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Emerging Business Models for Local Distribution Companies in Ontario

By: Julia Zeeman

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Supervisor: Mark Winfield

York University Faculty of Environmental Studies

Foreword:

There is a direct relationship between this major research paper (MRP) and all three components of my Plan of Study (POS). The area of concentration of my POS is Business Models for Sustainable Energy Transitions with a focus on the following three components:

1) Community Energy Planning, Community Power and Community Engagement
2) Socio-Technological Transitions for Sustainable Energy
3) Business Models for Sustainable Energy Transitions (In-Depth)

My MRP has the greatest connection to my second and third components. My Second component, which is Socio-Technological Transitions for Sustainable Energy refers to sustainable energy transitions (SET) for institutions. In this paper, I assess the role of Local Distribution Companies (LDCs) in Ontario and their ability to catalyze a sustainable energy transition. LDC's are institutional incumbents in the energy system and have traditionally benefited by maintaining the status quo of a centralized electricity gird. However, under their conventional business model, they are unable access the benefits of distributed energy resources that are necessary in order to transcend to a clean energy future. The institutional lens that has been used to frame LDC business model innovation reviles the relationship between my MRP and POS Component two.

My MRP is also directly related to my third component of my POS. This is achieved by my MRP's evaluation of seven emerging business models for LDCs in Ontario. My MRP also proposes a potential business model pathway called the Steward of the Grid (SOTG). The SOTG business model can addresses the challenges that LDC's face with business model innovation, as well as leverage their pre-existing assets in order to help LDCs champion a Sustainable Energy Transition. My MRP meets the Learning Objectives in the third component of my POS by acquire knowledge of different business models that can support a SET.

My MRP is also supported by the first component of my POS by maintaining a Community Power lens through out my evaluation. All of the business models that I evaluate in the MRP are owned locally by municipalities, which are considered community assets and an important aspect of community power.

The themes in my MRP are significantly interconnected with the Learning Objectives and the Areas of Concentration in my POS.

Abstract: Local Distribution Companies (LDCs) have the potential to be leaders in coordinating and stewarding a Sustainable Energy Transition (SET) in Ontario. However, under the current LCD business model structure, LDCs are unable to capture the benefits from sustainable energy and advance a sustainable energy transition. Separately from LDC operations, sustainable energy is disrupting the electricity system through the proliferation of Distributed Energy Resources, Information and Communication Technology occurring Behind the Meter (BTM). The adoption of BTM applications erodes LDC profitability and threatens their existence. The pushing force from an outdated LDC business model compounded with the pulling force from disruptive sustainable technology has created an opportunity for LDCs to innovate their business model in order to adapt to the changing energy paradigm of the 21st century.

This paper explores and evaluates seven emerging LDC business models used in Ontario and provides a recommendation of a possible pathway for a viable LDC business model that can leverage sustainable energy while maintaining the electrical grid infrastructure.

List of Acronyms

LDC = Local Distribution Company
DER = Distributed Energy Resources (Renewable Energy Generation and Storage)
ICT = Information Communication Technology
I of T = Internet of Things
SET = Sustainable Energy Transition
BTM = Behind the Meter
EE = Energy Efficiency
CDM = Conservation Demand Management
OEB = Ontario Energy Board
OPG = Ontario Power Generation
UDM = Utility Distributed Microgrid
VPP = Virtual Power Plant
SOTG = Steward of the Grid

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Chapter 1: The *Changing Energy Paradigm of the 21st Century*

There are interconnected crises that threaten the sustainability of societies' increasingly brittle global social-ecological system. These crises include climate change, the imminent peak and decline in key non-renewable energy resources and loss of biological diversity that may reduce the resilience of our global ecosystem and its ability to provide for human needs (Beddoe, et al., 2008). Western society has been trained to believe that the economy and lifestyle depend on ceaseless, constant, ever growing and never ending supply of electricity. This myth is being flipped on its head as the cost of climate change impacts many individuals around the globe (Lovins, 2011). The transition to a sustainable energy system is crucial for the survival and prosperity of the next generation. Thus, the electricity industry is now challenged to transform the current energy system to one that relies on sustainable energy resources.

In Ontario, Local Distribution Companies (LDCs) have remained the incumbents in the conventional system and have been hesitant to adopt sustainable energy technology because there is no economic incentive to do so. However, with changes to their current business model, LDCs can leverage new technology to champion the transformation into a sustainable energy transition. As conveyers of the grid and owners of the wires and poles through which energy passes, LDCs have a unique potential to lead the mainstream transition towards sustainable energy.

1.1. CONVENTIONAL UTILITY MODEL:

For most of the 20th century, the utility business model has remained the same: build out the central grid and power system, a regulated monopolized entity designed to achieve economies of scale and to maintain the infrastructure over the long term. Utilities in partnership with regulators have created a central grid where utilities send high voltages over long distances to passive customers (Bade, 2015). Keeping electricity reliable at a low price have been foundational goals for the industry.

Economies of scale have been essential to the conventional utility model. When demand rises past the point of the central plant’s capacity to meet it, utilities make a request to regulators to propose the development of another central power plant. Once approved, LDCs build the project and over the long-term pay off the high fixed cost required for central plants. The rate of return on projects is regulated and cost recovery occurs over time via customers’ monthly electricity bills. Eventually a utility earns a modest return on the asset (Lovins, Reinventing Fire: Bold Business Solutions for the New Energy Era , 2011).

For readers unfamiliar with Ontario’s electricity supply chain, please see the text box for a description of the electricity supply chain that underpins the conventional utility model.

Conventional Electricity Supply Chain (Valocchi, Juliano, & Schurr, 2010):

Generation: The transformation of primary energy resource into electric power. The largest share of electricity in Ontario is generated from large-scale nuclear energy, as well as gas and hydro power plants.

Transmission: The transport of electricity at high voltage over long distances via the transmission grid. The transmission system operator handles the balancing of the electricity supply and demand in the area. The conventional model is designed to deliver energy from a few central production points to a large number of customers. Control overall grid stability. In Ontario, each LDC's operates in its own geographic region and has a natural monopoly (IESO, 2015).

Distribution: Network operators are designed to deliver electricity to the end customers at low voltage level. The Distribution Network Operators is responsible for the connection of end users to the grid. As more customers become energy producers, an increasing number of renewable energy and storage projects will be connected to the grid. Electricity and information will flow in two directions. This creates the need for flexibility and stewardship of the distribution network (Lovins, 2011)

Retail: Communication with the end customer.

Consumption: The consumption of electricity takes place on the customer side of the meter; "behind the meter" often characterizes this.

For much of the century the conventional utility model has fuelled the economic growth and wellbeing of North America society. However, in the 21st century this model is not effective in meeting sustainability goals required to transition society away from fossil fuels. The conventional utility model is defined by it's centralized generation and grid infrastructure that is characterized by high cost to build central power plants, economics of scale, and the incentive to maximize production and sale of electricity. However, the growing cost of climate change has challenged the effectiveness of the conventional utility model. In addition, much of the benefits of the conventional utility model that were experienced in the 19th and 20th centuries are no longer being realized. The trend of cheap and reliable electricity is diminishing. As a result, this model is no longer sustainable. The centralized model is now facing decreasing rates of returns, increasing costs, falling profits, and increasing failures. In fact, today's electricity system is aging and in need of renewal. It was built well before the digital era and is unable to leverage sustainable energy required to meet the needs of the 21st century society (Lovins, 2011).

BARRIERS TO UTILITY BUSINESS MODEL INNOVATION

In Ontario, as well as across Europe and North America, utilities are experiencing institutional, economic and structural challenges that entrench the conventional utility business model making it difficult for utilities to integrate sustainable energy technology. The *changing energy paradigm of the 21st century* is a term used in this research paper to describe the change in energy goals and technology. The 21st century energy paradigm is a low carbon energy system that meets the needs of the 21st century society. Decentralized renewable energy resources and the Internet of Energy are fundamental to the 21st century energy system.

Renewable energy resources oppose the original centralized constructs of the conventional electricity system. This is because renewable energy is decentralized, variable, and it is compatible with energy conservation and efficiency (Electricity Innvoation Lab , 2013). As a result, utilities have remained incumbents that reinforce the conventional electricity system and oppose the adoption of sustainable energy technology because there is limited economic incentive for the utility to integrate it. In Ontario, similarly to the rest of the developed world, LDCs operate in the face of a changing energy environment and uncertain future. Therefore, understanding the barriers that constrain LDCs from advancing SET is essential.

The institutional, economic and structural barriers entrench the conventional utility business model and restrict utility innovation. The sales incentive, flat and falling demand, aging infrastructure, the institutional lock-in through economics of scale and learning effects are all factors that conventional utility experiences in the 21st century (Lovins, 2011) (Electricity Innvoation Lab , 2013) (Foxon, 2002) (Zincone, 1982) (Valocchi, Juliano, & Schurr, 2010).

"Sales Incentive": The conventional utility model has created a perverse incentive for LDC to maximize production and the selling of electricity (Zincone, 1982) (Lovins, 2011). The sales incentives in the 19th century drove innovation in the electricity sector. However, in the 21st century, the sales incentive revenue model has become the greatest obstacle between the current utility structure and a sustainable energy system (Valocchi, Juliano, & Schurr, 2010). In fact, the sales incentives are the primary reason for LDCs being not active in integrating Behind the Meter (BTM) developments. Without appropriate change in regulation and transformation of the utility business model, integration of BTM developments will be constricted (Electricity Innvoation Lab , 2013). The Utility sales incentive perpetuates the conventional model and contrasts goals for sustainability.

Flat and falling demand: Growth in electricity demand has been a fundamental requirement for to the conventional utility model to run smoothly (Valocchi, Juliano, & Schurr, 2010). The growth in demand for electricity has been steady throughout the 19th and 20th century, however in the 21st century demand for electricity has been flat and falling. The trend of flat and falling demand that is predominant across the utility sector at large is occurring in the developed countries. For the last twenty years in Ontario electricity demand has been flat and in some years falling. This is due to energy efficiency gains in technology, decreases in GDP and closures of key industries in manufacturing (IESO, 2015). Flat and falling demand is a signal that the conventional utility model is outdated. Economies of scale can no longer be realized with decreasing electricity demand and have resulted in decreasing rate of return (Lovins, 2011).

Aging infrastructure is common across many utilities, including Ontario. The cost of maintaining the central system is a depreciating investment burden. Aging infrastructure makes it more challenging for utilities to recover their growing costs. In Canada, the required national investment in electricity infrastructure is estimated to be $347.5 billion. Ontario is expected to spend more than all other provinces and territories with an investment of over $100 billion to replace or refurbish 80% of its electricity system over the next 20 years (Conference Board of Canada, 2011).

Causes of Institutional Lock-in

Economies of scale are an economic and structural barrier that has caused institutional lock-in and limited LDCs from transitioning to sustainable energy. Simply put, each unit production cost decline (as cost spread over increasing production volume) has locked-in utilities in a cycle of grid maintenance in the centralized electricity model (Foxon, 2002).

The reliance on the increasing returns through economies of scale by building large central power plants has created an institutional lock-in. Due to the lock-in nature of economics of scale for electricity generation, transmission and distribution, utilities continue to operate under this model even though their rate of return is decreasing. The conventional utility model that is reliant on economies of scale for a centralized grid is no longer profitable (Fox-Penner, 2010). The lack of innovation to the model reflects the institutional lock-in that has been created over time. It is difficult for utilities to transition away from their conventional model.

Innovation is not familiar to the utility industry. In Ontario, the reliance on the economies of scale business model paired with the dominance of nuclear generation has created a scenario of institutional technical lock-in and path dependence. In addition, the electricity ecosystem of regulation in Ontario further reinforces the LDC institutional lock-in. This has resulted in mounting debt for the owners of the centralized generation and has limited investment in sustainable energy technology (Clean Air Alliance Research Inc. , 2016)

The Learning Effects **make up** an institutional barrier that LDC sector experiences. The *learning effects* act to improve procedures or reduce cost as specialized skills and knowledge accumulate through production and market experience (Foxon, 2002). The learning effects have reduced LDCs' at large, unit costs of operations with cumulative production in generation and transmission of electricity. The slow accumulation of "know-how" related to the conventional utility model makes internal innovation and transformation unlikely. In addition, innovation is not rewarded within the LDC management structure resulting in a culture that is slow to adopt sustainable energy technology (Bade, 2015). Within the techno-institutional complex theory, LDCs possess characteristics that demonstrate that there is difficultly in advancing innovation. A learning effect has occurred in the LDC sector incrementally for over 60 years resulting in a regimented institutional regime and a centralized electricity grid (Foxon, 2002).

In conclusion, the institutional, economic and structural challenges entrenched in the conventional utility make business model innovation difficult. The sales incentives, flat and falling demand, aging infrastructure, institutional lock-in and learning effects are common challenges that utilities face across developed countries. Amidst all of these challenges utilities have to "keep the lights on". Their rate of sales growth is highly uncertain (Fox-Penner, 2010). The amount of DER impacting their systems will grow, causing their cost to increase. With or without increasing sales, new plants will be needed to replace older units being retired, and greenhouse gas limits will force many high-carbon plants into early retirement. Therefore, the conventional utility business model is under pressure to transform to meet the requirements of energy in the 21st century (Shahan, 2013).

The conventional utility model is the dominant regime within the electricity system. The challenges experienced in the utility industry have resulted in utilities' resistance to sustainable energy adoption because it does not align with the current utility business model structure (Gang, 2013). This is an unfortunate consequence that delays the proliferation of sustainable energy to the mainstream. In addition, the compounding impact of these challenges has resulted in the creation of a brittle regime. The brittleness of the conventional utility model is vulnerable to disruptions that occur outside the utility system. This process may lead to the irrelevance of the utility system. Therefore, utility business model innovation is required to keep utilities relevant in 21st century and it can accelerate the widespread adoption of sustainable energy technology.

1.2. LDCs AND SET ARE COMPLEMENTARY BUT CURRENTLY SEPARATED

A successful Sustainable Energy Transition (SET) consists of extensive deployment of clean distributed energy resources to replace all major fossil fuel primary energy inputs (Sgouridis & Csala, 2014). Within this overarching understanding of SET there are three goals that contribute to the success of a SET. The ability for renewable energy resources to eliminate dependence on fossil fuels, an efficient rate of adoption of renewable energy resources and the ability of renewable energy resources to empower local communities constitute these goals (Stunz, 2014) (Sgouridis & Csala, 2014).

Distributed Energy Resources (DER) and Information Communication Technology (ICTs) are fundamental to sustainable energy transitions. Disruptive technology is enabling a decentralized customer-centric energy transformation. Distributed Energy Resources are fundamental to a low carbon energy and economy transformation because

DER applies renewable energy resources, which have low carbon impact and displace fossil fuel energy resources (Sgouridis & Csala, 2014).

Distributed Energy Resources (DERs) are positively transforming the energy system. DER have experienced declining costs and improved performance. DER such as wind and solar have no costly long-term obligations, waste, climate burdens or risks, and they have small operating cost. DER are increasing the range of choices for onsite generation and management of electricity (Electricity Innvoation Lab , 2013).

DERs have made astounding progress. Large-scale wind and solar farms have been built in an average of 1.6 years - six times faster than nuclear power. Small-scale solar home or village projects can be up and running in weeks. Renewable energy thrives on fair and open competition on which no new nuclear plant anywhere has survived (Lovins, 2016). DER can generate and distribute wealth, manage and reduce climate risk, as well as reduce economic and security risk associated with fossil fuel dependence. Moreover DER can create opportunity and choice for customers, expand innovation, and create more jobs (Lovins, 2011).

Currently, Sustainable Energy Transitions are occurring in isolation from the conventional utility model. This transformation is happening behind the meter via new energy players that are competing for current utility customers. DER and ICT disrupt the current utility regime. BTM applications of DER and ICT challenge the conventional utility model by reducing utility customers' demand for electricity, thus reducing the utilities' revenue generated from selling electricity (Fox-Penner, 2010).

This paper argues that with utility business model innovation, utilities can benefit from the integration of sustainable energy, as well as become champions of a sustainable energy transition.

As a result of the push factor of institutional, economic and structural challenges to the conventional model and pull factor of disruptive sustainable energy technology, BTM, the utility sector at large is being confronted with the decision to innovate their business model or risk becoming irrelevant (Valocchi, Juliano, & Schurr, 2010) (Fox-Penner, 2010) (Lovins, 2011). The big challenge with utility business model innovation is that there is no proven utility business model for many new BTM products and services today (Fox-Penner, 2010).

Business model transformation has become the greatest singular focus of the utility industry. Without addressing the challenges of their conventional business model, utilities will not find it easy to seize new opportunities related to sustainable energy, and thus risk becoming irrelevant (Bade, 2015). Innovation is not familiar to the utility sector and so the path forward is unclear. Therefore, researching emerging innovative business models is necessary to support LDC transformation to unlock a SET.

This paper narrows the focus of utility business model innovation and focuses on LDC business model innovation in Ontario. However, the analysis drawn from the Ontario LDC context reflects a growing trend beyond Ontario that is occurring across the United States and Europe. In Ontario, LDCs have the potential to decrease electricity rates in the long term, improve resiliency and to become leaders in coordinating and stewarding a sustainable energy system. In order to do this, LDCs must adapt their business model so that they can encourage the adoption of BTM developments while also allowing the utility to maintain the grid infrastructure (Lovins, 2011).

1.3. **DRIVERS OF DISRUPTION IN THE ELECTRICITY SYSTEM**

Renewable energy, storage, information and communication technology (ICT) and the Internet of Things (I of T) together embody sustainable energy. These components drive conservation and demand management (CDM), as well as energy efficiency (EE) to meet electricity demand from carbon-free energy sources. These forces of sustainable energy are disruptive to the dominant utility regime in an energy system. DER, ICT and the I of T enable decentralization of electricity and unlock the smart grid (Weiler, 2014). They disrupt the current regime because they can cause utilities to experience decreased rates of return, increasing costs and falling profits. These combined impacts can increase in grid failures, thus further diminishing customers' trust and satisfaction (Fox-Penner, 2010).

This section of the paper further identifies and describes in detail how sustainable energy is disruptive to the conventional utility model.

Development on the grid edge: The grid edge can be described as disruptive technology that comprises the technologies, solutions and business models advancing the transition towards a decentralized, distributed and transactive electric grid (GTM Research Whitepaper, 2015). Accelerated technological change in the area of grid modernization and distributed energy resources (DER) and new non-traditional competitors are beginning to change the structure of energy delivery model.

Innovation on the grid edge has commonly translated to ownership of behind the meter assets. BTM activities can be placed into three broad categories: Generation, Storage, and – Internet of Things. BTM activities erode utility profitability in various ways, depending on behind the meter asset (Weiler, 2014). For example, the most common model for renewable energy is when customers or the third party own and control the system. The utility provides the connection to the grid and is obligated to purchase the electricity generated from the renewable energy project. The cost associated with grid connection for the renewable energy asset is absorbed by the utility. In most cases, the regulator allows the utility to pass the costs on to the consumer, thus raising the price for electricity. In this situation there is no economic benefit for the utility (Richter, 2012). Innovation on the grid edge continues to progress at a rapid pace and will continue to transform the electricity systems in ways that are unknown. Without a change to the utility business models, Ontario LDCs are poorly positioned to take advantage of the changing energy landscape.

Distributed Energy Resources are smaller, decentralized power sources that consist of renewable energy generation assets and storage units. DERs are leaders in facilitating the transition to a smarter grid reliant on sustainable energy. However, DERs can increase grid complexity and can cause LDCs' costs to rise. This is due to inter-connection processes of two-way power lines, as well as costs associated with managing new variable load on an aging electricity grid not built to support small decentralized generation (Richter, 2012).

New information communication technology (ICT) enables advanced energy management systems to unlock the smart grid. Accelerated by the Internet, ICT offers grid solutions, as well as BTM solutions. ICT grid solutions enable developments to reduce demand and create smooth energy consumption through demand response, energy conservation and efficiency, storage technology and renewable distributed generation (GTM Research Whitepaper, 2015). Without new business models that take advantage of ICT, utilities will not be competitive in the future.

Furthermore, ICT BTM solutions are disruptive to utilities. ICT can integrate DER and offer customers new tools to decrease their demand in order to save money. BTM applications of ICTs reduce customers' demand for electricity and erode the utilities' revenue share. BTM solutions are taking shape in the form of the Internet of Things (King, 2013).

The "Internet of Things" (I of T) refers to the growing world of connected devices. These devices can be remotely controlled or they can monitor and respond to events without human intervention. The convergence of the I of T within the electricity system is with Home Energy Management Systems or smart home uses that utilize the open platform of the Internet rather than proprietary networks. Electricity Internet mash-ups are seen as a looming threat to the conventional utility business model. NEST energy management system owned by Google is an example of this (Weiler, 2014).

The utility vision of the Smart Grid ICT application would have these networked enabled devices communicating with the utility through the smart meter. However, the smart meter is not the only gateway into the smart home. Utilities and regulators get bogged down with standards and privacy concerns, while third party entities are competing for the same market share. Security companies are now entering this space. Since third party companies are unregulated, they are much more agile and they can offer better products and services than the utilities (Weiler, 2014). Many utilities have not been able to keep up with the innovation brought on by the digital era. The lack of new utility business models that leverage the Internet is a testament to this.

Active Customers: Customers are now empowered to become more involved with the control of their electricity consumption. Their expectations are being shaped by their experiences in other industries, including financial services and retail, which provide personalized, relevant and on-demand service. Customers are decreasing their energy demand while increasing their expectations for LDCs (Pricewaterhouse Coopers LLP, 2015). More engaged and educated consumers are spurring development on the grid edge. Now customers can generate and store electricity with on-site generation and battery storage. Thus, they can have more control over timing and amount of their electricity use. Customers can also invest in and manage the on-site resource to achieve cost savings, reliability and environmental goals. Customers are rapidly finding new ways to reduce their demand and consequently save money. There is a widening array of options to meet customer demand. Customer profiles are not similar anymore. With DG and electric vehicles or other distributed resources, now network users can have very different impacts on the distribution system (Hedin & Wheelock, 2010).

Traditionally, LDCs have had limited relationships with their customers. The conventional utility business model is poorly structured, so it cannot engage and capitalize off of their increasingly active customers. Utilities are lagging with respect to customer interface. Little innovation has occurred in utility customer segmentation and communication channels (Richter, 2012). Although sustainable energy is becoming more desirable for utility customers, there is a limited ability within the utility business model to exploit these opportunities. Moreover, new products that operate behind the meter are interacting with energy customers and putting a wedge between the utility and their customer, which is further eroding the utilities' profitability (Henderson, 2015).

As a result, the disruptive forces occurring on the grid edge and behind the meter through DER, ICT and I of T increase costs for LDC and reduce revenue earned by the LDCs. Utility business model innovation is required to create economic incentives for EE, CDM and BTM developments so that utilities can remain relevant as sustainable energy technology dominates the electricity system. Under the current scenario there is no business interest that encourages utilities to advance a SET. Regulations and the utility business model must align with the economics of sustainable energy to intensify EE, CDM and BTM (Fox-Penner, 2010).

1.4 THE IMPACT OF DISRUPTIVE TECHNOLOGY ON THE CONVENTIONAL LDC BUSINESS MODEL

The institutional, economic and structural barriers that the conventional utility business model experiences in addition to the negative impact of disruptive forces on their cost and revenues create upward pricing pressure for customers (King, 2013). The increase in electricity rates can increase an unsavory customer relationship. As innovation increases through the disruptive forces and lags with utilities, the evolution of this dichotomy can have detrimental impacts on utilities in the long run. Grid parity, load defection, grid defection and the utility death spiral are plausible results that utilities may experience in the future. In several places in the United States and Europe, these impacts have already occurred (Gang, 2013).

Grid Parity: As storage and renewable energy become competitive, the opportunity for grid parity for electricity customers becomes more appealing. Grid parity is when cost self-generation is lower than the retail cost of electricity from central grid. This phenomenon may cause customers to leave the grid, resulting in increased load and grid defection (GTM Research Whitepaper, 2015). Grid Parity may not be a serious concern for Ontario LDCs now, but in the future, it is foreseeable. Innovation on the grid edge has contributed to decreased electricity demand, and in the future it is expected to reduce customers' dependence on the grid.

Load Defection: BTM activated by renewable energy generation, storage and Internet of Things can decrease consumers' demand for electricity on the grid, thus eroding the utility business model. This process is often referred to as "load defection" (Creyts & Guccione, 2014).

Grid Defection is when customers choose to leave the grid. This phenomenon is expected to occur when solar power or another form of renewable energy pair up with storage and the grid becomes unnecessary. This is called "utility in a box" (Creyts & Guccione, 2014).

Grid defection can cause utilities and regulators to increase the price of electricity to ensure that LDCs make enough to cover the cost associated with an increasingly complicated grid. Increase in pricing pressure can make more customers unhappy, and thus further encourage them to generate and store their own electricity resulting in a positive feedback of grid defection. In addition, low-income customers who cannot afford the upfront cost of "utility in a box" or energy retrofits can become financially burdened by price increases (Creyts & Guccione, 2014).

The utility death spiral is when grid maintenance costs go up and the capital cost of renewable energy moves down, and as a result more customers become encouraged to leave the grid. In turn, this phenomenon pushes grid costs even higher for the remainder of customers, who then have even more incentive to become self-sufficient. Meanwhile, utilities are stuck with a growing pile of stranded assets (Gang, 2013). The utility death spiral has become a common theory in electricity transformation literature. The utility death spiral is the result of load defection and grid defection (Fox-Penner, 2010).

Ultimately the developments on the Grid Edge enabled by ICTs and DER will negatively impact LDCs' ability to recover costs accrued through an outdated system bounded by institutional, economic and structural challenges. There is urgency for utility business model innovation. If LDCs ignore these disruptions, they will only intensify.

Ontario's Fixed Electricity Price

Currently, LDCs and the Ontario electricity system at large are concerned by the increase in BTM developments because of the possible erosion of their future revenues. This has resulted in a defensive approach towards integrating sustainable energy technology.

Recently, many LDCs have proposed to the Ontario Energy Board the shift of prices away from consumption and into a fixed fee for connection. The implication of a fixed electricity price for electricity consumption is the reduced incentive for BTM developments. This is because no matter how much customers reduce their electricity consumption, they will have to pay the same price for electricity (Ontario Energy Board, 2016). Therefore, there is limited economic savings for the customers to invest in BTM development. The acceptance of this policy is poorly aligned with the behavior economics that surround a SET.

1.5. ONTARIO'S ELECTRICITY SYSTEM:

The institutional framework that shapes Ontario's electricity market is comprised of the Independent Electricity System Operator (IESO), Ontario Energy Board (OEB) and the Ministry of Energy (IESO, 2015). IESO is the provincial regulator that makes sure that there is enough power to meet a province's energy while also planning for the province's energy future. The IESO balances supply and demand, oversees the electricity wholesale market and does medium long term planning. The Ontario Energy Board regulates the LDC rates for customers. The Ministry of Energy has legislative responsibility for the IESO, OEB, OPG and Hydro One. The Ministry of Energy regulates Ontario's electricity sector by creating policies (IESO, 2016).

At a very high level Ontario's ecosystem of LDCs and regulators is very similar to the western utility model of centralized electricity distribution. Similarly to the rest of the developed countries, Ontario operates as a natural monopoly in a heavily regulated electricity market. Therefore, Ontario’s utility sector experiences the same institutional, economic and structural challenges with their business model in addition to the challenges from the disruptive players occurring at the grid edge and behind the meter.

In 2008, LDCs were mandated to install smart meters for every home in Ontario. More than four million smart meters have now been installed across the province. There is an emerging smart home ecosystem of solutions where new smart technologies are defining the way electricity consumers are connected to the grid (Pricewaterhouse Coopers LLP, 2015). Ontario’s mandatory smart meter integration makes it a leader in the adoption of the smart grid. Many other jurisdictions across North America and Europe do not have smart meters for every customer as Ontario does. This makes Ontario a leader in the smart grid development.

Moreover, Ontario has several unique qualities that do not exist in other utility jurisdictions. Ontario has close to 70 Local Distribution Companies, one central generation company (Ontario Power Generation), and one central transmission company (Hydro One) (IESO, 2015). A typical utility in the United States is normally privately owned and vertically integrated, controlling and operating generation, transmission and distribution in either a competitive market or in a regulated natural monopoly market (Fox-Penner, 2010). Ontario has 70 LDCs. This is a very unique setup. Therefore, the Ontario LDC system is unique.

Ontario's LDCs are responsible for delivering power from high voltage transmission lines to low-voltage distribution system into people's homes and businesses. Each LDC is held responsible for distributing electricity to a specific region in Ontario under a natural monopoly. LDCs are generally not in the business of owning generation assets. Thus, there are no LDCs that own large generation assets such as nuclear power plants. Some LDCs have medium-sized generation assets but many have none (IESO, 2015). Not owning large generation assets protects LDCs from acquiring stranded assets in the midst of a SET.

The vast majority of LDCs are owned by Ontario municipalities, so they are considered to be community assets. The modest returns that LDCs receive for their services go back to the municipality and can be reinvested into the community. In addition to distributing power to customers, LDCs create and implement conservation and demand management programs. They also own, operate, maintain and control local wires and infrastructure Ontario (IESO, 2015). The fact that there is a large number of LDCs that are considered to be community assets and ones that own very few generation assets is unique. The unique role of the LDCs in Ontario will be further explored in this paper as their unique characteristics position them to be change makers for a SET in Ontario.

The Meter as a Boundary

The provincial regulators have decided not to regulate development behind the meter within Ontario's electricity system. Therefore, the meter acts as a boundary for regulated and unregulated businesses. The meter is in effect the "edge" of the grid. Regulated business occurs up to the point of the meter. However, the unregulated business that occurs behind the meter can potentially have a significant impact on the functioning of the regulated side of the grid because BTM activities can lead to load defection and eventually grid defection (Weiler, 2014).

Unregulated LDC affiliates can compete with independent companies for BTM market share. It is in the BTM space where innovation is occurring and challenging the conventional LDC business model (Weiler, 2014). This trend is occurring in Ontario, as well as in North America and Europe.

5. THE CHANGING ENERGY PARADIGM OF THE 21st CENTURY — ONTARIO CONTEXT

Infrastructure in the twenty first century is emerging as an organic relationship between communication technology and energy sources, which together create a living sustainable economy (Rifkin, 2013). Sustainable energy transitions offer an opportunity to re-create an energy system that is affordable, stably priced, clean and safe, fair, does not disadvantage others, modern, and is continuously improving through innovation (Lovins, 2011).

LDCs in Ontario are uniquely positioned to integrate sustainable technologies, but without the LDCs business model’s innovation, this will not be possible. The institutional economic and structural barriers have prevented LDCs from playing a large role in Ontario's SET. Moreover, sustainable energy technologies are disrupting the LDC economic and technical structure. These push and pull forces place LDCs in a unique position to innovate.

Local Distribution Companies are at the forefront of Ontario's Changing Energy Paradigm. LDCs in Ontario are community assets that own, operate and control the local distribution system. Their role in Ontario's SET is currently restricted and limited but with changes to their business model, LDCs can become champions of Ontario's Sustainable Energy Transition. With adaptions to the current business model, LCDs can transform to become Stewards of the Grid (SOTG). The SOTG model will be shaped in this paper as a possible viable business model that can advance SET and maintain the grid infrastructure.

Chapter 2– MRP Research Methodology and Paper Outline

1. Ontario LDC's as a Research Focus
2. Clarify and Narrow Research Problem
3. Selective Literature Review (Chapter 2 and 3
4. Identifying Appropriate Theoretical Frameworks (Chapter 3)
    a. SET
    b. Socio-Technical Institutional transformation & MLA
        i. MPL
            1. Three levels – landscape, regime, niche
            2. Four transition pathways
            3. Nature of interaction and timing of interactions.
    c. Evolution Revolution
5. Normative Framework (Chapter 4)
    a. Graphic illustration
6. Evaluation Criteria (Chapter 4)
    a. Reinventing Fire
    b. Resilience and Adaptive capacity

   c. Utility Side and Customer side business model
   d. Business Model conceptualization
7. Selecting a Sample (Chapter 5)
8. Case Study Analyses (Chapter 6)
9. Conclusion and considerations (Chapter 7)
10. Overview of Research Structure - Graphic

Qualitative Research Design and Process

The research method used in this paper is qualitative. Within this paper the main methods being applied are a selective literature review and case study analysis.

1. Ontario LDCs as a Research Focus

The Ontario LDC landscape has been selected as the focal point of this research. This is because Ontario has a very unique LDC ecosystem and it is a leader in sustainable electricity innovation and smart grid development (Pricewaterhouse Coopers LLP, 2015). This research is based on the frontier of LDC innovation in Ontario.

2. Clarify and Narrow Research Problem

Clarifying the research question will begin by conducting a selective literature review using primary and secondary sources as a method to understand the current energy landscape that reflects the changing energy paradigm for local distribution companies.

3. Selective Literature Review (Chapter 2 and 3)

The literature review will use primary and secondary sources that focus on Ontario's energy sector. However, the literature review boundary will somewhat expand beyond Ontario to encompass emergent trends in the energy landscape across North American and Europe.

Over the course of 8 months (November 2015–June 2016), literature reviewed was related to Utility Business Model Yransformation. This involved a review of key issues and trends in the energy landscape and how they shape the developments of LDC transformation (Chapter 3). Here, the key search words used to conduct the research were: Sustainable Energy Transitions, Utility Business Models, Socio-Technical Transitions, Distributed Energy Resources and Utility Innovation.

Secondary research was sourced from provincial research studies, programs and pilot projects. Reports on the Smart Grid forum and fund were reviewed. In addition, reports on similar topics prepared by consultants and academics were reviewed. Research beyond Ontario was based solely on secondary sources. Primary research for Ontario LDCs came from annual reports, council minutes, and municipal energy plans.

4. Identifying Appropriate Theoretical Frameworks (Chapter 3)

Part of the selective literature review explores the theoretical concepts that can ground the research that is taking place. The following theoretical frameworks are used to shape the research process and guide analysis on insights. More specifically, the theoretical frameworks have been used to inform decision-making for the proposed normative framework and evaluation criteria.

- Sustainable Energy Transitions (Stunz, 2014) (Sgouridis & Csala, 2014) (Aklin & Urpelainen, 2013) (Beddoe, et al., 2008)
- Multi-Level Perspective theory (Geels & Schot, 2007)
- Socio-technical institutional transformation (Geels & Schot, 2007)
- *Evolution* , *revolution* and the *adoption* of smart grid technology (Weiler, 2014)

Sustainable Energy Transitions is a body of literature that defines and discusses key aspects of a sustainable energy transition. It focuses on the difficulty of achieving a SET from the "carbon lock-in" that industrialized societies have experienced in the past century. The current techno-institutional regime favours fossil fuel and discriminates against new energy technologies (Aklin & Urpelainen, 2013). Therefore, SET as a theoretical framework is rooted in an overarching theory of regime change away from fossil fuels. A SET requires cultural, economic and political disruptions that push society to reach a tipping point to a new low carbon equilibrium (Beddoe, et al., 2008).

A SET can be applied through two scopes. The first one is a SET that emphasizes the social dimensions of sustainability. This scenario emphasizes a fully decentralized energy supply in order to empower local communities. In Germany this scenario is referred to as the "Thousands Flowers" vision. The second competing vision views SET as a purely technological endeavour, which should be implemented in the most efficient manner one that emphasizes economics of scale and a highly centralized infrastructure (Strunz, 2013). This scenario focuses on systems engineering as a main goal. A middle of the road compromise of the two opposing visions for SET are explored in this paper through the lens of Local Distribution Companies (LDCs) in Ontario.

The overarching goals of SET have been elaborated in this paper and have distilled into three goals that contribute to the success of a SET: the ability for renewable energy resources to eliminate dependence on fossil fuels, an efficient rate of adoption of renewable energy resources, and the ability of renewable energy resources to empower local communities (Stunz, 2014) (Sgouridis & Csala, 2014).These goals have been used in this paper to broadly define the objective of LCD business model innovation. LDC business model innovation should reflect the three goals of SET because they provide an adaptation and mitigation strategy for climate change.

Socio-Technical Institutional Transformation — A Multi-Level Perspective

The theoretical framework of Multi-Level Perspective theory and Socio-technical institutional transformation provides a context for institutional transformation that can be applied to the LDC business model transformation. This section will discuss how LDCs can adapt and transform to enable a SET.

The multi-level perspective (MLP) is a central analytical framework in sustainability transitions research. It conceptualizes transitions in socio-technical systems as a dynamic interplay of processes across three levels: landscape, regime and niches (Geels & Schot, 2007).

The first level landscapes provide a relatively stable environment, which is characterized by large-scale developments and long-term trends that are not easily influenced by individuals or specific groups of actors. A regime is defined as a set of structure, culture and practices that guides actors by shaping their perceptions of problems, as well as the range of possible solutions. The regime is a dynamic social structure that is firmly established because it is constantly reproduced; yet, it also leaves room for limited degrees of variance. For new rules and routines to become part of a regime, individual and social learning processes are essential. Niches emerge where actors engage in new practices and proactively deviate from regime rules and routines, thus emerging transitions begin in niche developments (Geels & Schot, 2007)

A multilevel socio-technical system perspective is an attractive theoretical framework that is used by this research study to analyze the role of SET in LDCs. The MLP framework is valuable because it recognizes that the adoptions of DER are impacted by changes in the broader social, economic and political landscape. In Canada, the current focus on a national energy and climate change strategy reflects landscape changes.

Although sustainable energy technology is ready for integration, there are regime actors such as LDCs and regulators that reinforce the existing energy structure. The role of niche developments will be explored in this paper through the lens of emerging business models.

Within the multi-level perspectives on social-technical transitions there are four transition pathways The four transition pathways, *transformation, de-alignment and re-alignment, technical substitution* and *reconfiguration,* help to provide context to the landscape pressures on LDC regime control and niche innovations outside and inside of the LDC regime. In addition, the four transition pathways also help to qualify emergent business models for LDCs.

Each transition pathway has different characteristics and can be applied to the changing energy paradigm that the LDC'-s are experiencing. To determine if a transition pathway is occurring, evaluation is based on two criteria: the timing of interactions and the nature of interactions. The timing of interactions between landscape pressures and readiness of niche innovation determine if there is a window of opportunity for a transition. The nature of the interaction is determined by understanding if the niche innovation is competitive or symbiotic with the current regime (Geels & Schot, 2007). Understanding the timing and nature of the interaction helps to qualify which transition pathway is likely occurring. The sociotechnical transition pathways are theoretical frameworks that ground the current LDC landscape.

Evolution and revolution and the adoption of smart grid technology

Significant advances in smart grid and DER have caused utilities to experience many disruptive challenges to their business model, consequently threatening their ability to remain profitable and relevant in the 21st century. As utilities progress in an increasingly uncertain future there are two research frames, *Evolutionary* and *Revolutionary, which* can be used to understand the paths of smart grid technology that utilities are immersed in. The evolutionary and revolutionary theory holds relevance when aligned with the two most common business model structures utilities use for distributed generation— utility side business model and customer side business model.

The first research frame, *Evolutionary*, views integration of smart grids as the integration of modern communication and control technology into the grid infrastructure that in centrally managed and controlled by existing regulatory and institutional order (Weiler, 2014). A *revolutionary* transition sees grid modernization as a disruptive force, like the Internet. Described here as the Internet of Energy, this path will disrupt the existing institutional order and completely transform how energy is generated, distributed and used (Weiler, 2014).

Both paths hold opportunities and consequences for utilities. At the moment in Ontario smart grid technology is following an evolutionary path. However, the Ontario regulators have made an explicit decision not to regulate initiatives that are "behind the meter". The electricity meter is widely seen as a boundary of regulated electricity systems. This decision poses opportunity for disruption because most Smart Grids development and progression occurs “behind the meter”, which consequently reinforces a revolutionary pathway.

LDCs are tasked with balancing these divergent pathways. For an industry that holds a reputation of conservatism, risk adverse utilities must consider alternative business models in the face of uncertainty so that they can remain relevant in twenty first century. The newfound focus on utility business model transformation creates an opportunity to advance the goals of SET that eliminate dependence on fossil fuels, efficient adoption rate, and local community empowerment.

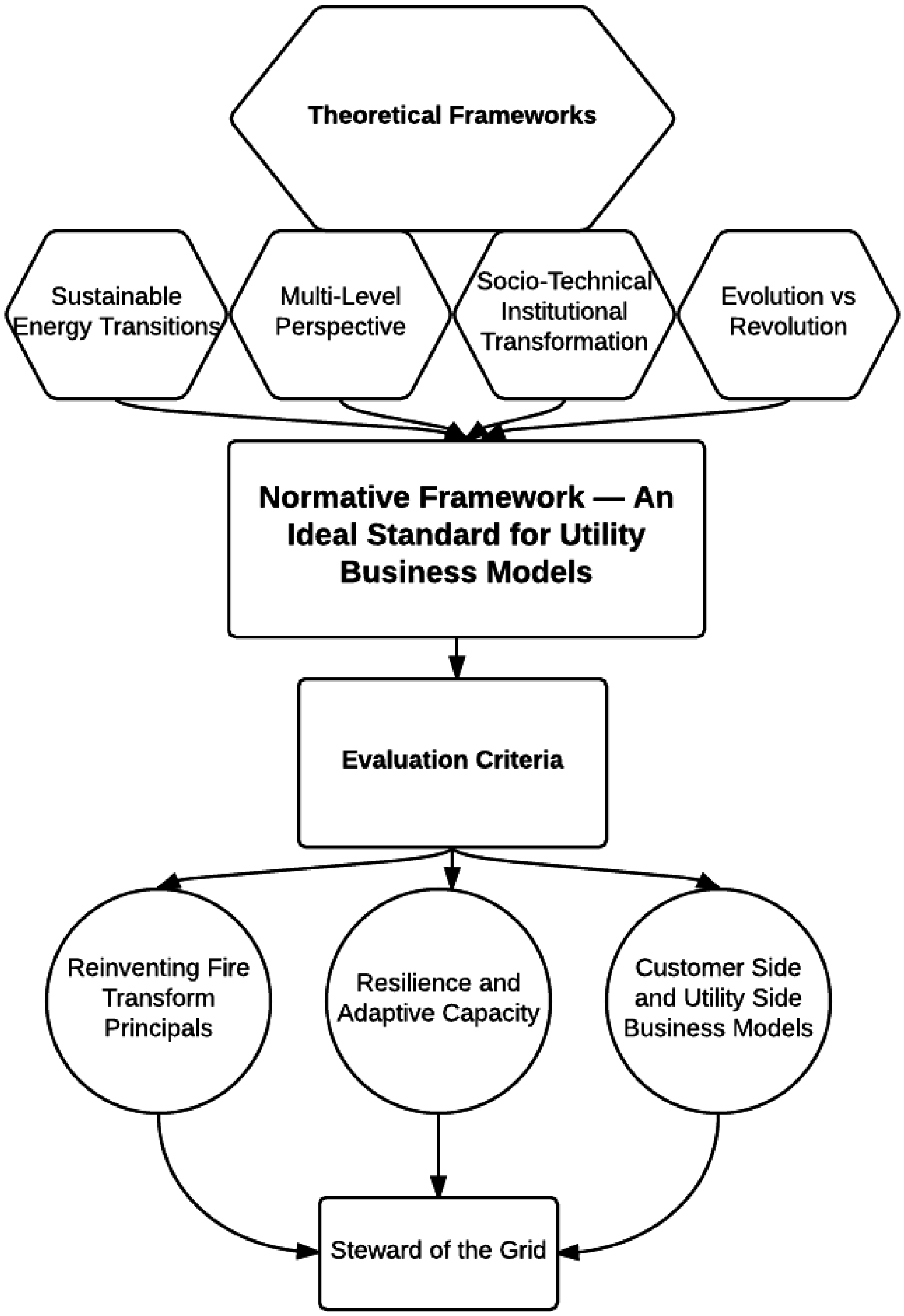
5. *Normative Framework (Chapter 4)*

A normative framework is an ideal standard of performance. The normative framework frames of how LDC should act in the face of change in the electricity sector. The concept of the normative framework is being applied to LDC emergent business models. The normative framework poses the question: “How should Local Distribution Companies deal with the Changing Energy Paradigm of the twenty first century?” The normative framework is based on the theoretical frameworks that have been sourced from the literature review. The theoretical frameworks guide the normative framework so that a clear standard of business model is demonstrated.

6. Evaluation Criteria (Chapter 4)

The evaluation criteria are an expression of the normative framework that is used to assess the sample of business models of LDCs. The evaluation criteria builds off the ideal standard presented in the normative framework and establishes metrics that go one step further and begins to frame a potential business model called the Steward of the Grid (SOTG). The SOTG metrics for the evaluation criteria are based on the literature review and theoretical frameworks.

Normative Framework and Evaluation Criteria Configuration



7. Selecting a Sample (Chapter 5)

The sample of 7 case studies was chosen based on

The sample of seven LDCs have been chosen because they have met a pre-determined basic level of criteria that reflects their interaction with sustainable energy transitions, they are essentially early adopters of integrating sustainable energy technology. The selection of the seven case studies is based on three principles:

1) Each LDC is publically owned by one or more municipality across Ontario.
2) The business models reflect a response or reaction to disruption of “Behind the Meter” developments.
3) The business models’ ability to advance a sustainable energy transition.

In addition, each of the seven case studies has been showcased as leaders in Ontario’s LDC sector through conferences and publications. In 2014, the Sault St. Marie PUC utility distributed microgrid project was the host of the Microgrid Today, a Conference in partnership with the Advanced Energy Center at MaRS Discovery District. This case study was the first to be selected because it has surfaced in the LDC and innovation community to have a transformational capacity both at MaRS and the Sault St. Marie Innovation center. Oakville’s geo-exchange, ERTH Corporation were chosen because of their role in previous work at the Pembina Institute and the Advanced Energy Center at MaRS in a report titled “Innovations in Ontario’s Utility Sector”. In 2013, QUEST conference the Markham DE and CHP project was the key project highlighted. In 2015, both PowerStream projects were key features of the SmartGrid conference. Lastly, the Woodstock White Lane Smart Microgrid project has been showcased within the FES Sustainable Energy Initiative.

Through these direct connections, these case studies became apparent as leaders in innovation in the sector.

To further the validly of the chosen case studies, the review of IESO Smart Grid Fund and Conservation Fund played a role in confirming that the selected case studies were considered early adopters of sustainable energy. Lastly, a general literature review of business model innovation in the Ontario LDC space contributed to confirming which seven cases would suitable for the purpose of this research (Angen, 2015) (Ministry of Energy, 2015) (IESO, 2013). Therefore, all seven case studies have been showcased in Ontario as early adopters for integrating sustainable energy and have been identified through the process of conferences, review of literature from innovation think tanks and regulatory bodies.

The sample size of seven was selected because seven case studies allow the research to demonstrate a variety of emerging business models. With innovation in the sector still at an early stage of development, it is important for readers to understand the diversity of opportunities for business model innovation. There is no one set path of how LDC should evolve and the selected case studies reflect this.

In addition, with roughly 70 Local Distribution Companies in Ontario, of this amount, many LDCs are continuing to maintain the status quo and have a limited contribution to the innovation in the sector. Only small portions of the LDCs are considering utility business model transformation. Therefore, the seven selected case studies represent about half of total LDCs that are involved with innovation in the sector. Moreover, seven case studies is a large enough sample size that ensures that there is limited duplication in the reviewed business model. In addition, 7 case studies is a manageable sample size for the purpose of this paper.

This sampling of business models from Ontario's LDCs reflects a qualitative research design that allows a deeper exploration into the nature of the emerging business model. This is a Purposive Sampling method commonly used in qualitative research in topics that are not trying to make generalizations from the sample population, but rather allow the researcher to focus on particular characteristics of a population that is of interest (Patricia, 2014). The evaluated emerging business models are not a representation of the LDC population but rather reflect niche developments occurring in the LDC landscape that may pose transformational change to the utility business model.

8. Case Study Analyses (Chapter 6)

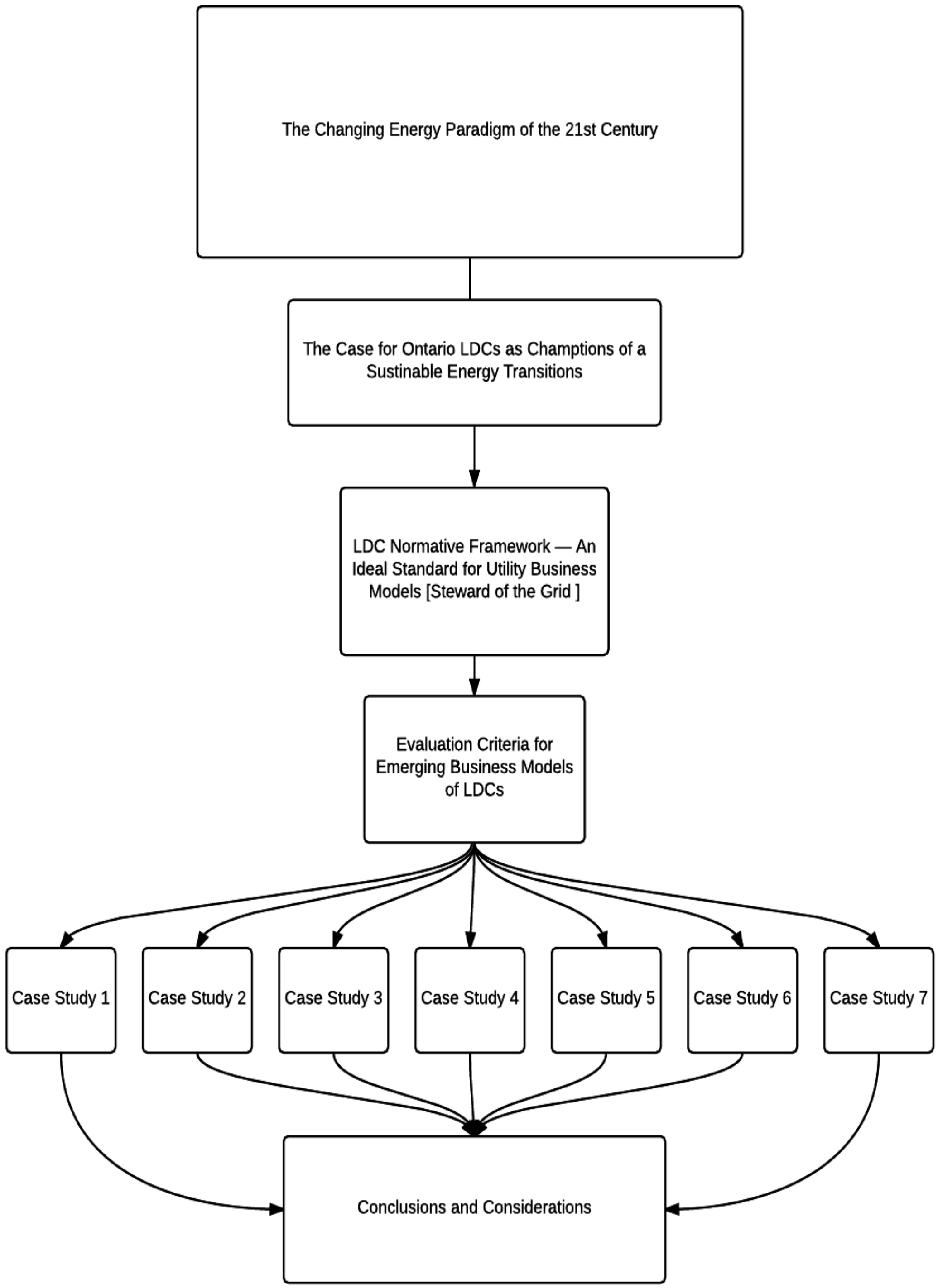
After each case study has been evaluated against the proposed criteria, there is a written discussion on the implications identified during the evaluation process. This section will demonstrate what LDCs are doing to cope with the changing energy paradigm. Through this approach, major themes will be identified and explored through the research problem.

9. Conclusion and Considerations (Chapter 7)

Lastly, I will synthesize results, write a discussion and conclude this research.

10: Overview of Research Structure

Research Structure



CHAPTER 3 LDC Champion of SET in Ontario

3.1 Why LDCs are well positioned to champion a SET
1. Community Assets
2. Government Investment and policy support
3. Existing customers
4. Big Data
5. Own existing infrastructure
6. Electricity Planning
7. Convergence of energy and electricity
8. Cost of Not Transforming / Aging infrastructure

3.2 Smart Grid & SWAT Analysis for LDC Business Model innovation
3.3 What would a new business model look like — Potential features of emerging models
3.4 introduce and frame Research Question

3.1 LDC ARE WELL-POSITIONED TO CHAMPION A SET

In Ontario, local distribution companies have potential to be champions to usher a transition to sustainable energy. LDCs in Ontario have a competitive advantage relative to other energy companies.

In Ontario, most LDCs are community assets and they are owned by local municipalities. Furthermore, they are an avenue to create local economic prosperity. Ontario LDCs also have access to large sums of low cost funding and they have many policy and regulatory mechanisms that can be used to achieve long-term objectives. In fact, they are the only energy service providers with existing customers and a billing relationship. They have knowledge of their customers' energy use, and they own the existing infrastructure. In addition, LDCs play a primary role in future electricity planning and are well-positioned to increased electrification and decentralization of the electricity system. Moreover, LDCs are strategically aligned to foster partnerships with insurgents rather than dismiss them as threats. For these reasons, LDCs have an advantage over insurgents in DERs and ICTs to integrate SET (Fox-Penner, 2010) (Lovins, 2011).

Ontario LDCs are in a good position to transform Ontario's electricity system into a smart grid. Advancing a smart grid is fundamental for a sustainable energy transition. A Smart Grid is an electrical grid which includes a variety of operational and energy measures including smart meters and smart appliances that enable the integration of renewable energy resources, conservation and demand management and energy efficiency resources (Lovins, 2011). Ontario LDCs are in a unique position to benefit from and integrate a smart grid. LDCs can become leavers of change for a sustainable energy transition.

For reasons discussed below Ontario's LDCs are in a good position to advance smart grid applications to lead and accelerate SET.

1. LDC' as Community Assets: The majority of LDCs in Ontario are community assets. This is because municipalities own most LDCs. This ownership model is unique in Canada. In some cases, municipalities have consolidated their local LDC with other municipalities so that efficiencies can be achieved resulting in lower operation costs. The revenue generated from distributing electricity to local customers remains with the municipalities and can be invested back into the local community (Gilmour & Warren, 2008). The fact that LDCs are community owned means that the local communities can directly benefit from a SET. If LDCs do not innovate their business model, these community assets will be in jeopardy of becoming an investment burden. This result would be unfortunate.

2. Government, policy and investment: LDCs have worked in tandem with government regulators. Through this partnership, LDCs have built a long lasting, trusted and reliable relationship with national and provincial government institutions to meet the needs of their customers. As customers needs sway to embody sustainable energy and climate goals, LDCs can leverage their relationship with government to secure investment for a sustainable energy transition. LDCs have access to low cost funding through government investment that no third party has access to. The affordable funding can pay for the transformation of LDCs (Fox-Penner, 2010) (Lovins, 2011).

In Ontario municipalities can access an Ontario infrastructure loan for about 2% (Gilmour & Warren, 2008). Investment for grid renewal creates opportunities for utilities to create new products and services that can support a SET (Lovins, 2011). In Ontario LDCs can potentially access funding from Ratepayers, Taxpayers, Public utility shareholders, private sector equity and debt financing. There are pooled funding models, recovery from rate base options, private funding and public private partnerships, as well as industry collaborations (Ontario Smart Grid Forum, 2015)). Moreover, there is the conservation fund and Smart Grid fund.

In Ontario and in the rest of Canada, new investment for grid modernization can be expected. The change in federal government has created a focus for a coupled national energy and climate change strategy (Liberal Government, 2015). Canada has newfound climate and energy commitments that were sparked during Paris 2015 Climate Negotiations (Federal Government, 2015). Commitment to sustainable energy is profound. In Ontario, there is a fertile environment to support LDC transformation to achieve SET, thus further insure government investment in LDCs.

3. Existing Customers

LDCs are the only energy service company with pre-existing customers. As the accessibility for sustainable energy and smart grid technology become more available for customers, LDCs will have a competitive advantage in offering new products and services to their customers. In addition, many LDCs in Ontario have long trusted relationships with their customers therefore they are in a good position to integrate the adoption of smart grid technologies with their customers (Lovins, 2011).

Furthermore, LDCs can leverage their pre-existing billing relationship to offer unique funding models that can capture different customers' segments for their smart grid products and services (Lovins, 2011). Relative to other energy service companies, LDCs are in a powerful position to integrate SET.

4. Big Data: Big data enabled by smart grids makes LDCs competitively positioned to conduct research regarding their electricity customers. Currently, customer segmentation consisted of retail, commercial and industrial sectors. Big data collected from smart meters have enabled customer segmentation, which can allow utilities to develop new products and services that better meet the needs of a growing diverse customer base. Having a clear idea of what customers want will help LDCs to integrate smart technology and advance a SET. For example, LDCs can develop new services that can help low-income customers and early adopters of new technology, and so on. (Henderson, 2015). Other energy services companies have limited access to smart meter data from LDC customers, but LDCs do not (Lovins, 2011) Their access to big data can help utilities tailor new products and services to their customer base while enabling a SET. This is a competitive advantage.

5. Own Existing Infrastructure: LDCs have an advantage in integrating BTM developments because they already own and operate the existing electricity distribution infrastructure. Therefore, LDCs are best suited for integration of smart technology, which results in the advancement of SET (Lovins, 2011) (Fox-Penner, 2010). Moreover, since LDCs do not own large generating assets, their risk of incurring stranded assets is limited.

Across North America and Europe, stranded asset are a major concern for utilities that integrate SET. This is because SET ultimately reduces customers' demand for electricity. Due to the sales incentive, the reduced load reduces utility profits. The profits that utilities earn go towards paying back of large generation assets over a 30-year life cycle. Therefore, the disruption of sustainable energy can leave utilities with stranded centralized assets. Ontario LDCs are unique because the result of stranded assets is not likely. Therefore, LDCs' risk for stranded assets is not likely. These factors put LDCs in a unique position to advance a SET.

6. Electricity Planning: LDCs are well-positioned for long-term planning to decrease cost electricity for their customers. The growth of BTM developments increase the complexity of the grid and generate a growing need for better coordination. Utilities have been planning for electricity needs for close to a century (Lovins, 2011). In Ontario, LDCs work with municipalities to plan future changes in electricity consumption (IESO, 2015). Therefore, LDCs are well-positioned to coordinate the deployment and integration of disturbed resources, invest in grid infrastructure that support old and new systems, convey signals about system conditions and integrating distributed resources to harvest the benefits of diversity for all stakeholders (Council of Energy Ministers, 2009). The LDCs in Ontario are appropriately situated to take on the role of planners and coordinators as they integrate smarter grid technology.

7. **Convergence of Energy to Electricity — Increased Electrification —Decentralized Grid**

The process of replacing fossil fuels with DER means that the energy supply will no longer be recognized as a stock, but a flow of electricity. This process is necessary for a SET (Aklin & Urpelainen, 2013). In Canada, 87.1 % of primary production of energy comes from fossil fuels (Canada, 2013). In order for Canada to meet our energy demand without using conventional sources, Canada will need to electrify its energy supply. The electrification of energy will inherently change societies' relationship to energy (Fox-Penner, 2010). The electrification process is an opportunity for LDCs to transform the centralized grid to a decentralized grid that is powered by DER. LDCs are well-positioned to instigate this process.

Electricity demand is expected to increase as society transitions away from fossil fuel forms of energy. As the process of electrification occurs, LDCs are in a strategic position to transition to the electrification of transportation, industrial process etc (Fox-Penner, 2010). Energy and the economy are heavily intertwined. Due to climate change threats, electricity will play a central role in mitigating GHG emissions while providing enough energy to meets the demands of the economy (Beddoe, et al., 2008). LDCs in Ontario are in a good position to increase sustainable electricity capacity. A prime example of electrification is the electrification of the transportation sector through public transit and electric vehicles (Fox-Penner, 2010). LDCs will be distributing electricity to these emerging electrification assets. Therefore, they are strategically positioned to integrate them on a large scale.

8. Cost of not Transforming: **Aging Infrastructure**

The cost of continuing on the path of incremental change to the conventional utility model is enormous. The consequences of path dependency brought on by an incremental approach are large and risky. The cost to update the existing centralized infrastructure will be more than the transfer to a decentralized system (Lovins, 2011).

Flat and falling demand does not work with the conventional utility business model that is dependent on economies of scale because longer payback periods make investments difficult to recover and can result in stranded assets. Although, LDCs have a reduced risk of acquiring stranded assets because they are restricted from owning large scale generation assets, they are still the direct link to customers. As a result, the cost of stranded assets would be pushed onto the customer. In order to avoid future stranded assets brought on by decreasing electricity demand, LDCs can act and transform their business model so that it is not reliant on increasing electricity demand (Lovins, 2011). LDCs can innovate their business model that benefits from a SET and help customers reduce their cost of electricity. As this process occurs, LDCs can transition away from the centralized model with isolated centralized assets, making them easier to manage and pay off. LDCs can save money from future losses by capitalizing on new energy opportunities presented in the changing energy paradigm and SET. Failing to act on sustainable energy opportunities sets LDCs and Ontario's electricity system at large on a pathway to incur more loses.

It is tempting to channel investments into the renewal of the central grid through an incremental process. However, it is crucial that LDCs recognize the opportunities that come with transformation. LDCs that recognize their powerful position and act as leaders in the SET process can accelerate the adoption and integration process. Increased leadership in a model of innovation and energy system sustainability are essential to any larger vision of sustainable development such climate change and energy security (Fox-Penner, 2010) (Lovins, 2011).

The SMART GRID:

The Smart Grid represents the shift from energy to electricity and the transformation of the central grid to a decentralized grid. The Smart Grid creates an opportunity for LDCs to leverage themselves as community assets. LDCs are the only energy service company that can access low cost funding and can enable the development of supportive policy and regulation. They have pre-existing customers with billing relationships and they also have access to big data from their customers. These attributes position LDCs in a strategic position to develop new products and services that can reinvent their business model. They own the existing electricity distribution infrastructure and have a wealth of experience planning for future electricity needs. Although, LDCs are hindered by the brittleness of their conventional utility model, with initiative and leadership LDCs are very well-positioned to champion change in Ontario’s electricity system to create a SET.

The convergence of information communication technology with the electricity grid is creating the emergence of smart grids opening up a platform for an Internet of Energy (Weiler, 2014). LDCs are uniquely positioned to leverage the smart grid capabilities that will benefit consumers and accelerate a sustainable energy transformation. Smart Grids are able to modernize the electricity systems’ antiquated architecture and provide consumers with dynamic new ways to produce, use and conserve electricity (Weiler, 2014). The objective of smart grid technologies and the associated processes are to modernize LDCs' operations and information systems. Smart grid technology will specifically enable LDCs to monitor, analyze, and synchronize their networks to improve reliability, and increase efficiency of the grid (Hedin & Wheelock, 2010). Furthermore, Smart Grid technology can provide new business opportunities for utilities as new electricity services emerge.


The Business Case for LDC Business Model Innovation
STRENGTHS
• Community Asset
• Government investment and policy
* Low cost funding
• Pre-existing customers
• Access to big data
• Owe existing infrastructure
• Experience in electricity planning
• Ability to increase electrification of economy
• Enabling decentralized grid
WEAKNESSES
(Push Factors)
• Sales Incentive
• Flat and falling demand
• Aging Infrastructure
• Institutional Lock-in
*Economies of Scale
*Learning Effect
SWOT
OPPORTUNITIES
• Champion SET
• Reduce risk of future stranded assets
• Reduce risk of becoming irrelevant
• Unlock smart grid
• Be an international role model
THREATS
(Pull Factors)
• Distributed Energy Generation (storage and renewable energy resources)
• New information and communication technology
• The Internet of Things
• Active customers
• Grid Parity
• Load defection
• Grid Defection
• Utility Death Spiral
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3.3 WHAT WOULD A NEW UTILITY BUSINESS MODEL LOOK LIKE—Potential Features of Emerging Models

There are a number of ways in which utilities can respond to the challenges and drivers of the changing energy paradigm of the 21century. The analysis of emerging business models used by LDCs is central to the research discussed in this paper.

A normative framework is used to clarify an ideal standard that utility business models should embody. To being the process of determining an appropriate utility business model transformation in Ontario, this section of the paper outlines the potential features of a transformed LDC business model that can unlock a SET while ensuring enough revenue to maintain the grid.

The table below describes the predominant characteristics of the conventional utility model, which are contrasted with those of the emerging utility model.

Emerging Utility Model

Conventional Utility Model	**Emerging Utility Models**
Centralized Grid	Decentralized Grid
Supply Management	Supply and Demand Management
Large scale projects far away from load demand	Small scale projects matched to end-use demand

Reliability	Reliability and Resiliency
Economies of Scale	Generation is close to load
Interconnection	Integration
Passive Customers	Active Customers
Sell electrons	Sell new products and services

(Electricity Innvoation Lab , 2013) (Shahan, 2013) (Valocchi, Juliano, & Schurr, 2010)

Research Question

The focus of the research discussed in this paper is LDC business model transformation in Ontario. To shape this discussion the following research question has been proposed.

Is there a viable business model that does not reduce the incentives of behind the meter developments and still allows LDCs to maintain the grid infrastructure under the scenario of decreased load demand?

There are two components to this questions that can be broken down to qualify the research and analysis presented in later chapters.

[A viable business model that does not reduce the incentives of behind the meter developments] This portion of the question refers to the proposed fixed price of electricity policy that many LDCs have petitioned for to the Ontario Energy Board (IESO, 2015). A fixed price for electricity would dramatically reduce customers' incentives to invest in BTM developments because customers would end up paying the same rate for electricity regardless of how much they reduced their consumption. Therefore, the purpose of this research is to assess viable business models that encourage BTM developments.

To the latter part of this research question, **[that still allows LDCs to maintain the grid infrastructure under the scenario of decreased load demand].** BTM developments are inevitably going to reduce customers' demand for electricity beyond the current flat and falling scenario (Fox-Penner, 2010). Significantly reduced electricity demand can result in the LDCs' inability to maintain the grid infrastructure. Therefore, this research aims to determine possible viable business models that still allow LDCs to earn enough profits to maintain the grid infrastructure.

The transition to a SET is not easy but Ontario LDCs are in a strategic position to champion this transition. There is urgency for LDC business model innovation. In Ontario, a select few of LDCs are considering these push and pull forces by advancing innovation in the electricity sector. This paper aims to evaluate these innovations and propose a solution to the identified research question.

Chapter 4: Normative Framework for Steward of the Gird

4.1 Normative Framework

e. Reinventing Fire Principles

f. Resilience and Adaptive Capacity
g. Customer Side (Evolution) and Utility Side (Revolution) Business model Theory
h. Is there a viable business model for LDC to fit into low carbon energy system? Business model Conceptualization

4.2 Introduce SOTG
4.3 Evaluation Criteria

Across Ontario, there are several LDCs that are spearheading innovation in the sector. Currently, it is unclear how LDCs can structure new business models so that they can integrate sustainable energy while still earning enough profit to maintain the grid infrastructure. Some LDCs in Ontario are attempting pilot projects, prototypes and offering new services in the unregulated energy service sector through BTM developments to customers. Furthermore, a handful of LDCs in Ontario are experimenting with sustainable energy technology to determine if the technology can be applied and included in current LDC operations (IESO, 2013) (Ministry of Energy, 2015) (Angen, 2015).

As new business models emerge in Ontario, this thesis research paper is proposing a normative framework that can be used to assess the strategic capacity and alignment of the emergent business model with sustainable energy goals. This proposed normative framework is a broad overview of the principles, elements and models that embody the characteristics of a "utility of the future". The normative framework has been used in this paper to introduce the key elements of a 21st-century utility business model that can be used to frame the evaluation criteria.

The evaluation criteria is an expression of the normative elements that go one step further and begin to frame a potential business model called the Steward of the Grid (SOTG). The grid is becoming more complex, diverse in terms of stakeholders and technology, as well as variable in electricity generation. Therefore, there is a greater need for stewardship of the grid (Lovins, 2011). The SOTG has emerged as a potential business model construct that LDC could transform into. The broad constructs of the model enable an LDC to integrate a SET in addition to maintaining and advancing the infrastructure of the grid. Moreover, the normative framework has influenced the shaping of the SOTG model that is expressed in the evaluation criteria.

4.1 NORMATIVE FRAMEWORK

A normative framework is an ideal standard of performance (Cambridge Dictonary, 2016). The proposed normative framework demonstrates how LDCs should act in the face of change and uncertainty. It is a broad outline of "good to haves" in business model structures as LDCs progress into an uncertain future. New LDC business models that encourage the proposed normative framework will be better aligned to respond to the occurring disruption BTM, as well as reducing their own risks arising from an outdated system. Moreover, the normative frameworks proposed can align LDCs to become champions of SET.

The proposed Normative Framework consists of three principles used in Lovins' Reinventing Fire, Resilience and Adaptive Capacity of an energy system, and the integration of Customer side and Utility business model. The Reinventing Fire principles, the Resilience and Adaptive Capacity and Customer Side and Utility Side Business Model create a foundation of normative features for a sustainable energy system. These normative features when expressed in the normative framework generate a broad construct for a positive outcome for an emergent LDC business model. The construct suggests what an optimal LDC will look like in the 21st century.

Normative Framework:

1. Reinventing Fire Principles (Lovins, 2011)
2. Resilience and Adaptive Capacity (Winfield, Gibson, Markvart, Gaudreau, & Taylor, 2010) (Martin, 2013) (Beddoe, et al., 2008)
3. Integration of Customer Side and Utility Side Business Model (Richter, 2012)

1. Reinventing Fire Principles

Reinventing Fire Principles create a foundation for a sustainable energy system that is led by Utilities. The three simple principles summarized by Lovins' Reinventing Fire are: doing more with less, modulating demand, and optimizing supply (Lovins, 2011). Together these principles constitute a broad normative framework that LDCs can use to assess the capability of their emergent business model in order to take full advantage of DER, as well as its ability to direct a SET.

Doing more with less is the cheapest and best option for meeting energy demands. In regards to the electricity system, doing more with less is a simple way of referring to energy conservation and efficiency. Energy conservation and efficiency are essential to a low-carbon energy system because reducing demand for energy reduces the need for supply. In addition, increasing energy productivity delivers the same or better services at lower cost while also reducing the risk of energy price spikes or supply failures. Doing more with less is crucial in a SET. Thus, increasing energy conservation and efficiency to reduce demand within the utility electricity system is an opportunity to save money and improve internal processes (Lovins, 2011). Doing more with less is a fundamental feature of the normative framework.

Modulating demand is a key principle in the proposed normative framework because enables LDCs to integrate DER and it puts the LDC in a good position to benefit from DER integration. Learning how to control and modify demand is necessary for a low carbon energy system because distributed energy resources are highly variable. Integrating variable DER through modulating demand will encourage LDCs master coordinating supply and demand resources so that electricity is distributed seamlessly. Moreover, innovative technologies, smart controls, IT-enabled services allow for adjustments to energy demand to match more closely and strategically with a wide range of supply technologies. In the electricity sector, these emergent ICTs are applied to use demand response, which is a method used to alter the demand for electricity so that it is used when it is cheapest, thus reducing the pressure on the grid during peak periods. This reduces costs and smooths the supply curve (Lovins, 2011).

Optimizing supply is the final Reinventing Fire Principle. It is a key element of the normative framework because it refers to the optimization of renewable energy resources to meet electricity supply needs. Electricity grids that continue to rely on centralized generation assets do not optimize supply for reasons mentioned in chapter 1 that discusses barriers to the conventional utility model. Optimizing supply through DER results in new ways to control energy risks, decrease costs and prompt a more stable supply and prices of energy resources (Lovins, 2011). Optimizing supply in a low carbon energy system is characterized by a transition from fossil fuels to a mixed source of renewable energy generation.

2. Resilience and Adaptive Capacity

A SET goes beyond the industry standard of reliable and affordable electricity to include environmental, social and economic impacts. A sustainable electricity system relies on low carbon distributed energy resources. Distributed energy resources are optimal in a desterilized energy system, where resilience and adaptive capacity become new industries standards (Winfield, Gibson, Markvart, Gaudreau, & Taylor, 2010) (Martin, 2013). LDC Business models that encourage resilience and adaptive capacity are important because resilient and adaptive energy systems are necessary for a low carbon energy system.

Resilience and adaptive capacity provide a matrix that evaluates the extent to which a system can adapt to a current energy system and respond to supply and demand requirements, which consider locality and flexibility (Martin, 2013). Locality and flexibility play an increasingly larger role as more DERs enter the grid. Resilience and adaptive capacity stem from the ability of a system to adapt and to continue functioning in the face of stress and shocks (Beddoe et al., 2008). Business models that encourage resilience and adaptive capacity can be measured by the ability of the new business venture to decrease path dependence of the conventional system, as well as its ability to increase flexibility, reliability, locality, and use narratives (Beddoe, et al., 2008) (Martin, 2013) (Augenstein & Palzkill, 2015).

Lower path dependency is the degree to which an energy system can overcome the current inertial lock-in forces of path dependence on large centralized energy systems, and create a platform for future innovation and constant technological improvement (Martin, 2013).

Flexibility, reliability and locality reflect the characteristic of DER and their objectives on the grid. Wider use of variable renewables will create demand for more flexibility to match fluctuating supply and demand. In response, smart grids and advanced control systems will balance a larger share of responsibility as buildings, factories and households automatically respond to system needs (Martin, 2013).

The use of narratives is a set of strategies that is used to overcome challenges during Socio-Technical Institutional Transitions. The use of narratives has been linked to increases in organizational resilience and adaptive capacity. Internal and external narratives during organization transformations reduce risks by inter-connecting stakeholders and by building robust relationships with customers and producers. Furthermore, narratives reduce complexity, create a basis for current and future-oriented actions plans, and are a foundation for the cooperation between actors. In addition, narratives used in sustainability transitions can serve as "boundary objects", and thus improve the processes of translation and knowledge integration between different actors (e.g., between companies and their external stakeholders, or more generally between niche and regime (Augenstein & Palzkill, 2015). LDCs that apply narratives internally and externally can reduce the risk for their emerging business models.

LDC Business Models that support a system's resiliency and adaptive capacity are fundamental to SET and to a low carbon energy system. Therefore, resiliency and adaptive capacity are crucial to the normative framework.

The elements of resilience and adaptive capacity, path dependence flexibility, reliability, locality, and use of narratives shadow some of the criteria included in the SOTG evaluation criteria.

3. Customer Side (Evolution) and Utility Side (Revolution) Business Model Theory

In addition to the three reinventing fire principles and resilience and adaptive capacity, the evolution and revolution theoretical framework, which is demonstrated through customer side business models and utility side business models, will be used as parameters for the normative framework.

The customer side and utility side business model are two business models that utilities use to integrate DER. The SOTG model exemplifies an attempt to integrate the customer side and utility side business models. Characteristics of both models have been used in the SOTG evaluation criteria.

Revolution: Customer Side Business Model is based on a large number of small projects, where utilities develop infrastructure geared towards small scale energy systems on the customer's property. This requires utilities to have a completely new approach to asset management and operation. This process also requires new customer interface, segmentation and communication channels. Furthermore, utilities must frame business models to deal with higher transaction costs. In addition, the regulatory framework needs to be adjusted. Utilities will need to expand on and develop new core competencies to address these challenges, which are associated with transforming their current business model to a customer side business model (Richter, 2012).

The upside to the customer side business model is that it offers a whole new host of new value propositions that leverage the characteristics of a low carbon decentralized energy system. However, there is more risk associated with this business model pathway. Customer side business models are in an early stage of development globally. Thus, it is unclear whether utilities can make this model profitable (Richter, 2012). As conventional business model continues to be eroded by third party players offering customer side behind the meter services, there may be space for utilities to risk the challenge for a large reward.

Evolution: Utility Side Business Model is based on large-scale low carbon distributed energy projects that operate in the centralized system. The projects provide bulk of the power to the grid. Through this process the utility improves gird infrastructure to accommodate the DER. This model is seen as a gateway to customer side business model because it an evolutionary step that requires the utility to update the grid infrastructure so that it can integrate DER at an intermediate level. As a result, the grid becomes situated in a better position to aggregate many small-scale projects (Richter, 2012).

This model is based on a small number of large projects. There is not much change to the conventional utility model. The new value creation could be based on selling renewable energy as a premium. This would require customer segmentation to determine which customers would pay more for renewable energy. In this model, utilities use the same core competencies (Richter, 2012).

This model is more practical and has less risk than the customer side business model. Many leaders believe that the utility side business model stems from a natural evolution from their conventional utility model because utilities do not need to change much, thus the evolutionary pathway appears more attractive in terms of risk and return (Richter, 2012). However, it is important to recognize that this model does not directly address revenue erosion by third party players. Therefore, the utility side business model does not champion a SET, but rather it evolves as other parties lead the transformation.

Although, the utility side business model (evolution) and customer side utility business model (revolution) differ, many utilities are looking to incorporate both options. This is because both models have the ability to create value-added services for customers and the energy system at large, such as offsetting the development of a large-scale power plant. The SOTG model incorporates aspects of both models, such as aggregating assets and infrastructure improvement, which appear in the SOTG evaluation criteria. By doing this, utilities are able to hedge risk against an uncertainty in the electricity sector.

4.2 Steward of the Grid (SOTG) — The Guiding Model for the Normative Framework

During the course of research into utility business model innovation, the Steward of the Grid (SOTG) has emerged as a potential business model construct that enables an LDC to integrate a SET, as well as to maintain and advance the infrastructure of the grid. The core element of this potential LDC business model is that the LDC charges for the coordination of electricity assets, rather than charging for the consumption of electricity.

A Definition and Discussion of SOTG: Enabled by the smart grid, charging for coordination allows the LDC to benefit from the integration of DER. The SOTG model enables coordination between utility and customer-owned assets to provide specific locational benefits that result in a reliable and resilient grid (Gupta, 2015). In addition, the model can create alternative revenue sources that can withstand decreasing demand so that the LDC is still able to maintain grid infrastructure. The SOTG model is a theoretical construct of what a LDC business model could look like in the future. Practical and commercial implementation of the model has yet to take place in North America, but many similar models are beginning to emerge (Accenture, 2016).

The concept of Stewardship, the conducting, supervising, or responsible management of something entrusted, has been applied to the electricity grid (Oxford Learner's Dictionaries, 2016). The LDCs are currently transforming from their role as distributors to become the stewards of the grid. The process of stewardship is what the LDC charges for. The origins of SOTG utility business model is referenced in Lovins' Reinventing Fire, as a metaphor of conducting a symphony. Lovins explains that just as a conductor orchestrates a variety of instruments to create a composed song, the role for a conductor of the grid is to orchestrate a variety of generation and CDM assets. Lovins argues that there is an emerging job for a grid manager. As the grid becomes more complex, diverse in stakeholders and technology, and variable in electricity generation, a utility or a third party company will need to steward the grid so that it is resilient and reliable. As DERs enter the grid, forecasting their variation and integrating them with dispatchable renewables, flexible fueled generators and demand response will become an essential full-time job (Lovins, 2011) (Electricity Innvoation Lab , 2013). This paper argues that the Ontario LDC is in a good position to fill the role of the SOTG. The SOTG as potential business model concept for Ontario LDCs was presented at the Ontario Network of Sustainable Energy Policy and has further been research for the purposes of this research paper (Winfield, Weiler, & Zeeman, The Emerging Universe "Behind the Meter" and its Implications for Electrcity System, 2016).

Ontario LDCs are in a good position to integrate medium sized DER and BTM developments because of their strategic position with customers and regulatory body. Medium sized BTM developments are much cheaper to install than small DG for individual household use. A community systems approach can accrue significant benefits from Integrating medium sized DER and ITC. There are cost advantages from this systems approach. Linking homes with vehicles and addressing energy issues on a community level rather than on individual households has greater cost advantages then compared to the costs of integrating small DER and ICT for individual households (Fox-Penner, 2010). This logic of developing medium sized BTM developments puts Ontario LDCs in a strategic position to integrate these assets into their local communities.

The SOTG model is a new avenue that allows the LDCs to create value for their customers. In this model, the LDC drives demand for knowledge of the energy system, manages diverse, dynamic variable energy mix, provides system coordination and is the supervisor and collector of data management. The steward of the grid model can own, operate and maintains infrastructure BTM (Accenture, 2016) (Electricity Innvoation Lab , 2013) (Fox-Penner, 2010) (Lovins, 2011). Ontario LDCs are in a good position to fill the role of the SOTG because the majority of LDCs do not own generation assets, so stranded assets are not a major concern. In addition, LDCs have proven relationships with their customers. For more detailed reasons, please see Chapter 3 (*The Business Case for LDC Champions of SET).*

The SOTG model is also a broad enough concept that there is potential for the LDCs to participate in a range of rapidly growing new business sectors ranging from energy efficiency services to developing distributed resources for customers. The SOTG model also creates opportunities for new entrants on the grid without diminishing the value of the LDCs.

To this date, there is no utility operating under this model, but there are many utilities and regulatory regions considering elements and versions of this model. Aspects of this model are arising in utility progressive states like New York's Reforming the Energy Vision (REV model) and California's regulatory model (Accenture, 2016). The details of these models remain slightly different because they are based on the unique characteristics of different regional operating bodies. How LDCs charge for coordination has not been determined yet, but studies on new rate structure models are currently experimenting with this idea (Perez-Arriaga & Bharatkuma, 2014). The unpacking of the rate structure for the SOTG model is beyond the limits of this paper.

Although there is no current concrete SOTG structure, this chapter has outlined fundamental elements of the model that coincide with the current Ontario electricity landscape. The founding elements of the SOTG have become apparent through the research and analysis that has been informed by theatrical frameworks used in this research paper, the literature of Utility business model innovation, as well as by the bodies of literature that speak to local Ontario LDC constructs. The SOTG founding elements shadow the principles and models described in the normative framework.

4.3 SOTG Evaluation Criteria: The core criteria that support a SOTG model are:

1. Aggregating assets
2. Bundling of services
3. Collaboration with new entrants
4. Infrastructure maintenance and improvement to facilitate aggregation functions
5. Flexibility
6. Resilience
7. Public ownership by municipalities
8. Financial sustainability

These criteria are the basic elements of the SOTG in the Ontario context. These 8 metrics will make up the criteria used to evaluate the seven emerging business models in Ontario.

Below is a brief description explaining why they are considered to be relevant elements to the SOTG model and how they relate to the components of the normative framework.

Aggregating Assets: *Aggregating assets* is an important feature of the SOTG model because it demonstrates that the utility recognizes the large-scale benefits from DER and

BTM developments which are achieved through aggregation (Richter, 2012). This is because DER and BTM developments are diverse, decentralized and often small-scale. Aggregating assets constitute a metric that became apparent in the three reinventing fire principles, customer side business model and resilience, and adaptive capacity.

Bundling of Services: *Bundling of services* is an important feature of the SOTG model because it implies that the utility is offering more services than the sale of electricity. For example, bundling services means offering customers the installation of the smart meter or smart thermostats in addition to the electricity that they already receive. This is done so that customers are able to modulate their electricity demand to reduce the cost of their electricity bill. Bundling services typically allows the customers to participate in energy conservation and efficiency initiatives, as well as DER initiatives. The process of bundling services creates new value propositions. It can also benefit the utility in grid optimization (Richter, 2012). Bundling of services reflects an integration of the Customer Side Business Model with elements of Reinventing Fire Principles, which leads to optimizing supply and modulating demand.

Collaboration with New Entrants: *Collaborating with new entrants* is important to the SOTG model because it means that the utility is enabling the participation of different stakeholders in the grid. Collaborating with new entrants is also important because it puts the utility in a good position to integrate various initiatives from different stakeholders. With sustainable energy rapidly transforming the electricity system, it will be difficult for utilities to be masters of every aspect of energy facilitation. However, collaborating with new entrants is a positive force that can enable a smoother transition to sustainable energy. Thus, collaborating with new entrants is a method to achieve resilience and adaptive capacity, along with the three reinventing fire principles.

Infrastructure maintenance and improvement to facilitate aggregation functions: *Infrastructure maintenance and improvement to facilitate aggregation functions* is an importation feature of the SOTG model because the grid currently caters to centralized generation assets, therefore maintenance and improvement to the grid through smart grid adoption is very helpful when integrating DER and BTM development (Richter, 2012). Infrastructure maintenance and improvement to facilitate aggregation functions is part of the resilience and adaptive capacity components within the normative framework.

Flexibility of the Grid: Flexibility is an important element of the SOTG model because the electricity must become increasingly more flexible to that it can integrate variable DER (Martin, 2013). Flexibility is an element that comes directly out of the resilience and adaptive capacity component in the normative framework.

Resilience of the Grid: Resilience is a key feature of the SOTG model because resilience is a key goal of the electricity system in the 21st century. With extreme weather becoming more frequent and the increase of variable DER, resilience of the grid is necessary for "keeping the lights on" (Beddoe, et al., 2008) (Winfield, Gibson, Markvart, Gaudreau, & Taylor, 2010). Resilience is a primary concept in the resilience and adaptive capacity in the normative framework.

Public ownership by municipalities: **Public ownership by municipalities** is important to the SOTG model because it creates a venue for local economic development and prosperity (Electricity Innvoation Lab , 2013). In Ontario, almost all LDCs are publically owned. Public ownership can interplay with Reinvented Fire Principle Optimization of Supply because local ownership of DER and grid infrastructure can benefit the local community. For the same reasons, public and local ownership can increase the resilience of the electricity sector's financial system.

Financial sustainability: **Financial sustainability** is important to the SOTG model because it ultimately determines the success of the model. If the SOTG is not financially viable, it is not possible for the model to be successful (Richter, 2012). Financial sustainability is part of the customer side and utility side business model components in the normative framework.

These founding elements of the SOTG model are the metrics that will be used to evaluate the seven emerging LDC business models.

Chapter 5: Evaluation of Seven Emerging Business Models

5.1 Overview of Emerging Business models
5.2 Funding Sources for Emerging
5.3 Regulation Status for Emerging Business models
5.4 Evaluation of Emerging Business models

After transforming the Normative Framework into a tangible evaluation criterion, this chapter will examine seven emerging business models of local distribution companies in Ontario.

5.1 OVERVIEW OF EMERGING BUSINESS MODELS

Case Study 1: PowerStream and Rogers Communications — Residential Conservation and Energy Management (REM).

This emerging business model is a pilot project funded by the Smart Grid Fund. Rogers Communication is the project owner, but the company works closely with PowerStream in partnership. The objective is to evaluate new technologies that increase customers' control over their electricity. The program gives participants an advanced energy system to help them automate their home and better manage their electricity costs, while giving customers greater control over their day-to-day usage. Rogers and PowerStream will be implementing new technologies to provide benefits to consumers, distribution companies and the grid as a whole by creating a more efficient energy grid (Ministry of Energy, 2015). The REM program has been offered as a one year pilot program to a limited number of PowerStream customers.

Customers will be the first to test the system, which is designed to automatically adjust to users' preferences, continuously learn and adapt to the users' lifestyle and provide insights on energy use. Participants will be equipped with a new thermostat, a touchpad, two smart plugs, two door sensors and two motion sensors. The energy system is designed to automatically adjust temperature, lights and small appliances. The system continuously learns and adapts to the program, and it participates in the customers' routines and lifestyles. The goal of the project is to reduce customers' demand, modernize the system and provide efficient power use. This pilot project is an example of the smart grid entering the smart home. This pilot project is the first step to bringing the next generation of smart grid solutions to the market (PowerStream, 2015).

PowerStream consists of City of Vaughan, Town of Markham, Town of Richmond Hill, Town of Aurora and Town of Collingwood, City of Mississauga, Cities of Hamilton and St. Catharine's, as well as the Town of Brampton (Ministry of Energy, 2015).

Case Study 2: PowerStream and Sunverge — Virtual Powerplant— Power House

The PowerStream Power House Program is a small pilot project consisting of 20 participating homes over the course of 5 years. The objective of this pilot is to evaluate customers' CDM and improve understanding of grid and utility benefits of a virtual power plant. The Conservation Fund is sponsoring this project. PowerStream is showcasing how residential customers can simultaneously generate their own clean energy and work together as a virtual plant to augment the grid (IESO, 2013).

Each house that is participating splits the installation cost with PowerStream to receive a 5kW of Solar Energy, 11.4 kWh Lithium-ion battery for energy storage, 6.8kW inverter, a bi-directional meter and remote access to an energy management system that will allow customers to monitor the system. PowerStream uses an aggregate fleet of 20 residential solar and energy storage systems located in the customers' homes that can be autonomously controlled through intelligent software to simulate a single, larger power generating facility. Customers will benefit from generating their own clean, renewable energy and displace a portion of their energy from the provincial grid, leading to reduced exposure to peak electricity rates and significant bill reductions (PowerStream, 2016). Customers reduce their bill by offsetting their load using by solar power and either store excess energy in the battery or transfer it back to the grid for extra bill credit (IESO, 2013).

From a utility perspective, leveraging, carbon-free generating resources and fast responding energy storage assets can play a pivotal role in several grid supporting functions. These resources can be used to reduce peak systems' loads, regulate frequency, and even defer capital costs associated with traditional electricity delivery infrastructure (Lovins, 2011). The convergence of solar, storage and home energy management makes this project unique in applying DER to reinforce the grid. This project serves as a "win-

win" proposition for customers and utilities alike. With this project, PowerStream is the first Canadian Utility to pilot residential storage units (PowerStream, 2016).

A virtual power plant (VPPs) is an aggregation of demand response or DER under one type of pricing mechanism. The VVP business model optimizes the use of renewable energy, electric vehicle, and energy storage on the grid (Lovins, 2011).

Case Study 3: Hydro One (Previously Woodstock Hydro) — Woodstock White Lane Smart MicroGRID.

White Lanes MicroGRID integrates Electric Vehicles and Charging, Solar Energy, Energy Storage, PowerMatching, Weather Data and Smart Metering. The objective of this project is to match the customers' loads with renewable energy generation and energy storage by applying smart metering data. This concept is referred to as PowerMatching. As customers become "distributed generators", their consumption and generation habits (including generation and load shedding capabilities) will become part of a more dynamic electricity network. Similar to PowerStream PowerHouse, this microgrid project is also applying the concept of a virtual power plant. This project is aimed at understanding electricity imports and exports intelligence, net metering and smart metering applications to reduce the drain on local utilities and offset the need for large-scale generation (Ministry of Energy, 2015).

All applications of the system are coupled with residential and commercial load. The system will power several apartments, a law office and financial institutions. Woodstock residents involved with the microgrid will benefit from reduced consumption and costs while playing a key role in the reduction of fossil fuel consumption and carbon emissions (Rivers, 2014). In addition, the microgrid project is a pilot project that can help utilities to see renewable energy and distributed energy as opportunities. This project has ongoing research partnerships with Fanshawa College, Ryerson University and York University. Fanshawa's goal is to research an algorithm to bridge the gap between current energy production, transmission line capacities and customers' needs. This project focuses on customer engagement and energy education (O'Malley, 2015).

This project is unique because since the project's execution, Hydro One has absorbed Woodstock Hydro. In addition, Hydro One is a crown corporation and is going through the process of privatization and is set to sell up to 60% of its assets (Shane, 2016). Consequently, the future of the Woodstock White Lane Smart Microgrid project is unknown.

A microgrid is an electrical system that includes multiple load and DER that can be operated in parallel with the broader utility grid or as an electrical island (Heaman, 2015).

Case Study 4: Oakville Enterprises Corporation Sandpiper Generation — Geo-exchange.

Oakville Enterprises Corporation is a dynamic energy service company comprised of twelve separate business entities that are entirely owned by the Municipality of the Town of Oakville. Municipality of the Town of Oakville's has an Electricity Distribution Company Oakville Hydro along with six infrastructure service companies that provide construction, contractors, engineering, consulting and vehicle based mapping. The town also has three energy services companies that provide metering and home and commercial energy managing services. Lastly, Oakville Enterprises Corporations has two generation companies providing renewable energy development and geo-exchange services (Oakville Enterprises Corporation, 2016).

OEC & Sandpiper Generation's mission is to invest in renewable and high efficiency distributed thermal and electrical generation projects, as well as to create reasonable utility rates of return by partnering with host using sound, proven technology. The Geo-Exchange delivered by Sandpiper Generation under the Oakville Enterprises Corporation is the program that will be evaluated under the proposed criteria. (Oakville Enterprises Corporation, 2016).

The Geo-Exchange program applies geo-energy exchange technology to residential and commercial customers using geo-exchange wells and heat pump technology. The projects vary from small residential units to large-scale units used by institutions and condominiums. This program is a unique service offered to Oakville residence. In addition, the Geo-Exchange program is fostering new partnerships with large-scale landowners like condo developers and the condo board to offer sustainable energy solutions (Savel, 2014).

The utility model uses a long-term ownership model of a 30-year capacity based contract. The program also offers a rental based business model. The business model allows a steady rate of return. There is also an opportunity to combine the geo-exchange services with other services, such as metering. The geo-exchange system is a proven, relatively simple system with high reliability and a low risk of failure. This unregulated Oakville Enterprises Corporation is a strategic pathway to reduce carbon emission (Savel, 2014).

Case Study 5: ERTH Corporation

ERTH Corporation represents an amalgamation of nine separate public utilities owned by the Town of Ingersoll, Township of East Zorra-Tavistock, Township of Zorra, Municipality of Central Elgin, Township of South-West Oxford, Town of Aylmer, Township of Norwich, the Municipality of Central Huron, and the Municipality of West Perth. Each municipality became a shareholder in the ERTH Corporation, with one share one vote governance model.

There are three energy service companies within ERTH Corporation. Erie Thames Power lines are a regulated LDC. The other three company affiliates operate in the unregulated landscape. A metering service division for electricity and water, a construction and lighting division for utility construction, street light and traffic lights and a business technologies division that provides billing services, software solutions and renewable energy services (ERTH Corperation, 2013).

The business technology division that provides turn-key and consulting services for solar and wind energy installations will be evaluated through the proposed criteria. Within the solar and wind service offerings, ERTH Corporation acts as a traditional solar and wind developer developing projects for customers and participating in the province's competitive renewable energy program. ERTH develops large-scale operations for smaller commercial and residential systems. ERTH sees projects through from approval and procurement to collector systems, as well as high voltage grid tie connections, along with utility metering and settlement. Since ERTH offers solar and wind development services through the whole chain of operations, there are opportunities for ERTH to offer additional services such as metering and monitoring of systems (ERTH Corperation, 2016).

Case Study 6: Sault Ste. Marie Public Utility Commission (SSM PUC) — Utility Distributed Microgrid

The SSM PUC and the SSM Innovation Center are in the process of considering the development of a Utility Distributed Microgrid. This project will provide the SSM with better local control over energy assets and it will strengthen and stabilize regional grids. This project would be the first of its kind in Ontario. The SSM has a significant amount of renewable energy resources making it technically capable of decoupling from Ontario's central grid. The city hosts a 189-MW wind farm with enough output for a city twice its size. It also has 400mw of hydroelectricity, 60-MW solar energy farm and a 70-MW Combined Heat and Power (CHP) plant (Wood, 2016).

The City of Sault Ste. Marie is interested in developing a microgrid in order to maximize regional interests, benefits and environmental considerations). The transmissions in the region are predicted to expand, enabling the opportunity for grid modernization. In addition, the city has sophisticated GIS and energy managing control systems, which could embed a virtual power plant and new conservation and demand management capabilities, such as:

- Conservation voltage reduction (CRV), which would make it possible for the PUC to reduce distribution voltage at will, thus reducing the customers' energy consumption.
- Volt / VAR optimization, which would improve distribution system efficiency and reduces system losses through voltage regulation and power factor correction.
- Distributed automation–Automated distribution system devices designed to facilitate self-healing circuits that reduce outage times and improve reliability.

- Demand management – The utility would control customer loads, such as hot water heaters, to reduce customer energy consumption at peak demand times (Wood, 2016).

In January 2016, the city issued a RFP seeking a consultant to further analyze the utility microgrids’ socio-economic status. The hired consultant is expected to recommend an accounting framework for the project to fulfill Ontario Energy Board regulations, and identify possible financing or equity partnership alternatives for the project (Wood, 2016). This project is still in early development stages, therefore the final outcome is uncertain. A utility distributed microgrid is a powerful concept and is capable of integrating many new features. This is an exciting project to observe as it continues to evolve.

Case Study 7: Markham District Energy System — DE and CHP

Markham DES is North America’s first system to combine the use of hot water for heating, chilled water for cooling through a combined heat and power plant. Markham District Energy System is owned by the City of Markham, proving the city with a long-term investment. The city of Markham formed a corporation called Markham District Energy (MDE), which allowed the city to carry debt. MDE operates as a private corporation whose sole shareholder is the city of Markham. Operating as a private business with municipal oversight has financial and management advantages for Markham. For instance, as a private company, MDE can use tax advantages available for construction and operation of plants. At the same time, being a wholly owned municipal entity, MDE can leverage sources of provincial and federal capital (International District Energy Association, 2014). The DES and CHP plan provides long-term investment. By matching the municipality's long term interest rates, after 20 years or debt repayment, the project is able to provide the city with long-term stable rate of return (Heath & Ander, 2013).

The objective is to provide the city's business center with affordable electricity and heating and cooling services. DE and CHP plant is a very economical way to generate and distribute energy relative to other renewable resources. It is also very efficient. This model operates with long-term contracts for customers. The DE and CHP system encourages business and investment in the city and it has created a source of local economic development. Moreover, the system has enabled the City of Markham to increase the community's electricity resiliency in the case of severe weather storms. The system currently uses natural gas but it could be using biomass in the future. This project aligns with the municipality's urban planning and sustainability priories. This system has already cut the city's green house gas emission by 50% (Heath & Ander, 2013).

The table below identifies the funding sources used in the development of the seven case studies.

5.2 Funding Sources

Financial Stability	PowerStream - REM	Power Stream- Virtual Power Plant	Hydro One - Woodstock Whites Lane Smart Microgrid	Oakville Enterprises Corporation - GeoExchange	Erth Corporation - Solar and Wind Development	SSM PUC - UDM	Markham - DE and CHP
Rate Payers							
Conservation Fund		**X**					
Smart Grid Fund	**X**		**X**			**X**	
Public Utility Shareholder / Municipal Ownership				**X**	**X**	**X**	**X**
Industry Collaboration	**X**	**X**	**X**			**X**	
Federation of Canadian Municipalities							**X**
Natural Sciences and Research Council			**X**				

The table below identifies the regulatory status of seven reviewed case studies. For those case studies that operate in the regulated electricity system, it is important to highlight that the LDC's customer rate base has not funded any of the regulated case studies. All of these cases have been funded as one-off pilot projects that have received some form of outside funding.

The difference between Regulated and Unregulated LDC in is significant. There is an affiliates code of conduct that govern the relationships between a regulated entity and its affiliates to ensure that no cross-subsidization takes place between a monopoly distributor and any of its affiliates (Ontario Energy Board, 2007).

The primary difference between a regulated utility and an unregulated utility affiliate is the access to finance through the rate base. Regulated utilities can use the rate base to finance infrastructure improvements for the grid and unregulated utilities cannot. Regulated utilities are accompanied by a regulatory framework that replaces competition so that utilities have administrative restraints on profits. Electricity rates reflect an approximation of the long-run average cost of service, plus a markup to recover capital investment costs, this is referred to as “fair return standard”. Within the regulated regime, regulated utilities are limited to what and how they provide infrastructure improvements and have heavy oversight on how they spend earnings received from the rate base (Stevens, 2016).

Unregulated affiliates operate in the competitive market outside the regulated regime and the natural monopolies of the LDCs. Many LDC’s have one or more affiliates that provide services to the LDC and are involved in other business services. These service affiliates are active in the provision of energy and distribution services, telecommunication services, and generation (Ontario Energy Board, 2007). Unregulated LDC affiliates are profit driven and compete with other energy service companies behind the meter.

5.3 Regulation Status

Regulation Status	PowerStream - REM	Power Stream - Virtual Power plant	Hydro One - Woodstock Whites Lane Smart Microgrid	Oakville Enterprises Corporation - GeoExchange	Erth Corporation - Solar and Wind Development	SSM PUC - UDM	Markham - DE and CHP
Regulated	**X**	**X**	**X**			**X**	**X**
Unregulated				**X**	**X**		

5.4 Evaluation of Emerging Business Models

The table below is the evaluation of the seven case studies based on the SOTG criteria.

STEWARD OF THE GRID	**Power Stream - REM**	**Power Stream - Virtual Power plant**	**Hydro One - Woodstock Whites Lane Smart Microgrid**	**Oakville Enterprises Corporation - GeoExchange**	**Erth Corporation - Solar and Wind Development**	**SSM PUC - UDM**	**Markham - DE and CHP**
Aggregating assets (e.g. DG, storage/energy savings/smaller scale projects	**X**	**X**	**X**	/	**X**	**X**	**X**
Bundling of services	**X**	**X**	/	**X**		**X**	**X**
Collaboration with new entrants	**X**	**X**	/	/	/	**X**	/
Infrastructure maintenance/improvement to facilitate aggregation functions	**X**	**X**	**X**	**X**	**X**	**X**	/
Flexibility	**X**	**X**	**X**	/	**X**	**X**	
Resilience	**X**	**X**	**X**	**X**	/	**X**	
Public ownership by municipalities	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Financial sustainability	/	/	/	**X**	**X**	/	**X**

5.5 RESULTS: SUMMARY OF EVALUATED BUSINESS MODELS

Each case study met almost every criterion when evaluated within the proposed normative framework and evaluation criteria.

Case Study 1: PowerStream and Rogers Communications — Residential Conservation and Energy Management (REM).

In this business model, energy infrastructure is owned and operated by Rogers, an unregulated communication company operating behind the meter. However, PowerStream is using the partnership strategically to improve its understanding of the impact of the model on its customers. For a significant uptake of the model, PowerStream has aligned its operation to be in the best possible scenario to manage significant decreases in load demand (PowerStream, 2015) (Ontario Ministry of Energy , 2015).

This model aggregated assets. In this case, PowerStream and Rogers work together to get program participants to reduce their electricity demand. The savings are aggregated from all program participants to create large savings for PowerStream. This model bundles services, because now the utility is not only offering electricity. It is, along with Rogers, offering an advanced energy system that is a tool that can enable demand response and energy conservation. These are two new services. This model collaborates with new entrants because the utility has partnered with Rogers, who is responsible for selling the advanced energy system. The advanced energy system is an example of infrastructure maintenance because the system is providing the grid with information detailing what is happening behind the meter. This model increases flexibility because the advanced energy system can communicate with the grid and change the load of the buildings to accommodate needs on the grid, thus making the grid more flexible. This model meets the resilience metric because the advanced energy management can communicate with the grid and respond accordingly to power outages and grid failures. PowerStream is owned by a handful of municipalities in southern Ontario. Its financial stability is not viable at this moment because the program is funded through the smart grid fund.

Case Study 2: PowerStream and Sunverge — Virtual Powerplant— Power House

This model is a good example of a regulated entity providing new services to customers behind the meter. This model aggregates assets by aggregating storage capacity and solar generation capacity to meet supply and demands on the grid. This model bundles services by bundling storage and solar generation and advanced metering. The services are included as a package with the companies' regular service of electricity consumption. Furthermore, each component in the bundle works together to reduce the customers' electricity bills. This model improves the infrastructure by having demand response capability. This model also increases grid flexibility and resilience by having the capacity to island from the central grid and it can leverage DER assets to support the central grid by smoothing supply and demand.

This model is the closest to the SOTG model because it integrates sustainable energy technology and it offers a variety of new services to customers. The model creates a greater probability for the LDC to earn enough revenue from the new service to maintain the grid infrastructure. However, upon close analysis, it is evident that the financial sustainability of the model is unclear. Since the Conservation Fund funds the project, it is unclear if the cost to develop and service a virtual power is less than the revenue made on the model. As a pilot project, PowerStream is testing the benefits of this model for the customers and it is determining if it is feasible to have this model at a larger scale. The revenue stream is complex and indirect. PowerStream can charge for solar generation and storage services through the installation, maintenance and ownership of equipment. In addition, PowerStream can make money off of this service model by aggregating the supply and demand from the Virtual Power Plant to smooth the demand on the central grid, in addition to offsetting the development of larger generation. Therefore, the direct revenue source for this pilot project is unclear, but it has a lot of potential.

If this model becomes commercial, it would address the disruption of BTM activities. This business model is essential to overcoming the “disruption”. This model is best suited for utility business model transformation and it complements the SOTG model quite well. It advances SET, and it does not reinforce the “sales incentive”. It also has the potential to earn enough revenue so that the LDC can thrive in a scenario of decreased load demand.

Case Study 3: Hydro One (Previously Woodstock Hydro) — Woodstock White Lane Smart MicroGRID.

The Woodstock microgrid project is able to aggregate assets. This project applies solar generation and battery storage to aggregate energy savings and generation. Furthermore, this project implements the concept of Power Matching by matching customers loads with renewable energy generation and energy storage technologies, and making customers loads, as well as eliminating their demand for the central grid load demand (Heaman, 2015). A new service is being offered that has no clear bundling of storage and generation for customers, but it matches their load with DERs. This project collaborates with new entrants on the grid. In particular, this project has partnered with eCAMION, a turnkey solution provider for community energy storage, including microgrids (Ministry of Energy, 2015). This company provides some infrastructure improvement because it had integrated customer enhanced load-monitoring devices, making it easier to initiate aggregation functions. This model increases flexibility and resilience of the grid through the ability of the microgrid to island from the central grid. Moreover, the Power Matching reduces demand, which decreases pressure on the central grid, making it more flexible resilient. This is especially the case during peak demand periods. The Woodstock Microgrid project is owned by Hydro-One. Hydro-One is 40% owned by the Ontario provincial government and 60% owned by private shareholders. Therefore, a local municipality does not own the project (Shane, 2016). In regards to financial sustainability, similar to the previous two case studies, Woodstock Microgrid project is funded by the Smart Grid fund. It is unclear if the cost to develop, maintain and provide Power Matching services is greater than the savings and revenue generated by this project.

This project reflects a potential capability or service that the SOTG model could adopt — Power Matching. However, the SOTG is not limited to just this service.

Case Study 4: Oakville Enterprises Corporation Sandpiper Generation — Geo-exchange.

The Geo-exchange project does not aggregate assets because each geo-exchange unit is an isolated unit that provides autonomous energy to the customer (Savel, 2014). This project does bundled services by offering heating and cooling services, as well as electricity services. This project does not collaborate with new entrants. Oakville Enterprises Corporation operates from Sandpiper Generation which is a unregulated company affiliate. This project does not improve the grid infrastructure to facilitate aggregation because each geo-exchange unit operates in isolation from the central grid. This project indirectly increases flexibility and resilience of the grid. Furthermore, since the geo-exchange autonomous units collectively can decrease the local demand for electricity, this results in an increase in grid capacity. However, it is unclear if the geo-exchange units are having a large enough impact to reduce the need to build a large power plant.

This model is the only case study that operates behind the meter and clearly demonstrates revenue sustainability. It is import to note that this model is owned and operated by an unregulated utility affiliate, but is still owned by the municipality of Oakville. This model is successful commercially (Savel, 2014).

Case Study 5: Erth Corporation

This project does to some extent aggregate renewable energy assets to create a financially stable revenue stream, but it does so with a smaller number of large-scale projects. This project bundles services because the utility is now offering large-scale renewable energy development for customers that own large properties, in addition to metering services and general electricity consumption. This project increases infrastructure maintenance and improvement to the grid because at every point where a large-scale renewable energy project enters the grid the utility updates the grid infrastructure to allow for a two-way electricity flow. This project increases the flexibility and resilience of the grid because it is adding solar and wind energy to the grid, which are both flexible and resilient forms of energy generation.

This is an unregulated utility affiliate that is owned by a group of local municipalities and it is fully commercial (ERTH Corperation, 2016). Therefore, this project is financially sustainable. This model is not uncommon in the LDC space. It reflects the innovation of the utilities not wanting to “miss the boat” on commercializing the integration of renewable energy onto the grid. The business model does not address the disruption occurring behind the meter. If there is significant load defection on the grid due to BTM developments, this business model does not address this LDC concern. It does, however, advance a sustainable energy transition.

Case Study 6: Sault Ste. Marie Public Utility Commission (SSM PUC) — Utility Distributed Microgrid

This project similar to the PowerStream’s Virtual Power Plant Project, meets all but one criterion: financial sustainability. It is very important to note that this model is still in the preliminary stages and exists only as a proposal. It is unclear if the SSM will adopt the proposed model. Uncertain economic benefits for the municipality have caused the city to postpone the preceding of the UDM proposal (Wood, 2016). Since then, an RFP has been issued to determine the socio-economic and environmental benefits of the project. With the proposal being on the table for 2 years, the city may not proceed with the project at all, or it may only adopt some aspects of the model if the business case can be made. Moreover, if the risks are low, the project will move forward in its entirety. The potential of a utility distributed microgrid is vast. Thus, the city has many options on how to move forward on specific features of the microgrid. A microgrid is a mini grid with many applications; therefore there is lots of room for growth, where aspects of the grid can be developed over time. This model would reflect a major leap in utility business model transformation.

The goals and objectives of SSM PUC Smart Energy Strategy reflect aspirations for the utility business model (Parker, Felder, & Molinaro, 2013). Yet in practice the vast challenges of this transformation and the utility's conservativeness have resulted halting the project. It has become necessary to re-examine the business case for reasons for this decision. In addition, the revenue model, here, is unclear. The ability to commercialize is indirect, complex, and multifaceted. With a microgrid, there are many applications, so determining the priories is essential.

This project is able to aggregate assets and bundle services because of the basic capabilities of a microgrid. In addition, this project has collaborated with two new entrants, Energizing Co. and the Sault Ste. Marie Innovation Center. These two new partners support the SSM PUC with finances, as well as strategic planning and implantation of the project. The first phase of the project has focused on infrastructure improvement on the grid so that the integration of microgrid technology would be smooth in the future (Della-Mattia, 2015). If the microgrid is implemented, the grid has the capacity to island itself from the central grid and power itself with 100% renewable resources (Wood, 2016). Due to the basic capabilities of a utility distributed microgrid, flexibility and resilience are inherent features of the overall system.

Case Study 7: Markham District Energy System — DE and CHP

The DED and CHP is not a new utility business model. DE and CHP is a very common practice across the Scandinavian countries in Europe. This model does not do to well in terms of SET because it relies on natural gas. However, there is capacity to use biofuel instead of natural gas (Heath & Ander, 2013).

This model does not aggregate assets because the DE and CHP plant is a system that is isolated from the central grid. However, the savings stemming from customers using the CE CHP system and not the central grid can be aggregated into earnings. This project does bundle services. Similarly to the geo-exchange, the project offers heating and cooling services along with electricity. This project does not collaborate with new entrants as the project is solely owned and operated by the City of Markham. Furthermore, there is no direct infrastructure improvement to the central grid because the DE and CHP system operates in isolation from the central grid. Indirectly, there is an increase in flexibility and resilience because a significant portion of the City of Markham's energy demand is reduced, thus increasing capacity on the central grid.

This model is fully commercial and operated within the regulatory framework. In addition, the local municipality publically owns it. Its customers receive heating, cooling and electricity at a very competitive rate and the utility is able to earn a long-term stable return on investment (Heath & Ander, 2013). This model does not directly deal with BTM disruption; however it does reduce the incentive for its customers to engage with BTM activities because it provides power at such competitive rates.

5.6 EVALUATION SYNOPSIS OF INSIGHTS OF BUSINESS MODELS

***Innovation in Ontario's LDC sector*:** All seven case studies demonstrate some form utility innovation. The fact that each evaluated LDC is exploring the application of DER and ICTs reflects that there is a common understanding that the electricity sector is changing in the 21st century. These LDCs recognize that the conventional utility business model is being challenged by the disruption occurring behind the meter and they recognize the urgency for LDC innovation in the sector. Each business model uses smart meters and takes the grid one step closer to becoming a smart grid. The changing energy paradigm of the twenty first century is coming up fast and the following reviewed utilities and business models reflect a willingness of LDCs in Ontario to be part of this transition. Thus, these utilities represent innovation in the local distribution sector.

Large Rate Base and Innovation: Upon analysis, it has become apparent that each reviewed LDC has a large rate base relative to the majority of LDCs. PowerStream, Hydro One (Woodstock Hydro), and Erth Corporation have all have participated in mergers and amalgamations of smaller LDCs. Moreover, they consist of a collection of municipalities, where each LDC contributes to a large rate base. In regards to Oakville Enterprises, SSM PUC and Markham DES, each of these companies also have a large rate base. To provide some context, LDCs with a small rate base account for over a third of all the LDC in Ontario, but have less than 4% of the province's electricity customers (Ontario Ministry of Energy , 2015). This common thread has become apparent through the analysis of the evaluation of LDCs. Although a large rate base has not been chosen as an evaluation metric, it is a factor worth noting.

Having a large rate base may contribute to innovation. A large rate base means that there are greater economies of scale and more internal efficiencies that can be made, creating more capacity within the LDC to focus on innovation (Pricewaterhouse Coopers LLP, 2015). In addition, a large rate base could mean that there is greater variance in the customers' demands and expectations for sustainable energy and user experience. Greater variance in customers' expectations for LDCs, may contribute to increased demand for utility innovation. A larger rate base might also allow the LDCs to have greater influence or to receive more resources for innovation from regulating bodies (Henderson, 2015). A large rate base was a trend that was not considered in the sampling of case studies; however it may suggest that larger utilities are more likely to engage in innovation in the sector. Within Ontario, a large rate base may be an important ingredient in utility innovation.

***Financial Sustainability and Regulated LDCs*:**

Financial viability was a major unresolved factor for the business models that operated in the regulated environment and were still in pilot project stages. Within the sample of case studies evaluated there are mixtures of business models that operate in the regulated and unregulated environment. Out of seven emergent business models, there were four that operated in the regulated LDC system. The two PowerStream projects, HydroOne microgrid, SSM PUC microgrid and Markham DES existed within a regulated LDC environment. These case studies reflect many of the core elements of the SOTG model. However, none of the case studies, except for Markham, were commercialized. PowerStream's Residential Energy Management pilot and Virtual Power Plant pilot, as well as Woodstock Hydro's Microgrid and SSM PUC Utility Distributed Microgrid had showed no evidence that proved that the cost to produce the new product or service was less than the revenues that could be generated. These projects are pilot projects that demonstrate proof of concept, but they do not appear to have financial sustainability.

The two PowerStream projects and Hydro Microgrid projects were funded by the IESO through the smart grid fund or conservation fund. The SSM PUC project was funded through multiple sources including the smart grid fund, a private company, and the municipality (Della-Mattia, 2014). The rate base did not pay for the regulated pilot projects. The knowledge gap related to commercialization may reflect the necessity of financial support from government institutions. The Smart Grid Fund and Conservation Fund were necessary for the development of the pilot projects. This group of LDCs are driving innovation in the sector are dependent on outside funding. These case studies demonstrate proof of concept and lay the groundwork for commercialization but without government funding, the innovation will likely not occur.

In the future, there is a possibility that these projects can become economically viable. Around the world utilities providing BTM products and services are still very new.

Therefore, the commercialization of these projects would set precedence in the industry on a global scale. If and when these pilot projects become commercial and are paid for by the rate base, this will represent a transformation of the Ontario Utility business model. The current status of the programs as pilots represents the beginnings of Utility Business model innovation.

Markham's DE and CHP project is unique from the other case studies mentioned because it is regulated and paid for by the city's rate base, which is connected to the district's energy system. However, in the initial phases of the project's development, Markham received a low interest infrastructure Ontario loan. In addition, there is regulatory flexibility to encourage municipalities to consider developing DE and CHP systems (Gilmour & Warren, 2008). Therefore, initial funding support was required to get this project up and running. Markham is the only case study of the seven that have been evaluated that is commercial and operates in the regulated environment. Markham's DE and CHP do not integrate DER, but they are still worthy examples of profitable municipal ownership over a decentralized energy system.

Financial Sustainability of Unregulated LDC Projects:

In contrast, there were three evaluated business models that existed as unregulated LDC affiliates. They compete with other *behind the meter* companies for the same market share. All three of the unregulated evaluated business models were fully commercial. For many LDCs, this landscape is much easier to operate in. The unregulated affiliates do not need permission from the regulatory bodies to offer new products and services (BTM) to their customers. However, a clear distinction must be made. Any initiatives that operate under the unregulated body cannot use the rate base to cover their expenses. Unregulated LDC affiliates must devise alternative ways to earn capital investment for their projects, similar to any other business that does not operate in a regulated natural monopoly environment.

The trends of unregulated utility affiliates are beginning to emerge in Ontario. Unregulated LDCs are a very common business model used in the United States. In Canada, the electricity sector is predominantly regulated. All unregulated LDC affiliates operate BTM, so they operate beyond the limits of the provincial regulator. There has been little evidence of their impact on the provincial regulatory system. Moreover, unregulated LDC affiliates have yet to make a significant impact on the regulated side of the utilities' business operations. Most commonly, unregulated LDC affiliates are siloed from traditional LDC operations. Unregulated LDC affiliates are becoming more common as new products and services are developed by BTM. This trend is important to recognize as the electricity system transforms into the smart gird.

As a result of the complexity within the regulated and unregulated LDC operations, BTM and on the grid, the provincial regulators are tasked with the difficult challenge of maintaining a level playing field for electricity providers, as well as keeping electricity prices as low as possible for the customer. In Ontario and the rest of Canada, fair price for electricity is a key policy objective for the Canadian regulatory bodies. In order to keep rates from increasing beyond “fair” levels, the government regulates them. Large adoption of BTM technology where no regulation exists has created a complex environment that is capable of undermining the regulatory regime. As sustainable electricity becomes more common, the tension between LDCs that are regulated and unregulated operations will become more prominent.

The smart grid fund and conservation fund operated by the provincial regulatory body has created an overlap between regulated LDCs and their corresponding projects with BTM initiatives; a space that is not regulated. This overlap is an interesting frontier for LDCs. The next step for these regulatory funding bodies is to fund the integration and commercialization of these pilots on a larger scale so that the whole rate base can receive the benefits of SET. How they will accomplish this task is currently not known to the sector in Ontario, as well as globally in developed countries. This is why research utility business innovation is relevant.

Chapter 6: LDC Business Model Innovation to SET

In Chapter 5 the seven case studies were introduced, evaluated, results summarized and analyses of the results were provided. Economic viability was difficult to determine for projects that were not at a commercial stage and operated within the regulated system.

Lastly, overarching themes of large rate base and regulated and unregulated LDC business models were discussed with respect to the seven evaluated case studies.

Chapter 6 moves away from direct discussion regarding the seven case studies reviewed and moves into a higher-level discussion of the implications associated with LDCs' innovation of BTM.

6.1 Unpacking the Research Question: Is there a viable model?

Referring to the initial research question: *Is there a viable business model that doesn't reduce incentives for behind the meter developments and still allows LDCs to maintain the grid infrastructure under the scenario of decreased load demand?*

This is a difficult question to answer. BTM developments need to reduce customers' electricity bills in order to have an economic incentive to develop BTM infrastructure. In most cases BTM developments benefit the customer, but they indirectly raise the cost of operations for LDCs. BTM developments increase the cost of maintaining the grid infrastructure while reducing the load demand of customers and the revenue earned from selling electricity, thus reducing the LDCs' ability to maintain grid infrastructure. The LDCs' inability to afford the cost of maintaining the grid creates a scenario of unreliable electricity.

To the latter part of this research question, in order to maintain grid infrastructure the BTM business model needs to be in commercial operation funded by the rate base.

Currently in Ontario, there are no BTM business models that are commercial, supported by the rate base and operating within the regulated electricity system. Ontario LDCs are restricted from this market. Within the regulatory regime, LDCs are tightly managed to distribute electricity to their customers at a regulated rate while earning a modest return on investment over a long payback period. The seven case studies explored in this paper represent an attempt by LDCs and regulators to experiment with DER, ICT and BTM technologies. This is a step in the right direction for the integration of thw grid and a SET. However, there are still many challenges relating to how LDCs can integrate BTM while still maintaining the grid infrastructure.

Exploring new business models requires customer research, marketing, and customer services— all typical business start-up elements that LDCs are restricted from implementing because the cost of doing this does not directly benefit the rate base (Henderson, 2015). It is a widely held assumption that applying BTM business models within a regulated regime would raise the price of electricity. This is likely true, at least in the short term. Costs are expected to drop as adoption increases. BTM utility focused business models have the potential to be more cost effective than the conventional utility model, but the transition period to a decentralized system from a centralized system will cost LDCs (Fox-Penner, 2010) (Lovins, 2011). This may not be an investment that LDCs or regulators are prepared to take on. Therefore, restrictive regulations limit the LDC BTM business model innovation in Ontario, restricting new revenue streams that could potentially allow LDCs to earn enough revenue to maintain the grid under a scenario of decreased load demand.

The conundrum is that BTM developments are capable of delivering a SET, but the transition to this model will impose costs on LDCs and the cost recovery is outside the limits of the regulatory regime. The benefits of a SET are not direct and immediate. Therefore, under the current regime, LDCs cannot justify the expenses associated with exploring business models for BTM developments. Therefore, the answer to the proposed research questions is still unknown.

Although LDC business model innovation is taking place, the solution is still unknown. If PowerStream's Residential Energy Management pilot and Virtual Power Plant, Microgrid for Woodstock Hydro and SSM PUC Utility Distributed Microgrid are successful in achieving a commercial scale, these models will represent examples of a viable business models for LDCs BTM. These four models reflect almost all of the key elements of the SOTG model. However, under the current rate structure there is limited capacity for these models to be financially sustainable. Innovation with respect to the Ontario LDC rate structure is an area that requires future research.

Beyond the regulated LDC pilot projects reviewed, the unregulated projects that were reviewed play a dynamic role in business model innovation. The unregulated LDC affiliates are offering services that exist outside the regulatory boundary. From the sidelines unregulated LDC affiliates can create business models that could potentially be transferred to the regulated side of business. Therefore, it is beneficial for regulated and unregulated LDCs to continue to explore options in integrating DER and BTM developments.

6.2 How does price of electricity affect BTM & The Implications of Fixed Electricity pricing:

LDCs require new business models that permit LDCs to benefit from SETs. Many LDCs view BTM developments as a serious threat that can erode their business model. This threat has caused several LDCs to petition to the OEB for the price of electricity to reflect a fixed rate. A fixed rate would resolve the problem revenue loss due to reduced load demand. Instead of customers paying per electron, they would pay a fixed price for the use of the grid. A fixed price would ensure that LDCs cover their costs to maintain the grid, but it would come with unintended consequences. If the OEB were to accept the fixed rate for a grid connection, this would reduce the customers' incentives for CDM and BTM. There would be no difference in customers' electricity bills if they reduced their demand or not. Therefore DER and energy conservation and efficiency, the key components of a SET, would be undermined.

Moreover, a fixed price for electricity could encourage increased load defection among LDC customers. If customers were paying a high fixed price for electricity and it became cheaper for customers to have their own generation and storage, there is a likelihood that customers would opt out of the grid and rely on their own autonomous energy systems. This could produce a shrinking rate base, causing further increases to the electricity rate, which could lead to more defections. This concept was discussed in Chapter 3 and it is referred to as the *utility death spiral*.

Although dramatic load defection is not foreseen in the immediate future, the rate of innovation in the sustainable energy space has been rapidly increasing (Gang, 2013). SET and BTM developments are trends that are growing and cannot be ignored. A fixed rate for electricity access is not complementary to a SET and behind the meter developments. Therefore, there is a need for LDCs to have new business models that allow LDCs to benefit from the integration of sustainable electricity.

6.3 Ontario Electricity Sector —Niche development:

With no clear LDC business model that is financially sustainable and operating in the regulated space that integrates BTM, combined with pressure from the sector to adopt a fixed rate for electricity, Ontario is up for a significant challenge to integrate a SET. However, Ontario remains a hub for utility business model innovation. In Ontario we have roughly 70 LDCs that largely distribute electricity but also have assets in generation and transmission (IESO, 2015). Ontario has risen as a leader in integrating smart grid components, proving Ontario with a dynamic electricity system that fosters innovation.

Smart grid adoption in Ontario illustrates a key concept from the socio-technical institutional transformation theoretical framework - niche development.

The Ontario ecosystem of electricity stakeholders includes 70 LDCs, Ontario Energy Board (OEB), Ontario's Independent Electricity System Operator (IESO), Ministry of

Energy and Ontario Power Generation (OPG) and Hydro One. This complex institutional landscape has created a niche were smart grid innovation has occurred. The smart grid fund, smart grid forum and conservation fund are prime examples of an intersecting space that has facilitated niche development to occur. These funds are enabling LDCs to experiment with emerging technologies to determine the best ways of integrating them into the system (Winfield & Weiler, 2016). Niches emerge where actors engage in new practices and proactively deviate from regime rules and routines. Emerging transitions begin in niche developments (Geels & Schot, 2007). The intersections between Ontario's electricity stakeholders have created an environment for niche developments to occur (Winfield & Weiler, 2016).

Due to the space created in the Ontario electricity system for niche development, the business models reviewed have been able to integrate components of the smart grid. As these case studies evolve and more emerge, there is a fertile environment for these niche developments to eventually impact the regime and transform the status quo. However, for new rules and routines of sustainability to become part of Ontario electricity regime, individual and widespread learning processes are essential (Geels & Schot, 2007). Therefore, it will take the whole ecosystem to support the niche developments into maturity so that they can influence and shape the system into a SET.

6.4 Challenges Integrating The Steward of the Grid Utility Business Model:

Within the seven business models evaluated, there is no clear business model that is likely to be the first to be financially sustainable. In essence, there are multiple variations of utility business models that build off of each other, overlap and are changing as the applications with DER and ICTs evolve and grow. Innovative Ontario LDCs are not putting all of their eggs in one basket, but rather exploring several options. This trend is seen in other developed countries. In many regions where sustainable energy is flourishing, such as in North America and in Europe, the utility and electricity system structure varies (Accenture, 2016). SET and BTM developments continue to threaten utility business models across the board but with different electricity ecosystems these models remain a grey area of mixed approaches.

The SOTG is a possible evolution of the mixed bag of utility business model innovations. The steward of the grid model can own, operate and maintain infrastructure BTM. This model creates synergy between the grid and behind the meter (Fox-Penner, 2010). However, there are significant challenges to this model that require further research.

Sales Incentives & New Rate Structures: The SOTG model can be integrated by addressing the sales incentive issues by adopting a new rate structure. The removal of the sales incentive is fundamental to the SOTG model. In addition, a new rate structure is required to enable LDCs to earn revenues through the process of grid management. LDCs can begin to resolve this through dynamic pricing and a revised rate structure that helps customers save energy and allows LDCs to profit from providing services for grid coordination. Emerging models for rate structure and dynamic pricing that reflect the cost of integrating many DERs and BTM assets are essential, and require further research. This research should attempt to resolve the sales incentive at the same time.

Creating synergy between regulated and unregulated markets: This is a significant challenge the SOTG model would need to overcome especially in the wholesale electricity market. This model also should remain open for new entrants onto the grid. Therefore, LDCs using the SOTG model will have to integrate BTM assets even if they are not their own. Complementary regulation and universal dynamic pricing for all forms of generation and storage can help to ease this tension (Fox-Penner, 2010).

Keeping the Grid Open:

Achieving the transition to an electricity system largely dependent on renewable and distributed resources, and with far greater end-use efficiency require changes in provincial regulations to let LDCs embrace new ways of doing business (Lovins, 2011). Regulators must determine which applications and providers will be allowed onto the LDCs' grid controlled areas, the associated network platform, as well as BTM. The ability for the regulators to deal with the integration of new entrants on the grid will be a challenge, but is required to advance a smart grid and SET. The regulator can begin by encouraging electricity stakeholders to increase demand for DER and BTM developments using incentive based policies, reducing overall demand and incentives for the centralized grid (Fox-Penner, 2010).

Policies that keep the grid open so that new entrants can enter the market will drive innovation (Fox-Penner, 2010). Private deregulated companies will seek out the BTM market, and have already done so. This third party competition encourages LDCs to compete for this market share. This process has and will continue to spur innovation in the sector. Regulators must work with LDCs and third party energy companies to keep the grid open so that new entrants can enter the market. An open grid does not privilege the LDCs. Therefore, the LDC will need to learn to be more competitive than they have been in the past because they will not have a natural monopoly.

It is unclear what specific policies the regulators will need to adopt in order to make the playing field fair for new entrants while also allowing LDCs to use the rate base to intergrade BTM developments. LDCs will have to leverage their pre-existing advantages to remain competitive. This process may ignite the SET. Utilities are predisposed to being champions and catalysts for SETs, but this process will require hard work. Not every utility will be up for this challenge.

PowerStream's Virtual Power Plant (VPPS) is the best example of a SOTG business model. The Virtual Power plant allows the utility to manage an increasingly complex grid. It addresses concerns of rising prices, demand response and DER for load reduction. The innovation occurring in the Ontario LDC sector is exciting. Accelerating this momentum is crucial to advance SETs.

6.5 Innovation to Transformation

The best place for LDCs and regulators to advance innovation from pilot projects and unregulated company affiliates to a Sustainable Energy Transition are in the Conservation and Demand Management and Energy Efficiency programs that LDCs offer. Utilities need to pilot new ways to profit from CDM and EE (Fox-Penner, 2010). The smart grid and conservation fund should be framed to address the "Sales Incentive Problem".

In Ontario, the regulator mandates CDM and EE initiatives. Currently, CDM and EE LDC programs reflect a "compliance mindset" and are often one-off pilot projects and small programs that have a limited impact on electricity demand and the consumption behavior of electricity customers. LDCs get an order from regulators that they need to save "x" amount of electricity. Next, the LDC prepares detailed plans for a rebate program, measured savings, and budget. Then the regulators must approve the plan and budget, and eventually the program begins. This lengthy cycle of heavy over-sight makes LDC CDM and EE efforts slow-moving and highly risk-averse, and result in small one-off savings for certain customer segments. This method of answering to mandates is not effective in achieving significant demand reductions (Fox-Penner, 2010).

In order to move LDCs CDM and EE programs away from pilot projects and slow-moving marginal energy saving programs into commercialization, LDCs need to work with regulators to provide fair but genuine profit incentives for achieving high levels of customer energy savings. Utilities will find much more efficient ways to reduce consumption if they can make reasonable profits off EE and CDM initiatives. In some places in the United States, regulators treat expenditures on EE program, once savings are proven, essentially the same way they treat expenditures on new power plants— both are capital outlays on which the utility earns a profit. In some cases, some regulators add a premium on EE investments (Fox-Penner, 2010)

If LDC business model innovation can evolve from innovation to commercialization, transformation can occur. The commercialization of CDM and EE is the first step in reversing the "Sales Incentive". Advancing the commercialization of CDM and EE efforts can be enabled by the expansion of funding for research and development of new CDM and EE products and services. Specific market development policies that leverage strategic niches are also useful to fueling innovation in the traditionally conservative LDC sector (Geels & Schot, 2007). Lastly, committing to long-term outcome-based targets and financial incentives such a capital subsidies, and tax credits for CDM and EE programs can provide long-term stability for LDC planning and decrease the risk for LDC investments in CDM and EE initiatives (Fox-Penner, 2010).

The mission for utilities 100 Years ago was to ensure universal access to electricity. With that mission accomplished, the industry's mission for the 21st century is to go beyond the meter to provide universal access to clean energy that is used efficiently. This transformation can drive economic growth and preserve our environment, but requires new ways of thinking about utility business models. The mission for Ontario LDCs in this century is to redefine their boundaries—to go beyond the meter, creating new customer partnerships and providing universal access to clean and efficient energy (Fox-Penner, 2010).

There is no one-size-fits-all utility business model of the 21st century. Utility business models transformation will be different for many jurisdictions depending on local regulations, politics, economics and energy resources available. This is the frontier of sustainable energy integration and the race is still on.

Chapter 7: Conclusion

7.1 Summary of Chapters:

This research paper begins by describing the conventional utility model and discussing the institutional, economic and structural challenges to utility business model innovation. The sales incentive is the primary concern regarding utility business model innovation, due to perverse incentives to maximize the production and the selling of electricity. The chapter discusses the Changing Energy Paradigm of the 21st Century and the importance of Sustainable Energy Transitions enabled by Distributed Energy Resources (DER) and Information and Communication Technology (ITC) that occur Behind the Meter (BTM). Currently, SET is taking place in isolation to the conventional utility system, but with innovation to the utility business model SETs and LDCs can be complementary.

Following this, the chapter breaks down the impact of disruptive technology on the conventional system through DER, ITC and BTM developments as a "pulling force" of utility business model innovation. The impact of disruptive technology threatens utilities with load defection, grid defection, and ultimately a utility death spiral.

The research paper qualifies these discussion points in the context of Ontario's electricity system and it introduces the concept of Ontario's fixed electricity price. The meter is described, as the boundary of regulation and it has been an active place for disruptive energy players. The research paper reaffirms that DER and ITC resulting in BTM developments are transforming the grid from a centralized system to a dynamic decentralized system that represent a SET. The changing energy paradigm disrupts and threatens the conventional electricity business model that is operated by Local Distribution Companies in Ontario.

In the second chapter the methodology is used in this paper is discussed, detailing the Ontario LDC landscape as the research focus area. Sustainable Energy Transitions, Socio-Technical Institutional Transformation within a multi-level perspective, Evolution and Revolution of the Adopting of the Smart Grid Technology are the theoretical frameworks used to inform the normative framework and evaluation criteria in this research paper. The normative framework is used as an ideal standard of LDC operation in the 21st century. The evaluation criteria is an expression of the normative framework that goes one step further and frames a potential business model called the Steward of the

Grid (SOTG). The SOTG shadows the normative framework and offers direct success metrics that are the evaluation criteria. Lastly, the seven case studies are chosen using a qualitative research design called Purposive Sampling method. This chapter concludes by offering a visual overview of the research structure.

Following the methodology, the research paper begins by explaining that LDCs are well positioned to champion a SET. LDCs are community assets that have existing customers, and own and operate existing infrastructure. This part of the chapter is followed by a SWAT analysis that summarizes the "push" and "pull" factors that prompt LDC business model innovation. This is followed by a table that provides a high-level overview of what an emerging LDC business model would look like, including characteristics such as active customers, decentralized grid, and small-scale projects matched to end-use demand. This section of the paper concludes by introducing the research question "*Is there a viable business model that does not reduce the incentives of behind the meter developments and still allows LDCs to maintain the grid infrastructure under the scenario of decreased load demand?"*

After introducing the research question this research paper identifies that the path forward for LDCs in the 21st century is unclear. However, it also indicates there are several LDCs in Ontario that are experimenting with sustainable energy technology and that new business models are beginning to emerge. The chapter then goes on to outline the normative framework that embodies characteristics of a "Utility of the Future". The normative framework consists of Reinventing Fire Principles, Resilience and Adaptive Capacity, as well as Customer Side and Utility Side business models. After explaining why these three normative frames provide a foundational structure for an ideal utility business model, the chapter then presents the SOTG model in greater detail, outlying how LDCs can reverse the sales incentive by charging for the coordination of the grid rather than the consumption of electricity. This segment concludes by introducing and discussing the key components of the SOTG model that become metrics for the evaluation criteria.

Succeeding the evaluation criteria is an overview of the emerging LDC business models in Ontario. A table that explains the funding sources for the evaluated business models. A table of the regulatory status of each evaluated business model follows this. It is significant to note that four of the seven business models operate in the regulatory space but are pilot projects that have received outside funding from the Smart Grid Fund and the Conservation Fund. There is only one business model that operates in the regulated environment and is commercially viable; this is Markham's DES and CHP. The other two business models operate in the unregulated environment and are financial sustainable. In the middle of the chapter, the seven case studies are evaluated according to the SOTG criteria. For every case study, the business models meet most of the SOTG criteria. However, the four business models that exist in the regulatory system but are not financial sustainable align the most with the SOTG model. The chapter concludes by making the observation that a large rate base may contribute to an innovative environment for the LDCs. Lastly, the topic of financial sustainability for regulated and unregulated business models is discussed.

After discussing the analysis of the evaluated business models the research paper goes back to the research question by to unpacking the complex relationship between regulation and utility business model innovation. The answer to the research question is still unknown. However, if the four regulated business models become commercial, this would indicate a significant transformation in the Ontario electricity sector. The chapter moves on to discuss that a fixed rate structure for electricity consumption creates a negative incentive for customers to engage with BTM developments. Moreover, the imposed fixed rate may have an unintended consequence of load defection that could ultimately result in the utility death spiral. This section is followed by a discussion around niche development that has fostered innovation in Ontario's electricity sector. The chapter concludes by discussing challenges to the SOTG model. Most significantly, there is a need for a new rate structure in order to integrate the SOTG model. Furthermore, synergy between the regulated and unregulated markets and the grid must be kept open for new entrants that can advance SET. Lastly, the chapter argues that LDCs and regulatory bodies can transition from innovation to transformation by engaging in conservation and energy efficiency by making real profit incentives for LDCs.

7.2 Conclusion: Fixed Rate for Electricity Relative to the SOTG Model:

This paper will conclude by reaffirming the above-mentioned themes and discussion.

The policymakers who fashioned electric regulation in the 1920s and 1930s understood that they needed regulation that could transform society. Consequently, they designed regulation that would do what North America wanted: the largest, cheapest commodity power system possible. They accomplished this goal by ignoring most environmental constraints and by promoting energy efficiency. These goals remain, but they are now joined by a realization that the world's carbon budget is vastly overspent and our economic infrastructure was not designed for sustainability (Fox-Penner, 2010).

LDCs have good capital access, and they have the best platform for building a specialized, high-quality delivery system (Lovins, 2011). However, much of the Ontario electricity sector incumbents, such as large utility players and regulators, argue that a fixed rate for grid connection is the SOTG model. The OEB believes that the fixed rate design will:

1) Enable residential customers to leverage new technologies, manage cost through conservation and better understand the value of distribution service.
2) They believe it is a fairer way for LDCs to recover the cost of providing distribution services.
3) Lastly, they think it will provide greater revenue stability for distributors, which, will position them for technological change in the sector, moving any disincentive to promote conservation, and help with their investment planning (Ontario Energy Board, 2016).

This paper argues that the first statement is false, the second is debatable, and the last one is true. This paper does not support the view, which suggests that the fixed rate policy is conducive to leveraging new technologies, CDM and EE. This is because a fixed rate removes the economics incentive, and consequently the behavior that encourages DER, CDM, EE and BTM developments.

The fixed rate policy may be suitable for traditional passive customers, but is not suitable for active customers. It does not consider how customer's actions affect long-term costs of the system or allow any management of energy use to control distribution bills. This policy makes LDCs indifferent to increased penetrations of net-metered DERs, but it does not encourage DER investment (Ontario Energy Board, 2016). Fundamentally, a fixed rate for electricity removes incentives for a SET.

The implementation of a SOTG model that encourages a SET will likely require the regulatory bodies to allow LDCs to charge more for what they do. Increasing the price of electricity with adequate price signals that reflect the dynamic cost of generating and distributing electricity create an economic incentive for customers to engage in CDM, EE, DER and BTM developments (Augenstein & Palzkill, 2015). In addition, the SOTG model proposed in this paper also suggests that the regulatory bodies should allow LDCs to experiment with new business activities. Allowing the LDCs to take their pilot projects to the next step of commercialization could be transformational for the industry. The LDCs are well-positioned to facilitate aggregation of DER and CDM assets. Moreover, the LDCs are suitably positioned to develop the generation of small-medium DER generation assets. Therefore, the proposed SOTG model in this paper is a viable business model concept that can be used as a preliminarily framework for future areas of research.

The grid is becoming more integrated with DER, thus the regulators and utilities are presented with significant changes to technical operations, business models and industry structure (Fox-Penner, 2010). The normative framework described in this paper outlines the goals and possibilities that the Ontario LDC have in integrating a SET. In order for LDCs to catalyze a SET, the concluding findings below can be used to guide the development of the SOTG model.

Below is a summary of conclusions.

- Change starts with Conservation and Energy Efficiency. Reversing the sales incentive by making conservation profitable for LDCs is fundamental to a SET. Further research into business models that create a profit incentive for CDM and EE is required.

- Continued development of Smart Grid innovation is needed. Creating space for niche development to occur is valuable for continued innovation in the sector. The Smart Grid forum is an example of this fostered space for innovation. The smart grid forum included member organizations from Ontario's utility sector, industry associations, public agencies, and universities working together to develop the smart grid in Ontario, this import work must continue (IESO, 2013).

- Continued research into regulation alternatives beyond the fixed rate that encourage innovation and sustainability, which meet users' needs while ensuring the development and maintenance of infrastructure. Regulation must ensuring that a level playing field exists for electricity service business models that align with the following policy goals:
    a. Assurance of reliability and quality of electricity supply
    b. Affordability of electrical services
    c. Encouragement of innovation and economic growth
    d. Integrations of clean energy technologies that lead to decarbonization (Augenstein & Palzkill, 2015)

- Further research into innovation regarding Ontario's rate structure is required. Price signals play a crucial role in shaping the interactions between the physical components of the distributed system and network users. Ontario needs to encourage research and pilot projects that develop new ways to charge for DER, BTM and CDM. The electric grid is rapidly evolving. Passive network of consumers are transitioning to a more actively managed system of network users with diverse consumption and production behaviors. Infrastructure is aging and requires new waves of investment to upgrade the system. Therefore, new rate designs are required to facilitate the changes in the system and encourage sustainability (Lovins, 2011) (Augenstein & Palzkill, 2015).

Ontario has a unique electricity ecosystem that is ready for innovation. Electricity rates are predicted to rise in the province and surplus of electricity is expected to decrease as aging nuclear reactors retire. When demand for electricity is greater than supply, DERs become more competitive. Therefore, with higher rates per kWh, consumers, regulators, and LDCs will be in an optimal position to encourage investment into DERs.

The path forward for many LDCs in Ontario is unclear. However, the reviewed case studies are an example of leadership in exploring and testing alternative business models. The analysis uncovered in the case studies reflects a larger narrative of LDCs adapting to the rapidly changing energy landscape. The following findings uncovered through the case study analysis can be generalized for the utility industry at large. This is a challenging moment for LDCs across Ontario and the developed world as pressure mounts from disruptive technology and infrastructure. Utilities will continue to face pressure to modernize their business models in order to adapt to the energy and sustainability demands of the 21st century. This research builds on current smart grid research in Ontario and can provide insight for LDCs that are interested in transforming their current business models to accelerate a SET.

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