canada.

Waterloo Region is a Canadian community that has taken on the challenge of reducing local GHG emissions. In 2013, local civil sector actors led the collaborative creation of the Waterloo Region Climate Action Plan together with local governments, business and scholars. With a modest GHG reduction target of 6% between 2013 and 2020, this Plan reflects the incremental and piecemeal approach implemented by many communities around the world (Castán Broto & Bulkeley, 2013; O'Brien, 2012). However, in November 2016, local scholars convened 50 local experts from across many sectors to participate in the Decarbonize Waterloo Region forum, to explore the possibilities for pursuing deep decarbonization of Waterloo Region's energy systems. Despite two days of intensive collaborative work by these local energy experts, much more work needs to be done to articulate comprehensive scenarios for local decarbonization. Nonetheless, a nascent collective desire to advance a transformative vision for deep decarbonization was explicitly and widely articulated by the participants. The forum process also helped to identify

four major challenges which must be addressed by 2050 to achieve full decarbonization of the Region's energy systems. These will be outlined in the methods section.

This chapter is one product of a participatory action research project that engaged local actors to begin framing these challenges as transition arenas and articulating the next practical steps toward realizing the transformative vision of deep decarbonization in Waterloo Region. This approach is rooted in growing body of transition literature that recognizes arenas and experiments as powerful tools in the transformative work of decarbonization. The development, implementation and evaluation of transition experiments in the service of local decarbonization is gaining traction in the literature and practice, chiefly in Europe (Neuens et al., 2013; Voytenko et al., 2016), but this approach is not yet widely used in Canada. Therefore, the follow up to the Decarbonize Waterloo Region forum provides a propitious opportunity to investigate the question: How can arenas and experiments be used in the Canadian community of Waterloo Region as governance tools to facilitate the transformative goal of decarbonizing local energy systems by 2050?

This paper begins the exploration of that central question with a synthesis of the transformative potential of experiments based on a review of international transition literature. The central question is then grounded in the local context using the findings from focus groups conducted by the author to engage Decarbonize Waterloo Region forum participants in shaping local transition arenas and generating ideas for local decarbonization experiments. The paper concludes by proposing starting places for applying the transformative potential of arenas and experiments in the context of this Canadian community's decarbonization initiative, based on combined insights from the international literature and local primary research. Arenas and experiments are not presented as a panacea, nor the only solutions, but rather as a powerful set of

tools with potential to help local actors in Waterloo Region tip their community toward the transformative changes required for deep decarbonization.

While sustainability scholars afford ever increasing attention to the climate action being undertaken by local actors, some authors point to the “widening gap between rhetoric and action” (Lo, 2014). As mentioned, concerns are also expressed that much of the work of local actors is incremental in nature, at a time when transformative work is required to bring about deep decarbonization (Castán Broto & Bulkeley, 2013). These critiques are tempered by recognition that local actors possess limited resources and a relatively little experience in this milieu, especially compared to state level actors (Bulkeley & Betsill, 2005; Widerberg & Stripple, 2016). Scholars also note other barriers faced by local actors, in particular the paucity of governance tools to address long term, complex problems like climate change (van Buuren & Loorbach, 2009). Further, these local actors inevitably confront regime resistance when pursuing transformation of resilient existing carbonized energy systems (F. W. Geels, 2014; Meadowcroft, 2011; Schot & Geels, 2008). In short, local actors face myriad challenges when they pursue transformative action in their communities with a view to decarbonization.

To address these identified challenges, many scholars are striving to conceptualize, create and implement tools that facilitate transformative action at the local level for decarbonization. A long line of scholars has advocated the creation of spaces where innovative climate change solutions can be developed with some degree of protection from regime resistance (Geels, 2014; Seyfang & Haxeltine, 2012). Along the same vein, other scholars call for the development of shadow networks. Westley describes these as “informal networks that work both outside and within the dominant system to develop alternatives that can potentially replace the dominant regime if and when the right opportunity occurs” (Westley et al., 2011, p. 771).

4.2 Transformative Governance Tools: Arenas and Experiments

The conceptual and practical development of spaces for innovation and governance of transitions has become increasingly sophisticated over the last decade. Transition Management is an approach to governance that has been particularly well developed in the literature by some of the world's leading transition scholars. Transition management seeks to widen participation in transition governance by engaging actors across all sectors, taking a long-term perspective (Loorbach & Rotmans, 2010) and employing a systems thinking approach (Rotmans & et al, 2001). Transition Management also places a strong emphasis on learning by doing (Voss & Bournemann, 2011). Importantly, transition management does not seek to control the uncertainties of change but rather seeks to steer and influence communities in the direction of transformation toward sustainability (Jhagroe & Loorbach, 2015). The long-term aim is to transcend the unsustainable lock-in of current systems and completely transform them.

The monumental task of transforming entire systems requires a starting place, and in transition management approach, ground zero for that task is the transition arena. The transition arena brings together a small number of forward-thinkers to develop a new, shared perspective on a complex issue (like deep decarbonization, for example). As opposed to pilot projects, which van Buuren and Loorbach argue tend to produce “incremental change and super-local innovations,” transition arenas have a longer term and more transformative orientation (van Buuren & Loorbach, 2009, p. 389). Transition arenas engage local ‘front runners’ to create a new space outside of institutional democracy and formal policy channels where there is more freedom to be creative and radical (Jhagroe & Loorbach, 2015).

The shared visions developed in transition arenas are then tested through experiments, which facilitate learning and reflexivity (Stirling, 2011) and also help to engage actors beyond the initial frontrunners. Diverse scholars identify transition experiments as a tool with great potential. Smedby contends that experiments are: “(a) purposive and strategic while seeking to capture new forms of learning or experience, (b) carried out in the name of an urban community, and (c) they have the purpose of addressing global sustainability challenges.” (Smedby, 2016, p. 299). Luederitz et al further note that “a specific type of transition experiment has emerged during the last decade...characterized by cross-organizational collaboration between actors from academia and society (government, industry and citizenry) with the aim of collaboratively fostering transformational change and progress towards greater sustainability” (Luederitz et al., 2016, p. 2). Luederitz also highlights the potential of these new kinds of experiments to “facilitate ...learning based on participation and user involvement” (Luederitz et al., 2016). Nystrom et al (2014) accentuate the co-creative power of this new type of experimentation where, “users not only act as sources of information, but they are also testers, developers, and designers of innovation.” (Nyström et al., 2014, p. 483). Karvonen et al (2013) stress the special utility of experiments in a local context for “reframing the emphasis of sustainability from distant targets and government policies to concrete and achievable actions that can be undertaken by a wide variety of urban stakeholders.” In other words, experiments provide a tangible, manageable, but powerful starting place for transformative action.

While these protected spaces for innovation are important, the literature also identifies the risk that innovation in isolation will not be successfully scaled up through technological diffusion and policy change (van Buuren & Loorbach, 2009). Scaling *deep* is also a crucial consideration raised by Moore et al, who assert that “...durable change has been achieved only

when people's hearts and minds, their values and cultural practices, and the quality of relationships they have, are transformed.” (Moore & Riddell, 2015, p. 74). In other words, transformative change is not only about scaling up new technologies, or scaling out policy changes to other jurisdictions, it is also about scaling deep to change the local narratives that underlie barriers to innovation implicitly or explicitly undergird resilient, carbonized energy systems. Karvonen et al further explain that experiments can contribute to the essential work of scaling deep, contending that, “When they work, experiments re-write a local or regional development narrative.” Karvonen et al offer well-known success stories, such as the High Line in New York City, the bus rapid transit system in Curitiba, and the progressive planning agendas in the Swedish city of Malmö and the German city of Freiburg as evidence of this power (Karvonen et al., 2013, p. 3).

While there is a growing body of literature highlighting the ‘finished product’ of experiments that have changed local narratives, there is a need for more investigation of experiments in progress to gain understanding of their transformative power. This investigation has begun recently in Europe with the advent of Urban Transition Labs (Neuens et al., 2013), research initiatives such as the multi-city MUSIC project (ref) and networks such as the Governance of Urban Sustainability Transitions (GUST) project (Voytenko et al., 2016). Luederitz et al have also done pioneering work to propose an early framework for the evaluation of transition experiments (Luederitz et al., 2016). However, a significant lacuna exists regarding the investigation of transition experiments in North America, particularly in Canada, with its highly-carbonized energy systems and high per capita GHG emissions (Markard et al., 2012). The early efforts to decarbonize Waterloo Region present promising opportunities to explore the transformative potential of arenas and experiments in a North American context. This chapter

investigates the potential of these governance tools to facilitate development of transformative visions and provide practical and manageable starting places for local actors to implement those visions while learning by doing and scaling deep and rewrite local narratives.

4.3 Methods: Initiating Spaces for Transformation

To take full advantage of the opportunity to investigate the potential of arenas and experiments in this Canadian urban decarbonization process, participatory action research (PAR) was chosen as the method of inquiry. This approach facilitated the author's immersion into the process as a participant in the November 2016 forum. The role of the researcher as a full participant was explicitly disclosed in a participant information letter and an in-person introduction at the forum. Participants were also notified in advance that they would be invited to take part in a follow up focus group to explore the potential of transition experiments to implement the decarbonization of local energy systems. As mentioned, though there was excellent discussion about many innovative possibilities, the development of clear, comprehensive scenarios or pathways for decarbonization (understandably) proved to be a very challenging task for a two-day forum. More work needs to be done locally to develop those scenarios and pathways. Nonetheless, the transformative agenda articulated at the forum did resonate with participants and a collective desire to advance that agenda was clearly expressed in both the forum discussion and follow up participant surveys.³ Instead of complete and comprehensive pathways and scenarios, what did emerge were four key challenges to be tackled to advance the transformative agenda of local decarbonization. These four challenges were

³ The results of these surveys are discussed in a companion manuscript (Chapter 3).

articulated by the forum facilitators in the days following the forum, based on a synthesis of the dialogue and ideas generated by the participants in the two-day event:

- Challenge 1: Dramatically reducing energy needs of the built environment (by 50%)
- Challenge 2: Maximizing local renewable power generation
- Challenge 3: Eliminating fossil fuels-based transportation
- Challenge 4: Replacing natural gas as a source of energy for heating

These four challenges were recognized by the author as the potential foci for the establishment of local transition arenas. Subsequently these potential transition arenas were employed as the framework for the focus groups, with a PAR goal of engaging focus group members in shaping and scoping the emerging arenas. In addition, the focus groups began the early work of co-creating potential transition experiments to be carried out in those respective arenas. In the absence of clear pathways and scenarios, the potential of experiments as a transformative tool came into sharper focus as a means of “reframing the emphasis of sustainability from distant targets...to concrete and achievable actions that can be undertaken by a wide variety of urban stakeholders.” (Karvonen et al., 2013, p. 3).

This co-creative endeavour of shaping Arenas and Experiments is an exploration of new roles for researchers, and has been articulated by Wittmayer and Schapke.⁴ They contend that “action researchers can initiate these spaces and can be seen as an integral part of the process unfolding within them...rather than by remaining an outside observer.” And furthermore that,

⁴ The new roles for researchers proposed by Wittmayer and others require further investigation and development. Direction for further investigation are outlined in the conclusion chapter.

“creating and maintaining such spaces is a core activity of researchers” (Wittmayer & Schapke, 2014, p. 484).

The author set about creating this space by inviting forum participants to take part in one of four focus groups, scheduled approximately 12 weeks after the forum (with the holiday season intervening). One of these scheduled focus groups was cancelled due to low registration. In total, 19 out of 50 participants from the November forum (not including the author) took part in the three focus groups that were ultimately convened⁵.

The author sought input on the design and questions from experts in the fields of social innovation and sustainability transformations, as well as from a small number of forum participants in advance of the event. Members were provided with background materials prior to the focus groups, which explained the concepts of transition arenas and transition experiments. Each two-hour session began with a brief review of the background materials and an opportunity for questions and clarification on the concepts. Focus group members were then asked the following questions, regarding the specific transition arena being discussed in the respective focus groups (Challenges 1-3 above):

- Is the proposed Transition Arena clearly defined? What needs to be added, refined?
- What more do we need to know about this Arena to move forward?
- What potential transition experiments can you see emerging in this Arena?
- Who needs to be involved in the development of the Arena/Experiments?

⁵ The focus group on Challenge 1 (reducing energy needs in the built environment) had eight members. The focus group on Challenge 2 (maximizing local renewable energy) had six members. The focus group on Challenge 3 (decarbonizing local transportation) had five members. There was a reasonably diverse representation of various sectors. Out of a total of 19 focus group members, 8 were from universities, 6 were from the local civil sector, 3 were from the private sector and 2 were from the public sector.

Perhaps unsurprisingly, it became clear early in the focus group discussions that the specific contextual meanings of terms like arenas and experiments were not familiar to the members, even those who worked for local civil sector organizations with an explicit sustainability mandate. One such member jokingly remarked that when he first read the background materials he thought to himself, “Transition *Arena* – is that like fight club?” This amusing anecdote underscores the fact that arenas and experiments are potentially contested, or at least poorly understood terms outside of a small circle of transition scholars. In these formative days of dialogue on deep local decarbonization it is important to create participatory spaces for explaining, defining and creative brainstorming. These focus groups were convened in that spirit. Like the November forum, these first focus groups produced rich and diverse ideas, but these ideas require further investigation. For example, important questions regarding who would lead, support, pay for and evaluate the potential experiments are among the important questions that were not discussed in the focus groups due to time constraints. This presents excellent opportunities for further research and dialogue.

The two-hour sessions were recorded with permission of all focus group members, and the author facilitated the discussion and took notes. The focus group discussion produced ideas about how the arenas should be defined, the local frontrunners who should be engaged in those arenas, and a list of potential experiments that could be implemented in each arena. Discussion also generated valuable unanticipated insights into the underlying narratives that stifle innovative solutions that could contribute to decarbonization. The results of these wide-ranging discussions were analyzed to create a proposal for the development of three transition arenas and a transition experiment in each respective arena to contribute to the decarbonization of Waterloo Region’s

energy systems. The single experiment chosen in each respective arena was selected based on an analysis of its potential to engage several of the key frontrunners identified in the focus groups. Consideration was also given to the potential of the experiment to challenge (and change) the stifling narratives that were articulated by focus group members as well. This proposal is presented as a starting place for further creative dialogue with local front runners as opposed to a prescriptive pronouncement.

4.4 Findings: Insights from Focus Groups in Waterloo Region

With only two hours for discussion, the output of these initial focus groups inevitably only scratched the surface of complex issues and titanic tasks. Nonetheless, this initial brainstorming provided substantial starting places for future development of these transition arenas and experiments in Waterloo Region. As outlined in the methods section, each respective focus group discussion set out to: a) define the arena, and entry points for the transformative work to be undertaken; b) identify potential frontrunners to be engaged in the arena; and do some initial brainstorming about c) potential experiments that could be employed in the specific arena being discussed. This section summarizes the themes that emerged from each of the three focus groups and categorizes them according to each of these goals (a, b and c). This approach was taken to provide brevity, clarity and an opportunity for some comparison across the different groups.

More detailed descriptions of the discussion can be found in the Appendix.

For reference, this is the list of focus groups and the arena they discussed:

Focus Group on Arena 1: Reducing energy needs of the built environment by 50%

Focus Group on Arena 2: Maximizing local renewable power generation

Focus Group on Arena 3: Eliminating fossil fuels-based transportation

4.4.1 Defining the Arenas

After initial clarifications of terms (arena, experiment), the focus group dialogue centred on refining the proposed transition arenas. In each of the three groups, discussion around defining the arena tended toward expanding the focus of the arena rather than limiting or concentrating it. For example, in focus group one (reducing energy use in the built environment), members emphasized that the work of reducing energy needs in the built environment must include both residential and commercial/industrial buildings. In the focus group on transportation, members felt that it is important to include Waterloo Region's expanding air traffic and local airport expansion plans in the work of that arena. In the renewable energy group, members pointed out the need to look beyond local sources of renewable power – which also follows the theme of an expansive arena. It was clear in all focus groups that the proposed arenas represent broad playing fields. Members recognized the challenge of this broad focus, but also expressed hope that there are ample opportunities for innovation and improvement within the wide gambit that each arena encompasses. Several focus group members also expressed appreciation and approval for the bold goals that are encapsulated in the proposed arena titles such as 'eliminating fossil fuels- based transportation' and 'reducing energy needs in the built environment by 50%'. In short, all three focus groups framed their respective arenas in broad, bold terms.

This framing of the arenas opened the next part of the focus group discussions to generate a host of ideas for entry points for the transformative work that would be required to bring about deep decarbonization in Waterloo Region. Focus group members identified the recent development of practical tools for tracking energy usage and costs as an excellent entry point for engaging new actors in the work of decarbonization. For example, local small businesses have

developed several very useful tools for tracking their return on investment for energy retrofits and other upgrades that not only save money but also significantly reduce carbon emissions from their business. The transportation group also referenced the development of user-friendly tools that individual motorists can use to track, analyze and modify their driving behaviour to reduce their carbon emissions. In each focus group discussion arose around the growing recognition of co-benefits as key drivers of decarbonization. Examples were generated in each group, including: the potential for investment income from renewable energy projects; the cost savings that can be achieved through re-tooling transportation fleets; and the new talent that can be attracted by businesses that demonstrate a commitment to reducing their building energy use. Finally, sharing existing local success stories emerged in each focus group as a crucial entry point for transformative action in the Region. The remarkable returns on energy reduction investments by local manufacturer VeriForm; the implementation of the biogas plant in Elmira; and car-free days (Open Streets) in Uptown Waterloo were all mentioned as success stories with potential to build on for future success in decarbonization initiatives.

In the discussions regarding defining the local arenas and identifying entry points for transformative action, many challenges were also identified. According to the groups, the task of decarbonization involves changes to infrastructure and technology, from virtual net metering to bike lanes to building retrofits. It also necessitates changes to policies and practices from municipal regulations to transportation habits to building performance standards. The most difficult challenges identified were not changes to technology, infrastructure, policies or personal habits – they were underlying local narratives that foster resistance and contribute to inertia. Important elements of these narratives were articulated in all three focus groups, with these four emerging as some of the clearest and most prominent:

1. “We don’t think about where energy comes from.”
2. “Sustainability is seen as an elitist thing.”
3. “High energy use is accepted as the cost of doing business while the money bleeds.”
4. “Long term returns and savings are not sexy.”

Exposing some of these local narratives is only the tip of a very large iceberg that requires much deeper investigation. That investigation must delve into questions like: Who creates these narratives? Who is perpetuating them? Are there counter-narratives? What specific, tangible barriers do these narratives contribute to or undergird? Suffice to say, with these narratives in the background, it is difficult to advance proposals for transformative action for decarbonization at the kitchen tables of households or the boardroom tables of business and government.

4.4.2 Front Runners

After the discussion on refining and defining the arenas, the discussion moved on to generate ideas about which frontrunners could be most helpful as catalysts for transformation and decarbonization. The potential of local governments as facilitators of local decarbonization was highlighted in every conversation, in terms of their role in providing funding, fostering flexible regulatory environments, and incentivizing other actors like utilities and developers to take collaborative action. Local government were clearly perceived as playing a crucial function as ‘wheel greasers’ to get things moving. Small businesses also factored very strongly in each conversation as pioneers and practical innovators, including manufacturers, car rental franchises and real estate companies. Group members recognized that small businesses are already doing great things and need to be equipped, celebrated, educated on the benefits of decarbonization for

their businesses. Local developers were also named as potential front runners, especially those who are already demonstrating an appetite for pioneering projects like Evolv1, a net-positive office building, which recently celebrated its official ground-breaking.

Gatekeepers, like building managers and top business and institutional executives, were identified as very important actors to engage in decarbonization. It was also noted that more effort needs to be invested in ensuring that energy efficiency initiatives are not seen as only a ‘sustainability thing’ but a core part of their work that produces excellent and diverse benefits. Finally, some unusual suspects were named as potential frontrunners to be engaged in decarbonization. These included neighbourhood associations, as well as ‘new talent’ in the private sector who value working for companies that engage in action for decarbonization.

4.4.3 Potential experiments

Several potential experiments were generated in the focus group brainstorming. These ideas are summarized in Figure 3 below.

Figure 3: Potential Experiments in the Arenas

Focus Group on Arena 1: Reducing energy needs of the built environment by 50%

Community conversations on 50% building energy reduction

A series of conversations about energy efficiency and GHG reductions could be convened among ICI building owners/operators with a goal of putting this transformative goal on their agenda and generating innovative local solutions to achieve it.

Training for ICI building operators to address performance gaps

This experiment could be a follow up to the community conversations mentioned above (1), to provide the collaborative training and ongoing support that local ICI building operators need to improve building performance and reduce energy needs.

Tools for tracking energy use and ROI for small enterprises

As mentioned, several tools of this nature have already been developed, and this experiment would create supports for small businesses to access and implement those tools with a view to reducing their building energy needs by at least 50%.

Loans for residential retrofits from local credit unions

This experiment would engage local credit unions to provide loans for deep residential retrofits, perhaps on a neighbourhood scale to realize economies of scale and integrate a social component of collaborative community building. Some credit unions both locally and in other cities already have residential retrofit loan programs in place that can be built upon for this experiment.

Focus Group on Arena 2: Maximizing local renewable power generation

A Community Financed Solar Installation on the Evolv1 Net-Positive Building

Local renewable energy cooperatives could spearhead this project together with the civil and public sector collaborative developing the net-positive Evolv1 building in Waterloo. This installation could be financed through a green bond issued to the public by the energy cooperatives, in collaboration with municipal governments.

Focus Group on Arena 3: Eliminating fossil fuels-based transportation

Protected Bike Lane Networks in Neighbourhoods

This proposed experiment involves the creation of a small local active transportation network of protected bike lanes. The development of this network would go beyond painting bike lanes to engage local neighbourhood associations to foster a local cycling culture and greater local emphasis on active transportation in general.

Expansion of TravelWise to Schools and Seniors' Communities

This proposed experiment could help to expand the successes of this organization that currently engages local employers to encourage their employees to find creative ways to commute more sustainably (ride-sharing, biking, walking, etc.). This experiment would seek to expand the service to include local schools (student and staff) as well as seniors' communities.

Low or No-cost Ridership on the LRT

This proposed experiment would engage the Region of Waterloo in an experiment to allow universal free ridership in the first year or two of LRT operation. The objective would be to precipitate a major increase in public transportation use. Since the LRT is electrified (with low carbon electricity), this could represent a significant reduction in GHG emissions from transportation.

As can be seen in the figure, two groups generated several ideas for experiments, while focus group 2 generated only one. That group became very passionate about one idea because it aligned with several of their areas of expertise and passion. On one hand, this was a positive synergy, but on another it could also indicate a certain level of ‘group think’, which underscores the need for ongoing work to expand the diversity of stakeholders engaged in decarbonization dialogue and action. The focus group members also noted that it is important to connect these experiments to initiatives and plans that are already underway locally. Each group also emphasized the importance of forging and maintaining connections across the arenas and experiments so that they are not carried out in isolation but rather that synergies can be identified and fostered.

4.5 Discussion: Mobilizing the Transformative Potential of Experiments in Arenas to Decarbonize Waterloo Region

4.5.1 Experiments in the Three Arenas: Catalysts for Decarbonization

As mentioned, the development of clear, comprehensive scenarios or pathways for decarbonization (understandably) proved to be a very challenging task for a two-day forum. More work needs to be done locally to develop those scenarios and pathways. The local frontrunners who took part in the forum must now find practical starting places to make their transformative vision for deep decarbonization into a reality. The establishment of arenas and the implementation of experiments is presented here not as a panacea, but as one set of powerful tools with the potential to help tip Waterloo Region towards that transformation. The experiments in these arenas can also contribute to the ongoing development and elaboration of the vision for deep decarbonization, which cannot remain fixed or static.

Among the ideas for experiments generated in the focus groups, three have been selected for elaboration here (one in each arena), and proposed as starting places to ‘learn by doing’ in Waterloo Region’s energy system decarbonization process. The experiments below have been selected as starting places because they present opportunities to integrate the transformative potential of experiments into existing local initiatives that are in their very early stages (all of which were highlighted in the focus groups). They also present opportunities to engage multiple local frontrunners to make a specifically targeted and practical challenge to one or several of the local narrative barriers identified in the focus groups. This approach seeks to foster transformation, by aiming to change that narrative, thereby opening and expanding support for further creativity and innovation. In some cases, the experiments proposed here are a combination of several complementary experiment ideas from the focus groups.

4.5.2 Arena One: Reducing Energy Needs in the Built Environment by 50%

Experiment: Small Business 50% Energy Reduction Challenge

This experiment could combine three complementary ideas generated in the focus group that discussed this arena. The focus of this experiment would be on local small and medium enterprises (SMEs). As a first step, local SMEs could be engaged in a series of conversations about signing on to a 50% energy reduction goal, framed primarily in terms of the productivity and savings co-benefits. Success stories can be shared as part of these conversations, including current champions like VeriForm. Next, training and tools could be provided to SMEs who express interest in taking on the 50% energy reduction challenge. Focus group members noted that excellent tools for tracking energy and return on investment have already been developed and implemented by the local SME VeriForm.

Frontrunners

This experiment will provide multiple opportunities for local frontrunners to collaborate and co-create. Foremost are local SMEs, which represent an overwhelming majority of local businesses. SMEs are acutely impacted by rising energy prices (Fresner et al., 2017; North, 2016), and with the right supports, SMEs can move more nimbly to implement innovative approaches than large businesses and institutions (Bos-brouwers, 2010; Gunasekaran et al., 2017). Local SMEs like VeriForm have already been recognized for their outstanding leadership and results in this area. Key collaborators in this experiment include the Regional Sustainability Initiative (RSI), a program of local civil sector leader Sustainability Waterloo Region. RSI is already developing tools and supports for businesses seeking to become more sustainable in terms of energy, water and waste. Several other local frontrunners should also be engaged in the development and implementation of this experiment, including the Industrial Commercial Institutional (ICI) Committee of Climate Action Waterloo Region, and the office of the Minister for Small Business for Canada, local MP Bardish Chagger.

Target Narrative(s):

This experiment has the potential to cut across many of the narratives that were identified as barriers in the focus groups. This experiment encourages SMEs to think about where their energy comes from, and challenges the narrative that high energy use is an inevitable cost of doing business. By engaging a wide range of SMEs, the experiment can challenge the notion of sustainability as ‘elitist’, framing the 50% energy reduction goal in terms of co-benefits like increased productivity and reduced costs, which appeal to any business.

Over the medium term, the lessons and successes of this experiment can be shared more broadly in the local business community and beyond. This can help to bring larger businesses

and institutions on board, as many practical lessons can be shared across sectors. Over the longer term, the success stories of this experiment can help to establish a new narrative that links energy efficiency and the concomitant reduced GHGs to reduced costs and increased productivity. Once this new narrative becomes established in local business culture, it will exert positive pressure on all local businesses and institutions to find practical ways to reduce energy use in their buildings.

4.5.3 Arena Two: Maximize Local Renewable Energy Production

Experiment: Community Financed Renewable Energy at *Evolv1*⁶

This experiment would integrate a community financed renewable energy installation into the *Evolv1* net positive office building that is currently under development by Sustainable Waterloo Region, the Cora Group (developer) and EY Canada. The *Evolv1* is the first net positive commercial building in the Region and plans already include a solar installation. The objective of this experiment would be to make that installation a community financed project that provides an opportunity for Waterloo Region residents to invest in the creation of the renewable energy system and reap returns from its energy production. Existing local renewable energy cooperatives like LIFE and CED⁷ could be engaged to facilitate and administer the community financing. By connecting community financed renewable energy to a pioneering net positive building, the experiment can generate lessons on how to scale up and build support for both concepts in the private sector and the public. Building on this initial experiment, medium term

⁶ This project may in fact work better in a future net-positive office building project, since design and development of the *Evolv1* project is already well advanced.

⁷ LIFE Co-op is a renewable energy co-operative with its headquarters in Kitchener, ON. Established in 2006, the co-op is now over 440 members. Membership is open to all residents of Ontario 16 years of age or older. The Community Energy Development Co-operative (CED) develops professional investment opportunities by supporting distributed power generation projects across Ontario.

goals could include engaging local government to issue the Region's first municipal green bond to promote the development of local renewable energy.

Frontrunners

Frontrunners in this experiment include the Sustainable Waterloo Region, the Cora Group and EY (the lead organizations of the Evolv1 building project). Residents of the Region would also be engaged as investors, with local energy cooperatives facilitating and administering as mentioned. In the medium term, municipal governments could also be engaged to issue green bonds to help scale up initiatives and investments.

Target Narrative(s):

This experiment has the potential to not only challenge several narratives that confound progress toward decarbonization, but also strengthen an important emerging narrative that supports decarbonization. Engaging 'regular people' directly in financing renewable energy projects challenges the narrative that sustainability is elitist, and the returns on the investment begin to accrue in a short time period. This experiment also fits very well with emerging narrative of the Community Energy Investment Strategy (CEIS) being developed and championed by Region go Waterloo. One of the key objectives and messages of the CEIS is to increase local renewable energy production, with view to keeping energy dollars local. Currently 87% of local energy expenditures flow out of the Region⁸.

4.5.4 Arena Three: Decarbonize Local Transportation Systems

Experiment: Protected Bike Lane Networks to Decarbonized Transportation Zones

⁸ Source: <http://www.regionofwaterloo.ca/en/aboutTheEnvironment/community-energy-investment-strategy.asp>

This experiment would build on a pilot project that has been approved for implementation by Region of Waterloo. The project involves installing and monitoring the rollout of several small networks of protected bike lanes in a handful of neighbourhoods in Waterloo Region. It is proposed that this pilot project could become an experiment in this third arena. This would involve negotiation with the Region of Waterloo (regional government), which has been a key partner in local climate action to date. As an experiment in this transition arena, the initiative could evolve from a two-year test of an infrastructure innovation to a longer-term effort to shift the neighbourhoods hosting protected bike lane experiments toward a culture of active transportation. To take this even further, residents in these areas could commit to creating a decarbonized transportation zone in their neighbourhood, with a view to expanding and connecting these zones to include the whole region over the long term.

Frontrunners

The Region of Waterloo would naturally be a frontrunner in this experiment as the initiator of the protected bike lane pilot. Neighbourhood associations in the areas where the networks are tested would also be important frontrunners. There are many strong and active Neighbourhood Associations in Waterloo Region and they could help to engage residents in adoption of the bike lanes and longer term efforts to change transportation habits and culture. The Transportation Committee of Climate Action Waterloo Region would also be an important frontrunner to engage in this experiment.

Target Narrative(s):

This experiment in arena 3 can have impact on several of the narratives that confound transformative action. This experiment can help to change the notion that sustainability is ‘elitist’ by engaging a wide range of residents to think about and exercise alternatives to carbon-

burning transportation options. In so doing, these residents also become more conscious of their energy use. There is also an opportunity in this experiment to integrate an intentional focus on the co-benefits of creating decarbonized transportation zones. As these neighbourhoods evolve, this decarbonized status and the concomitant health and quality of life benefits could become part of the community's character. As these neighbourhoods become more liveable and desirable, other co-benefits such as higher property values will naturally challenge the narrative that the long term returns of decarbonization are “not sexy”.

In summary, these experiments can help local frontrunners to “reframe distant targets to concrete and achievable actions that can be undertaken by a wide variety of urban stakeholders.”, as Karvonen asserts (Karvonen & van Heur, 2014). In the context of arenas, the experiments also provide a context within which local frontrunners can collaborate and co-create solutions (Luederitz et al., 2016; Nyström et al., 2014; Voytenko et al., 2016). Experiments also provide the opportunity to not only ‘learn by doing’, but also build on that learning in the style of the transition management cycle presented by Loorbach et al (Loorbach & Rotmans, 2010). These experiments in arenas are more than pilot projects – they are a political endeavour. In these new spaces, frontrunners must be enabled and encouraged to be radically creative and innovative (Jhagroe & Loorbach, 2015). Most importantly, the process of developing experiments in arenas must be designed to scale deep, by challenging and changing the local narratives that present the most challenging barriers to transformative action (Avelino et al., 2016; Karvonen et al., 2013).

4.5.5 Limitations of Experiments

Experiments in arenas are not the only solution for deep local decarbonization, but rather proposed as one set of powerful tools that can be a starting place and a catalyst to tip toward

transformation. It must be acknowledged here that experiments have several potential limitations as well. Firstly, as Loorbach indicates, experiments require “a considerable amount of time—approximately 5–10 years. Transition experiments are often costly and time consuming.” Loorbach therefore advises: “it is important that wherever possible, existing infrastructure (physical, financial, institutional) is used for experiments, and that the experiment’s feasibility is continuously monitored.” (Loorbach, 2010, p. 176). Smedby also warns that local level actors often lack sufficient expertise or administrative capacity to implement innovative interventions such as experiments (Smedby, 2016).

Meadowcroft warns of the political complexities of implementing interventions like experiments, contending that “Many issues compete for the attention of the public and political leaders, and most have more immediate and concrete consequences. Uncertainties about the possible and the desirable, as well as about the implications of action and inaction, abound.” Further, Meadowcroft points out that, “intervention disrupts established entitlements. It has costs as well as benefits, and the distribution of these costs – that create winners and losers – is a locus of conflict. So a real (as opposed to a rhetorical) politics of sustainability implies hard choices: picking priorities (and setting aside other projects); making decisions that are almost guaranteed to be sub- optimal and assuming current costs to hedge uncertain future risks”(Meadowcroft, 2011, p. 72).

In terms of the experiments above, each one will have its own positive and negative impacts, creating ‘winners and losers’ as choices are made to facilitate deep decarbonization. For example, the experiment in Arena One (Small business 50% energy reduction challenge) could make ‘winners’ out of the businesses who succeed in radically reducing their energy consumption and concomitant costs. Conversely, there may be small businesses which try and

fail to meet the radical reduction targets because of factors beyond their control, such as the lack of affordable technology to make their particular business processes more energy efficient. These businesses may consider themselves to be ‘losers’ in this this scenario since they are unable to take capitalize on cost savings or have their contributions recognized to the same extent as other local small businesses. In the case of the community financed energy experiment in Arena Two, the citizens who have disposable income to invest will be the ‘winners’ who can make returns on renewable energy. Other citizens may not have that disposable income to invest. Finally, in the decarbonized transportation zone experiment of Arena Three, consideration must be given to the accessibility of active transportation, public transportation and alternative fuel vehicles. Adequate income, mobility and proximity to public transportation routes will all play roles in who can access decarbonized transportation options and those for whom it may be much more difficult. Considering these potential limitations, ongoing research and engagement is required to identify and develop strategies to address and mitigate the limitations and optimize the potential of experiments in arenas within the local context.

4.6 Conclusion

Canadian communities with their elephantine GHG emissions are stepping forward among the many other local level actors to take on climate action initiatives. Waterloo Region took its first steps with the Climate Action Plan of 2013-2020, an incremental approach reflective of many early efforts at the community level around the world. In 2016, a more radical and transformative approach advocating deep decarbonization of local energy systems was articulated at the Decarbonize Waterloo Region forum. Though no elegant pathways to decarbonization were clearly demarcated at the forum, four overarching challenges were

identified. Three of those challenges were framed in this paper as arenas in which local frontrunners can collaborate and co-create solutions. These arenas are spaces where those frontrunners can ‘learn by doing’ using experiments – a tool that is already being used and studied in Europe. As local frontrunners move decarbonization forward, a propitious opportunity has opened to test the utility of experiments in arenas within the context of a Canadian community pursuing the transformative goal of deep decarbonization.

There is much work to be done going forward, and this paper offers several starting places for that work, based on insights from scholarly literature and local input from participants at the Decarbonize Waterloo Region forum and follow up focus groups. To be successful, Waterloo Region’s arenas and the experiments within them require careful design and support from diverse local frontrunners. The work of experiments in the arenas must also be connected to the many established and emerging local initiatives and networks in Waterloo Region.

Those frontrunners must include scholars who build a rigorous participatory action research agenda to foster continuous learning that allows the best ideas to be scaled up in the community and beyond. As Wittmayer and Wiek contend, scholars can also perform valuable roles as visionaries, narrative challengers and facilitators of learning by doing. The Decarbonize Waterloo Region forum experience also shows that scholars can play a pivotal role in convening a wide variety of local actors for dialogue on deep decarbonization and transformation. Going forward it will be important for local scholars to continue to expand that engagement with diverse actors, including the local incumbents of energy and political systems. Decarbonization cannot be an academic exercise, confined to ‘ivory towers’. The establishment of arenas and implementation of experiments can provide a home for the transformative vision of deep decarbonization and practical starting places to begin making it reality. Most importantly, these

tools facilitate learning about a new way of governance. Each individual experiment will not lead to transformation on its own, but it helps to build the networks, skills and governance capacity that keeps the community tipping toward transformation.

Most importantly, the arenas and experiments will help to grow a new kind of space where frontrunners can be creative and radical. The work of decarbonization is inevitably political and the arenas and experiments must integrate the objective of reducing the “resilience of existing systems”. That work includes constructive and practical challenges to the local narratives that confound transformative action. As Burch contends: “transformative shifts require communities to be imaginative, radical and ambitious, pursuing sustainability as a complex set of value propositions about what defines a “good life” (Burch, 2016). Reducing the resilience of the systems and narratives upon which ‘the good life’ in its current form will involve using experiments to create a window into a decarbonized ‘good life’ that people can see; feel; co-design; and learn from. That window must also show them the co-benefits of this decarbonized ‘good life’ for their health, their bank accounts, their relationships, and their sense of pride in their community. Ultimately the work of decarbonizing Waterloo Region and other communities around the world aims to achieve an objective that transcends decarbonizing energy systems. Arenas and experiments aim to transform communities so that ‘the good life’ in communities is no longer at odds with global climate integrity. The experiments within Waterloo Region’s arenas will help to creatively imagine and practically implement the kind of ‘good life’ that can be enjoyed for generations to come.

Chapter Five: Key Insights and Future Investigation

5.1 Engaging in a Nascent Local Decarbonization Process

Against the disconcerting backdrop of the American juggernaut's withdrawal from the Paris Agreement, local level actors demonstrate promising potential for leadership on decarbonization. Cross sectoral collaboration (Hawkins & Wang, 2012; Nevens et al, 2013), a flourishing array of processes (Patterson et al., 2015; Robinson et al., 2011) and a plethora of technological solutions (Loftus et al., 2015; Raven et al., 2015) all add to the great potential of these ascendant local level actors. However, tensions arising in the local decarbonization space prevent local actors from harnessing their full potential as proponents of deep decarbonization.

Local actors must develop the capacity to address and ultimately resolve these tensions to take the transformative action required for deep decarbonization in their communities. Fortunately, local actors are developing and testing governance tools that hold promise for this endeavour, such as arenas and experiments. These tools have yet to be tested in North America's highly carbonized communities (Markard et al., 2012) but the Decarbonize Waterloo Region forum has opened an opportunity to investigate their potential in a Canadian municipality.

The author seized that opportunity to become immersed in the nascent stages of Waterloo Region's decarbonization process, in the spirit of a growing scholarly movement calling for more direct and active engagement in the development of local decarbonization processes. This research project aimed to join the community in the search for practical local solutions for deep decarbonization, to facilitate the initiation of spaces for change and to contribute to the growing critical body of literature on deliberate transformation. Presented here is a summary of what was discovered in this research process, along with proposals for next steps and directions for continued research.

5.2 Principle Findings

This research project employed two main data collection strategies, including an online survey of Decarbonize Waterloo Region forum participants and a set of three follow up focus groups. The survey responses revealed that Waterloo Region reflects a picture of local potential and tensions like that which emerges in the literature. The following chart outlines this interplay between potential and tension using illustrative sample quotes from survey respondents.

Figure 4: Potential and Tension in Waterloo Region

Potential	Tension
<p>Exciting technological solutions discussed at the forum...</p> <p><i>“the technical presentations that were given early helped to provide a toolbox of possible solutions for us to draw upon.”</i></p>	<p>can be stymied by innovation-stifling attitudes in this deeply political milieu;</p> <p><i>“it’s still a matter of convincing local folks that we really need to do this!”</i></p>
<p>The expanding collaboration among diverse actors...</p> <p><i>“I was encouraged to see many good minds engaged in the issue.”</i></p> <p><i>“the tone of conversation was very supportive of everyone.”</i></p>	<p>is also a space of intense contestation;</p> <p><i>“[I was surprised] how people think of the subject very differently. This is one important issue to remember in future work.”</i></p> <p><i>“Lots of good ideas generated, but there is also a very strong uphill battle.”</i></p>
<p>The local actors who propound bold visions for deep decarbonization...</p> <p><i>“I have to say how thrilled I am that we had a forum called ‘Decarbonizing Waterloo Region’ - I think that in itself is an incredibly important step forward in articulating what we need to do.”</i></p>	<p>...must confront the daunting complexity of systems and the uncertainty of the future;</p> <p><i>“Decarbonizing WR is a lot more difficult than I thought it would be.”</i></p> <p><i>“I knew the concept of decarbonizing Waterloo Region was complex but I didn't think it would be this complex!”</i></p>
<p>The small, local incremental steps are very important and can be influential...</p> <p><i>“So many small steps lead to big change - I don't know if we've captured those yet. I'm not sure how the way forward should be mapped out, other than to note that it is already being mapped out with each decision we take, for our businesses, for our travel, and for our homes.”</i></p>	<p>...but also seem inadequate in light of the transformative leap required.</p> <p><i>“[the forum] was a reminder that we need to stop burning fossil fuels - i.e. just making something a bit more efficient or cleaner isn't going to get us where we need to be.”</i></p>

In addition to revealing these tensions, the open-ended question format fostered candour from the survey respondents, yielding an uncommon glimpse into the thoughts, hopes and fears of the local proponents of deep decarbonization. A collective desire to move forward and continue developing and implementing deep decarbonization was also expressed in the surveys, but it was tempered with an uneasy uncertainty about what the next steps should be. This search for direction provided a fitting segue to the focus group discussions.

The focus groups provided an opportunity to discuss governance tools that might be helpful in addressing tensions, continuing to expand spaces for change and providing practical starting places for transformation. The first major finding from the focus groups discussions was that much work remains to be done toward understanding the new governance tools arenas and experiments – even among the people who do sustainability work for a living. The focus groups provided valuable input on the defining the arenas, and the local actors who need to be engaged in those arenas as they develop. They also generated many ideas for potential experiments that could be initiated in Waterloo Region in the respective arenas. The focus groups also generated some unanticipated feedback as they articulated many local narratives that they perceive as stymying local innovation for decarbonization. From all this excellent local input and in combination with the latest literature, a proposal was put forward regarding the experiments that show promise as starting places for transformative action in Waterloo Region.

This proposal seeks to harness the transformative power of these governance tools in the local context. The power of arenas as spaces for radical and creative thought and action, along with the power of experiments to translate distant goals into practical starting places and challenge narratives present a potent combination. It must be reiterated here that these experiments in arenas will not lead to transformation on their own. Their greatest transformative

power comes from the fact that local actors can learn from these experiments in arenas how to do transformative governance in a Canadian community.

5.3 Building on the Learning from Decarbonize Waterloo Region

The immediate next steps as a follow up for this research project (thesis) will be local knowledge translation work. In the fall of 2017, a one year follow up workshop will be organized with the local stakeholders who took part in the Decarbonize Waterloo Region forum to share the results of this research and develop next steps. This workshop could also be designed to feed into the development of the next Climate Action Waterloo Region plan, which will be launched in 2020, and Waterloo Region's Community Energy Investment Strategy. Both the plan and the strategy are currently in the early stages of development. The establishment of the arenas and experiments proposed in this thesis could be integrated into that development process. Part of that process will involve securing support and funding for the potential experiments, as well as developing evaluation frameworks.

It will be important to connect the work in Waterloo Region to the many other exciting and pioneering initiatives taking place in other communities. As mentioned in the introduction, Vancouver and Oxford County have already committed to 100% decarbonization of their communities by 2050, and Guelph is also discussing this possibility. Communication of the results of this research project to other Canadian communities can be facilitated through national networks like the Federation for Canadian Municipalities. Connecting with European communities that have created arenas and implemented experiments would also be helpful. This could be facilitated through learning networks such as GUST (Governance of Urban Sustainability Transitions) a collaborative project driven by four universities across Europe.

In addition to sharing the results of this research, there are ample opportunities for ongoing research to inform local deep decarbonization efforts in Canada. Below are several themes for future research and action in this incipient field.

5.3.1 Building a Culture of Governance by Experimentation in Canada

Firstly, more research is required to inform the establishment of a culture of ‘governance by experimentation’ in Canada. A great deal of research, knowledge generation and knowledge mobilization is required to inform this new way of doing governance. This will involve learning how to develop, implement and evaluate experiments in the polycentric space of local decarbonization. Perhaps most importantly, more research is needed to help local actors to navigate the practical politics of experiments, which come with economic and political risks.

5.3.2 Multilevel Governance Issues

Part of the research agenda will involve assessing which policies and support mechanisms at the provincial, federal, or municipal levels would be most conducive to achieving the goals of energy transformation. Policy recommendations need to be developed and shared with the leaders who can act upon them, such as local MP and federal Small Business Minister, Bardish Chagger. Exploring the space of multilevel governance on deep decarbonization will also involve investigating how local solutions and insights can be not only shared with other Canadian communities, but also how these solutions and insights can have impact across scales at the provincial, national and global levels.

5.3.3 Exploring and Expanding the Roles of Local Actors

The insights from the research project made it clear that many actors from different sectors have untapped potential regarding the roles that they can play in deep decarbonization. Entrepreneurs, local governments and civil sector actors all showed promise in this research project and more investigation needs to be done to uncover how that untapped potential can be successfully employed in Waterloo Region and other communities. Exploring and expanding the role of scholars in the transformative work of deep decarbonization is also important. As already noted in this thesis, there are many potential roles that scholars can play, including: initiating spaces, convening conversations, navigating politics, developing and evaluating reflexive experiments, articulating long-term visions and challenging local narratives that stifle innovation. Fortunately, there are three post-secondary institutions in Waterloo Region and a host of academics with varied expertise who can collaborate with other local actors.

5.3.4 Building a More Inclusive Decarbonization Process in Waterloo Region

The Decarbonize Waterloo Region forum is an early step in a long process. As such, subsequent steps must seek to engage beyond the frontrunners who attended the forum. Robinson et al insist that “for a truly consultative and consensus-oriented process to occur, it is important that a broad sample of the community be engaged in the discussion that are equipped with technical knowledge or understanding of the goals of the process in order to participate in an equitable and effective fashion.” (Robinson et al., 2011, p. 766). This imperative to expand participation opens yet another opportunity to employ a PAR approach. As MacDonald reflects, “the purpose of PAR is to foster capacity, community development, empowerment, access, social justice, and participation” (MacDonald, 2012, p. 48)

The November engaged the frontrunners but did not engage a full representation of Waterloo Region’s population. To their credit, several participants recognized this reality, with one survey respondent even labelling himself and his collaborators as “an elitist cohort”. Other members of that cohort responded in the survey that key actors were missing: people from rural areas, those without post-secondary education, people with low incomes. In addition to these gaps identified in the surveys there are many other facets of diversity that need to be considered in future steps – culture and ethnicity; age; ability. Local First Nations must also be engaged in the process. Further, an even deeper inclusion of the region’s diversity needs to consider housing tenure type; family composition; business size; location of housing and employment in relation to transportation options; and possibly many other aspects.

The Decarbonize Waterloo Region forum process was an imperfect opening – but an opening nonetheless. Local researchers and decarbonization proponents need to develop deeper skills in this approach as researchers. As Wittmayer et al caution, PAR approaches “blur traditional role understandings and raise questions with regard to training requirements (i.e. Which competencies are needed?), quality criteria (i.e. What are appropriate quality standards for this kind of research?) and intervention legitimacy (i.e. What kind of intervention is legitimate by whom and why?)” (Wittmayer & Schapke, 2014, p. 484). Much more needs to be learned about how to use PAR to engage an increasingly diverse cohort in the work of decarbonizing Waterloo Region.

5.3.5 Expanding Use of Participatory Action Research in Decarbonization

Use of the participatory action research approach helped to mine some of the hopes, fears and attitudes that animate and influence the deeply political space of local decarbonization.

However, more research and practice is required to gain a better understanding of how to use the PAR approach most effectively. There is a growing body of literature that delves into the deeper considerations regarding tradeoff and limitations of PAR. One particularly poignant observation from this literature is from Ballard and Besky (2009), who caution that the “PAR approach is a valuable tool for environmental learning but the extent to which learning can actually promote system change and greater resilience must also be understood within the underlying context, especially political realities” (Ballard & Besky, 2017). In the deeply political context of local deep decarbonization, this warning takes on added importance. Furthermore, another group of scholars has developed and continues to grapple with a set of “questions that won’t go away in PAR”. This intriguing and extensive list includes questions like, “What issues are raised when professional researchers assume different roles in the community (e.g., organizer, facilitator, teacher, consultant, supervisor, bringer of money, or provocateur)?” and “What responsibilities do professional researchers have in helping the community to address/resolve their problems?” (Long et al., 2017). As research continues in the growing field of deep local decarbonization, these important questions need to be addressed by scholars and other local actors throughout the process of developing local solutions.

5.3.6 Scaling Deep

One of the most interesting findings of this participatory action research project was the insight into the thoughts, feelings, hopes and fears of local actors regarding the difficult and complex task that lies before them. It is in this space of feelings, hopes and fears that ‘scaling deep’ happens. Scaling deep to change narratives, public opinion, political will and culture is essential to the work of deep decarbonization. This assertion is supported in the literature

(Avelino et al., 2013; Moore & Riddell, 2015; Potvin et al., 2017; Shaw, 2014) and in the local findings from this research project. Scholars and local advocates know implicitly that scaling deep is essential, but far too little is yet understood explicitly about how scaling deep works or how governance tools like arenas and experiments can be used most effectively to foster it. Waterloo Region's ongoing decarbonization efforts present an opportunity for a long term, participatory action research project on scaling deep for transformation of a local community's narratives and energy systems through experiments in arenas.

5.4 Decarbonizing the Good Life

Scaling deep is a fitting note to end upon. This research project made it clear that there is great potential at the local level in Waterloo Region to move deep decarbonization forward. It also showed that scaling deep is essential. Deep decarbonization efforts must ultimately engage everyone in the region. That will not happen unless they see their idea of 'the good life' in the objectives and the outcomes of decarbonization. The narrative of deep decarbonization must be shifted away from "it can't be done here" to "it must be done here". This change in the narrative will only happen when people can see that decarbonization brings with it a healthy life, desirable neighbourhoods, profitable and growing businesses, retirement income, and talented young workers. If communities engage imaginatively, collaboratively and reflexively, with the help of sophisticated governance tools, decarbonized life *can be* the good life.

Communities cannot build that life with pilot project and incremental goals. Powerful governance tools like arenas and experiments (among other tools not discussed here, or even developed yet) must be brought to bear. This is an exciting time to be engaged in the endeavour of deep decarbonization of communities. Hopefully the conditions can be created that tip toward

transformation and achieve the deep decarbonization that will protect the future of communities across Canada and the world.

References

- Avelino, F. (2011). Power in transition: Empowering Discourses on Sustainability Transitions, (January 2011), 405.
- Avelino, F., Grin, J., Pel, B., & Jhagroe, S. (2016). The politics of sustainability transitions. *Journal of Environmental Policy & Planning*, 7200(September), 1–9. <http://doi.org/10.1080/1523908X.2016.1216782>
- Avelino, F., Wittmayer, J., Haxeltine, A., Kemp, R., Riordan, O., Weaver, P., ... Rotmans, J. (2013). Game Changers and transformative social innovation: The case of the economic crisis and the new economy TRANSIT working paper, (613169), 1–24.
- Avelino, F., & Wittmayer, J. M. (2015). Shifting Power Relations in Sustainability Transitions : A Multi-actor Perspective. *Submitted to the Journal of Environmental Policy & Planning*, 7200(December), 1–23. <http://doi.org/10.1080/1523908X.2015.1112259>
- Ballard, H. L., & Belsky, J. M. (2017). Participatory action research and environmental learning : implications for resilient forests and communities, 4622(July). <http://doi.org/10.1080/13504622.2010.505440>
- Bataille, C., Waisman, H., Colombier, M., Segafredo, L., Williams, J., & Jotzo, F. (2016). The need for national deep decarbonization pathways for effective climate policy. *Climate Policy*, 16(sup1), S7–S26. <http://doi.org/10.1080/14693062.2016.1173005>
- Betsill, M., & Bulkeley, H. (2007). Looking Back and Thinking Ahead: A Decade of Cities and Climate Change Research. *Local Environment*, 12(5), 447–456. <http://doi.org/10.1080/13549830701659683>
- Biermann, F., Abbott, K., & Andresen, S. (2012). Navigating the Anthropocene: Improving Earth System Governance. *Science*, 335(6074), 1306–1307. <http://doi.org/10.1126/science.1217255>
- Bos-brouwers, H. E. J. (2010). Corporate Sustainability and Innovation in SMEs: Evidence of Themes and Activities in Practice, 435(June 2009), 417–435.
- Broto, V. (2017). Urban Governance and the Politics of Climate change. *World Development*, 93, 1–15. <http://doi.org/10.1016/j.worlddev.2016.12.031>
- Bulkeley, H., & Betsill, M. M. (2005). Rethinking Sustainable Cities: Multilevel Governance and the “Urban” Politics of Climate Change Rethinking Sustainable Cities: Multilevel Governance and the “Urban” Politics of Climate Change. *Environmental Politics*, 14(1), 42–63. <http://doi.org/10.1080/0964401042000310178>
- Bulkeley, H., & Betsill, M. M. (2013). Revisiting the urban politics of climate change. *Environmental Politics*, 22(1), 136–154. <http://doi.org/10.1080/09644016.2013.755797>
- Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers*, 38(3), 361–375. <http://doi.org/10.1111/j.1475-5661.2012.00535.x>
- Bulkeley, H., Coenen, L., Frantzeskaki, N., Hartmann, C., Kronsell, A., Mai, L., ... Voytenko Palgan, Y. (2016). Urban living labs: governing urban sustainability transitions. *Current Opinion in Environmental Sustainability*, 22, 13–17. <http://doi.org/10.1016/j.cosust.2017.02.003>
- 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. <http://doi.org/10.1016/j.gloenvcha.2009.11.009>
- Burch, S. (2016). *Will Ontario’s Climate Change Action Plan Transform Communities ?*

Waterloo.

- Burch, S., Shaw, A., Dale, A., & Robinson, J. (2014). Triggering transformative change: a development path approach to climate change response in communities. *Climate Policy*, 14(4), 467–487. <http://doi.org/10.1080/14693062.2014.876342>
- Burck, J., Marten, F., Bals, C., Rink, E., Heinze, I., Kolboske, B., ... Krings, L. (2015). *The Climate Change Performance Index Results 2016*. Retrieved from <https://germanwatch.org/en/download/13626.pdf%5Cnhttps://germanwatch.org/en/ccpi>
- Cameron, L., & Potvin, C. (2016). Characterizing desired futures of Canadian communities. *Futures*, 82, 37–51. <http://doi.org/10.1016/j.futures.2016.05.003>
- Carlsson-Kanyama, A., Dreborg, K. H., Moll, H. C., & Padovan, D. (2008). Participative backcasting: A tool for involving stakeholders in local sustainability planning. *Futures*, 40(1), 34–46. <http://doi.org/10.1016/j.futures.2007.06.001>
- Carney, M. (2015). Breaking the Tragedy of the Horizon – climate change and financial stability Speech given by Governor of the Bank of England Chairman of the Financial Stability Board Lloyd’s of London, (September), 1–16.
- Castán Broto, V., & Bulkeley, H. (2013). A survey of urban climate change experiments in 100 cities. *Global Environmental Change*, 23(1), 92–102. <http://doi.org/10.1016/j.gloenvcha.2012.07.005>
- Costanza, R. (2017). Trump: a confluence of tipping points? *Nature*, 542(7641), 295. Retrieved from <http://dx.doi.org/10.1038/542295b>
- Creutzig, F., Agoston, P., Minx, J. C., Canadell, J. G., Andrew, R. M., Quéré, C. Le, ... Dhakal, S. (2016). Urban infrastructure choices structure climate solutions. *Nature Climate Change*, 6(12), 1054. <http://doi.org/10.1038/nclimate3169>
- Frantzeskaki, Tefrati, Niki, N. (2016). A transformative vision unlocks the innovative potential of Aberdeen City, UK. In *Governance of urban sustainability transitions* (pp. 49–68). Springer.
- Frantzeskaki, N., Loorbach, D., & Meadowcroft, J. (2012). Governing societal transitions to sustainability. *International Journal of Sustainable Development*, 15(1/2), 19. <http://doi.org/10.1504/IJSD.2012.044032>
- Fresner, J., Morea, F., Krenn, C., Aranda, J., & Tomasi, F. (2017). Energy efficiency in small and medium enterprises : Lessons learned from 280 energy audits across Europe, 142, 1650–1660. <http://doi.org/10.1016/j.jclepro.2016.11.126>
- Fünfgeld, H. (2015). Facilitating local climate change adaptation through transnational municipal networks. *Current Opinion in Environmental Sustainability*, 12, 67–73. <http://doi.org/10.1016/j.cosust.2014.10.011>
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), 24–40. <http://doi.org/10.1016/j.eist.2011.02.002>
- Geels, F. W. (2014). Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory, Culture & Society*, (May 2013), 0263276414531627-. <http://doi.org/10.1177/0263276414531627>
- Graham, J., Amos, B., & Plumptre, T. (2003). *Principles for Good Governance in the 21 st Century*.
- Griffin, P. A., Jaffe, A. M., Lont, D. H., & Dominguez-Faus, R. (2015). Science and the stock market: Investors’ recognition of unburnable carbon. *Energy Economics*, 52, 1–12. <http://doi.org/10.1016/j.eneco.2015.08.028>

- Gunasekaran, A., Rai, B. K., Griffin, M., Gunasekaran, A., Rai, B. K., & Griffin, M. (2017). Resilience and competitiveness of small and medium size enterprises : an empirical research, 7543(June). <http://doi.org/10.1080/00207543.2011.563831>
- Hale, S. (2010). The new politics of climate change: why we are failing and how we will succeed. *Environmental Politics*, 19(February 2015), 255–275. <http://doi.org/10.1080/09644010903576900>
- Hawkins, C. V., & Wang, X. (2012). Sustainable Development Governance: Citizen Participation and Support Networks in Local Sustainability Initiatives. *Public Works Management & Policy*, 17(1), 7–29. <http://doi.org/10.1177/1087724X11429045>
- Haxeltine, A., Avelino, F., Pel, B., Dumitru, A., Kemp, R., Longhurst, N., ... Wittmayer, J. M. (2016). A Framework for transformative social innovation, (November). <http://doi.org/10.13140/RG.2.2.30337.86880>
- Hayes, J., & Knox-hayes, J. (2014). Security in Climate Change Discourse: Analyzing the Divergence between US and EU Approaches to Policy. *Global Environmental Politics*, 14(2), 82–101. <http://doi.org/10.1162/GLEP>
- Hughes, S. (2016). The Politics of Urban Climate Change Policy: Toward a Research Agenda. *Urban Affairs Review*, 1–19. <http://doi.org/10.1177/1078087416649756>
- Ivanova, M. (2016). Good COP, Bad COP: Climate Reality after Paris. *Global Policy*, 7(3), 411–419. <http://doi.org/10.1111/1758-5899.12370>
- Jakob, M., & Hilaire, J. (2015). Climate science: Unburnable fossil-fuel reserves. *Nature*, 517(7533), 150–152.
- Jhagroe, S., & Loorbach, D. (2015). See no evil, hear no evil: The democratic potential of transition management. *Environmental Innovation and Societal Transitions*, 15, 65–83. <http://doi.org/10.1016/j.eist.2014.07.001>
- Karvonen, A., Evans, J., & van Heur, B. (2013). The Politics of Urban Experiments. In *The politics of urban experiments: Radical change or business as usual?* (pp. 104–115). Routledge, UK.
- Karvonen, A., & van Heur, B. (2014). Urban laboratories: Experiments in reworking cities. *International Journal of Urban and Regional Research*, 38(2), 379–392. <http://doi.org/10.1111/1468-2427.12075>
- Kinley, R. (2016). Climate change after Paris: from turning point to transformation. *Climate Policy*, 3062(August), 1–7. <http://doi.org/10.1080/14693062.2016.1191009>
- Klewitz, J., & Hansen, E. G. (2014). Sustainability-oriented innovation of SMEs: A systematic review. *Journal of Cleaner Production*, 65, 57–75. <http://doi.org/10.1016/j.jclepro.2013.07.017>
- Kris A. Johnson 1, Genya Dana 2, Nicholas R. Jordan 3, Kathy J. Draeger 4, Anne Kapuscinski 5, Laura K. Schmitt Olabisi 6, and P. B. R. 7. (2012). Using participatory scenarios to stimulate social learning for collaborative sustainable development TL - 17. *Ecology and Society*, 17 VN-r(2). <http://doi.org/10.5751/ES-04780-170209>
- Lo, K. (2014). Urban carbon governance and the transition toward low-carbon urbanism: review of a global phenomenon. *Carbon Management*, 5(3), 269–283. <http://doi.org/10.1080/17583004.2014.981384>
- Loftus, P. J., Cohen, A. M., Long, J. C. S., & Jenkins, J. D. (2015). A critical review of global decarbonization scenarios: What do they tell us about feasibility? *Wiley Interdisciplinary Reviews: Climate Change*, 6(1), 93–112. <http://doi.org/10.1002/wcc.324>
- Long, J. W., Ballard, H. L., Fisher, L. A., Belsky, J. M., Long, J. W., Ballard, H. L., ... Fisher, L.

- A. (2017). Questions That Won't Go Away in Participatory Research. *Society & Natural Resources*, 1920(July), 250–263. <http://doi.org/10.1080/08941920.2015.1024368>
- Loorbach, D. A. (2010). Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance, An International Journal of Policy, Administration, and Institutions.*, 23(1), 161–183. <http://doi.org/10.1111/j.1468-0491.2009.01471.x>
- Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. *Futures*, 42(3), 237–246. <http://doi.org/10.1016/j.futures.2009.11.009>
- Loorbach, D., & Wijsman, K. (2013). Business transition management: Exploring a new role for business in sustainability transitions. *Journal of Cleaner Production*, 45, 20–28. <http://doi.org/10.1016/j.jclepro.2012.11.002>
- Luederitz, C., Schepke, N., Wiek, A., Lang, D. J., Bergmann, M., Bos, J. J., ... Westley, F. R. (2016). Learning through evaluation - A tentative evaluative scheme for sustainability transition experiments. *Journal of Cleaner Production*. <http://doi.org/10.1016/j.jclepro.2016.09.005>
- MacDonald, C. (2012). Understanding Participatory Action Research: A qualitative research methodology option. *Canadian Journal of Action Research*, 13(2), 34–50. Retrieved from <http://ezproxy.lib.ucalgary.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=89233336&site=ehost-live>
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41(6), 955–967. <http://doi.org/10.1016/j.respol.2012.02.013>
- Mccormick, K., Gaziulusoy, I., Twomey, P., & Mcgrail, S. (2014). Decarbonization of Cities: You're Dreaming!, (December), 12–15.
- McRobert, D., Tennent-Riddell, J., & Walker, C. (2016). Ontario's Green Economy and Green Energy Act: Why a Well-Intentioned Law is Mired in Controversy and Opposed by Rural Communities. *Renewable Energy Law & Policy Review*, 7(2).
- Meadowcroft, J. (2007). Who is in Charge here? Governance for Sustainable Development in a Complex World*. *Journal of Environmental Policy & Planning*, 9(3–4), 299–314. <http://doi.org/10.1080/15239080701631544>
- Meadowcroft, J. (2011). Engaging with the politics of sustainability transitions. *Environmental Innovation and Societal Transitions*, 1(1), 70–75. <http://doi.org/10.1016/j.eist.2011.02.003>
- Meadowcroft, J. (2016). Let's Get This Transition Moving! *Canadian Public Policy*, 42(S1), S10–S17. <http://doi.org/10.3138/cpp.2015-028>
- Moloney, S., & Horne, R. (2015). Low carbon urban transitioning: From local experimentation to urban transformation?, 7(3), 2437–2453. <http://doi.org/10.3390/su7032437>
- Moore, M. L., Riddell, D., & V. (2015). Scaling out, scaling up, scaling deep: strategies of non-profits in advancing systemic social innovation. *The Journal of Corporate Citizenship*, 58, 67–85.
- Nevens, F., Frantzeskaki, N., Gorissen, L., & Loorbach, D. (2013). Urban Transition Labs: Co-creating transformative action for sustainable cities, 50, 111–122. <http://doi.org/10.1016/j.jclepro.2012.12.001>
- North, P. (2016). The business of the Anthropocene ? Substantivist and diverse economies perspectives on SME engagement in local low carbon transitions, 40(4), 437–454. <http://doi.org/10.1177/0309132515585049>

- Nyström, A. G., Leminen, S., Westerlund, M., & Kortelainen, M. (2014). Actor roles and role patterns influencing innovation in living labs. *Industrial Marketing Management*, 43(3), 483–495. <http://doi.org/10.1016/j.indmarman.2013.12.016>
- O'Brien. (2012). Global environmental change II: From adaptation to deliberate transformation. *Progress in Human Geography*, 36(5), 667–676. <http://doi.org/10.1177/0309132511425767>
- Okereke, C., Bulkeley, H., & Schroeder, H. (2013). Conceptualizing Climate Governance Beyond the International Regime. *Conceptualizing Climate Governance Beyond the International Regime*, 9(1), 58–78.
- Olabisi, L. K. S., Kapuscinski, A. R., Johnson, K. A., Reich, P. B., Stenquist, B., & Draeger, K. J. (2010). Using scenario visioning and participatory system dynamics modeling to investigate the future: Lessons from Minnesota 2050. *Sustainability*, 2(8), 2686–2706. <http://doi.org/10.3390/su2082686>
- Olsson, P., Galaz, V., & Boonstra, W. J. (2014). Sustainability transformations: A resilience perspective. *Ecology and Society*, 19(4). <http://doi.org/10.5751/ES-06799-190401>
- Patterson, J., Schulz, K., Vervoort, J., van der Hel, S., Widerberg, O., Adler, C., ... Barau, A. (2015). Exploring the governance and politics of transformations towards sustainability. *Environmental Innovation and Societal Transitions*, 1–16. <http://doi.org/10.1016/j.eist.2016.09.001>
- Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G. S., Schneider, F., ... Wiesmann, U. (2010). Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. *Science and Public Policy*, 37(4), 267–281. <http://doi.org/10.3152/030234210X496628>
- Potvin, C., Sharma, D., Creed, I., Aitken, S., Anctil, F., Bennett, E., ... Wright, T. (2017). Stimulating a Canadian narrative for climate. *FACETS*, 2, 131. <http://doi.org/10.1139/facets-2016-0029>
- Raven, R., Kern, F., Verhees, B., & Smith, A. (2015). Environmental Innovation and Societal Transitions socio-political work . A meta-analysis of six low-carbon technology cases. *Environmental Innovation and Societal Transitions*, 18, 164–180. <http://doi.org/10.1016/j.eist.2015.02.002>
- Robichau, R. W. (2011). The Mosaic of Governance : Creating a Picture with Definitions , Theories , and Debates. *Policy Studies Journal*, 39, 113–131.
- Robinson, J., Burch, S., Talwar, S., O'Shea, M., & Walsh, M. (2011). Envisioning sustainability: Recent progress in the use of participatory backcasting approaches for sustainability research. *Technological Forecasting and Social Change*, 78(5), 756–768. <http://doi.org/10.1016/j.techfore.2010.12.006>
- Rockström, J., Gaffney, O., Rogelj, J., Meinshausen, M., Nakicenovic, N., & Schellnhuber, H. J. (2017). A Roadmap for Rapid Decarbonization. *Science*, 355(6331), 1269–1271.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Nykvist, B. (. (2009). A safe operating space for humanity. *Nature*, 461(September), 472–475.
- Rogelj, J., Luderer, G., Pietzcker, R. C., Kriegler, E., Schaeffer, M., Krey, V., & Riahi, K. (2015). Energy system transformations for limiting end-of-century warming to below 1.5 °C. *Nature Climate Change*, 5(6), 519–527. <http://doi.org/10.1038/nclimate2572>
- Rotmans, J., & et al. (2001). More evolution than revolution. *Foresight*, 3(1), 1–17.
- Schot, J., & Geels, F. W. (2008). Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management*, 20(5), 537–554. <http://doi.org/10.1080/09537320802292651>

- Schweizer, S., Davis, S., & Thompson, J. L. (2013). Changing the Conversation about Climate Change: A Theoretical Framework for Place-Based Climate Change Engagement. *Environmental Communication: A Journal of Nature and Culture*, 7(1), 42–62. <http://doi.org/10.1080/17524032.2012.753634>
- Seto, K. C., Davis, S. J., Mitchell, R. B., Stokes, E. C., Unruh, G., & Ürge-Vorsatz, D. (2016). Carbon Lock-In: Types, Causes, and Policy Implications. *Annual Review of Environment and Resources*, 41, 425–452. <http://doi.org/10.1146/annurev-environ-110615-085934>
- Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: Exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy*, 30(3), 381–400. <http://doi.org/10.1068/c10222>
- Seyfang, G., Park, J. J., & Smith, A. (2013). A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy*, 61, 977–989. <http://doi.org/10.1016/j.enpol.2013.06.030>
- Shaw, C. J. (2014). Reframing climate risk to build public support for radical emission reductions: the role of deliberative democracy. *Carbon Management*, 5(4), 349–360. <http://doi.org/10.1080/17583004.2014.997078>
- Sheppard, S. R. J., Shaw, A., Flanders, D., Burch, S., Wiek, A., Carmichael, J., ... Cohen, S. (2011). Future visioning of local climate change: A framework for community engagement and planning with scenarios and visualisation. *Futures*, 43(4), 400–412. <http://doi.org/10.1016/j.futures.2011.01.009>
- Smedby, N. (2016). Assessing local governance experiments for building energy efficiency – the case of Malmö, Sweden. *Environment and Planning C: Government and Policy*, 34(2), 299–319. <http://doi.org/10.1177/0263774X15614176>
- Smith, A., Vo??, J. P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research Policy*, 39(4), 435–448. <http://doi.org/10.1016/j.respol.2010.01.023>
- Steffen, W., Richardson, K., Rockström, J., Cornell, S., Fetzer, I., Bennett, E., ... Carpenter, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science (New York, N.Y.)*, 348(6240), 1217. <http://doi.org/10.1126/science.aaa9629>
- Stirling, A. (2011). Pluralising progress: From integrative transitions to transformative diversity. *Environmental Innovation and Societal Transitions*, 1(1), 82–88. <http://doi.org/10.1016/j.eist.2011.03.005>
- Talwar, S., Wiek, A., & Robinson, J. (2011). User engagement in sustainability research. *Science and Public Policy*, 38(5), 379–390. <http://doi.org/10.3152/030234211X12960315267615>
- Terhalle, M., & Depledge, J. (2013). Great-power politics, order transition, and climate governance: insights from international relations theory. *Climate Policy*, 13(5), 572–588. <http://doi.org/10.1080/14693062.2013.818849>
- Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N. H., & Kraines, S. B. (2014). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. *Science and Public Policy*, 41(2), 151–179. <http://doi.org/10.1093/scipol/sct044>
- van Buuren, A., & Loorbach, D. (2009). Policy innovation in isolation? *Public Management Review*, 11(3), 375–392. <http://doi.org/10.1080/14719030902798289>
- Voss, J.-P., & Bournemann, B. (2011). The Politics of Reflexive Governance: Challenges for Designing Adaptive Management and Transition Management. *Ecology and Society*, 16(2), 1–27. <http://doi.org/9>

- Voytenko, Y., McCormick, K., Evans, J., & Schliwa, G. (2016). Urban living labs for sustainability and low carbon cities in Europe: Towards a research agenda. *Journal of Cleaner Production*, 123, 45–54. <http://doi.org/10.1016/j.jclepro.2015.08.053>
- Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., ... Van Der Leeuw, S. (2011). Tipping toward sustainability: Emerging pathways of transformation. *Ambio*, 40(7), 762–780. <http://doi.org/10.1007/s13280-011-0186-9>
- Widerberg, O., & Stripple, J. (2016). The expanding field of cooperative initiatives for decarbonization: a review of five databases. *Wiley Interdisciplinary Reviews: Climate Change*, 7(4), 486–500. <http://doi.org/10.1002/wcc.396>
- Wiek, A., & Lang, D. J. (2016). Transformational Sustainability Research Methodology. *Sustainability Science*, (November 2009), 31–41. http://doi.org/10.1007/978-94-017-7242-6_3
- Wiek, A., Ness, B., Schweizer-Ries, P., Brand, F. S., & Farioli, F. (2012). From complex systems analysis to transformational change: A comparative appraisal of sustainability science projects. *Sustainability Science*, 7(SUPPL. 1), 5–24. <http://doi.org/10.1007/s11625-011-0148-y>
- Wittmayer, J. M., & Schepke, N. (2014). Action, research and participation: roles of researchers in sustainability transitions. *Sustainability Science*, 9(4), 483–496. <http://doi.org/10.1007/s11625-014-0258-4>

Appendices

Appendix A: Decarbonize Waterloo Region - Post Forum Survey

Q1 How effective was the forum in meeting its objectives? Please provide comments if you wish.

Q2 What were some key factors (2-3 max) that helped or hindered the forum in meeting its objectives?

Q3 Were there any MVPs in the forum process? (i.e. stakeholders who had an extraordinarily positive contribution or influence?). If yes, please identify and describe briefly.

Q4 Were any key stakeholders missing from the process? If so, who?

Q5 Were there any key turning points (positive or negative) in the forum process? If yes, please describe briefly.

Q6 What was done well in the forum? (before and/or during)

Q7 What could have been done differently or better? (before and/or during)

Q8 Did anything surprise you in the forum process? Please describe briefly. (this question is intended to be open ended – surprise us with your answer!)

Q9 Has your thinking or attitudes toward the possibilities for decarbonizing Waterloo Region changed as a result of participating in the forum? If so, please describe briefly. (this question is also intentionally open ended.)

Q10 How would you rate your interest/motivation to continue to be involved in the Decarbonize Waterloo Region process?

- Very interested to be regularly informed and highly involved
- Interested to be regularly informed and somewhat involved
- Interested to be regularly informed
- Interested to be periodically informed
- Not interested in any further involvement

Q11 If you want to continue to be engaged in the Decarbonize Waterloo Region process, how would you want to be involved?

- Investigate how my organization can be further engaged in Decarbonize Waterloo Region process
- Keep my colleagues/contacts regularly informed about this work
- Join a working group tackling a specific task/issue emerging from the forum

Q12 Would you be open to taking part in a follow up focus group in December or January to develop next steps? (one morning or lunch time session)

Appendix B: Focus Group Guide

9:00 Introductions (5)

9:05 Housekeeping (5)

- Research – this is for my thesis, no attribution, notes confidential
- Recording – can stop, confidential
- Can withdraw at any point
- Food
- Washrooms
- Fast-paced discussion – parking lot
- Wrap up by 11 am at latest

9:10 Food (10)

9:20 Input from Scott (15)

- Present the Arena
- Present UTL model
- Questions and feedback

9:35 Group Discussion (40)

- Do you think the UTL could be a useful model for DCWR? Please explain.
- Is the Arena clearly defined? What needs to be added, refined?
- What more do we need to know about this Arena to move forward?
- Do you see potential for an experiment in this Arena (social, financial, technical or a combination) – *imagining high potential interventions*

10:15 Moving Forward (25)

- Who needs to be involved in the development of this Arena?
- What role do you want to play going forward?
- Where could we find resources to support this ongoing process?
- How can this be connected to work that is already ongoing in WR?

10:40 Wrap up questions/ comments and parking lot (10)

- Also, any quick feedback on set up of the session...

10:50 Closing and Thanks (5)

Thesis timeline

Next steps DCWR

Thank you!! – please fill out feedback sheet if you wish

Appendix C: Forum Agenda⁹

Decarbonization Forum: Charting Waterloo Region's Energy Future

17-18 Nov. 2016 @ BSIA, Rm 1-42

Day 1: Visioning the Decarbonized Future of 2050

9:00-9:15 Opening Remarks and Welcome

9:15-10:30 Panel 1: State of energy use, energy efficiency, and carbon footprint for the Region

Dave Roewade (energy state of the Region)

Mary Jane Patterson (residential infrastructure and opportunities)

Olaf Weber (financial tools and co-ops)

10:45-12:00 Panel 2: Available but underutilized technologies

Maurice Dusseault—geothermal, energy storage

Klas Bockasten—district heating

Paul Parker—heat pumps

12:00-1:00 Lunch

1:00 – 3:50: Imagining Decarbonized Energy Future Scenarios

Small roundtable discussions—attendees rotating through tables (3 rounds: 1:00-1:50, 2:00-2:50, 3:00-3:50) focused on:

- 1) Residential energy use
- 2) Commercial/Industrial/Institutional energy use
- 3) Transportation energy use
- 4) Methane/Biodiesel/Cellulosic Ethanol
- 5) Electricity (PV, Wind, Small scale hydro)
- 6) Thermal Energy

Each table will have a rapporteur taking notes and helping to collate discussion results on templates. The facilitators' job is to:

- 1) Open each session with introductions to help build the collaborative atmosphere and to make the most of the expertise around the table
- 2) Share briefly what has come before in the earlier sessions (for sessions 2 & 3)
- 3) Help ensure that everyone gets to share their knowledge
- 4) Help ensure the rapporteurs capture the emerging ideas from the table
- 5) Keep the group focused on the objectives of the session (imagining how we could meet 2050 energy needs for the Region without fossil fuels)
- 6) Help the group notice when scenarios are bifurcating (which is okay—but may require another template form)
- 7) Help the group ask for additional expertise when needed (runners will be available)

4:00 – 5:00: General Discussion—What do our decarbonized futures look like?

At this session, rapporteurs will report back what has come out of each tables' discussions. Facilitators can comment as well.

⁹ *Forum Agenda was developed by Dr. Heather Douglas and Nigel Moore*

Day 2: Charting the Paths to the Decarbonized Futures

9:00-9:30: Review of decarbonized futures from the previous day

9:30 – 12:00: Finding the Pathways to the Decarbonized Futures

(2 rounds of small group discussions)

Each table will focus on the future scenarios for a particular sector (e.g. residential, transportation, etc.)

For each future, address these questions:

- 4) What is the path to that future? Where do we need to be by 2020? 2025? 2035?
What is the infrastructure investment timeline?
- 5) Which policies (including financial ones) at the municipal, provincial, and federal levels would help us along the timelines?
Which policies are inhibitors currently?
- 6) What are the additional benefits of pursuing this pathway?

Again, each table will have a rapporteur. Templates again will be used to help capture the discussions. Rough visualizations of the scenarios from the day before will be available. The facilitators' job is to:

- 1) Open each session with introductions to help build the collaborative atmosphere and to make the most of the expertise around the table
- 2) Help ensure that everyone gets to share their knowledge
- 3) Help ensure the rapporteurs capture the emerging ideas from the table
- 4) Keep the group focused on the objectives of the session (how to get to the futures, the obstacles in our path, and the co-benefits)
- 5) Ask for additional expertise when needed (runners will be available)

12:00-1:00 Lunch

Full Group Discussions will take up the afternoon of Day 2. Rapporteurs will report back from the morning's work to spur the discussions. Again, facilitators can comment as well.

1:00 – 2:15: Policy recommendation discussion: what policy changes are needed, and which ones occur across scenarios?

2:30 – 3:45: Assessing the Futures & Pathways

What are the co-benefits of following particular pathways?

How might pursuing decarbonization serve other community goals?

4 pm – 5 pm: Discussion of next steps

Citizen engagement

Process dissemination

Pilot projects