100% Renewable Energy Cities

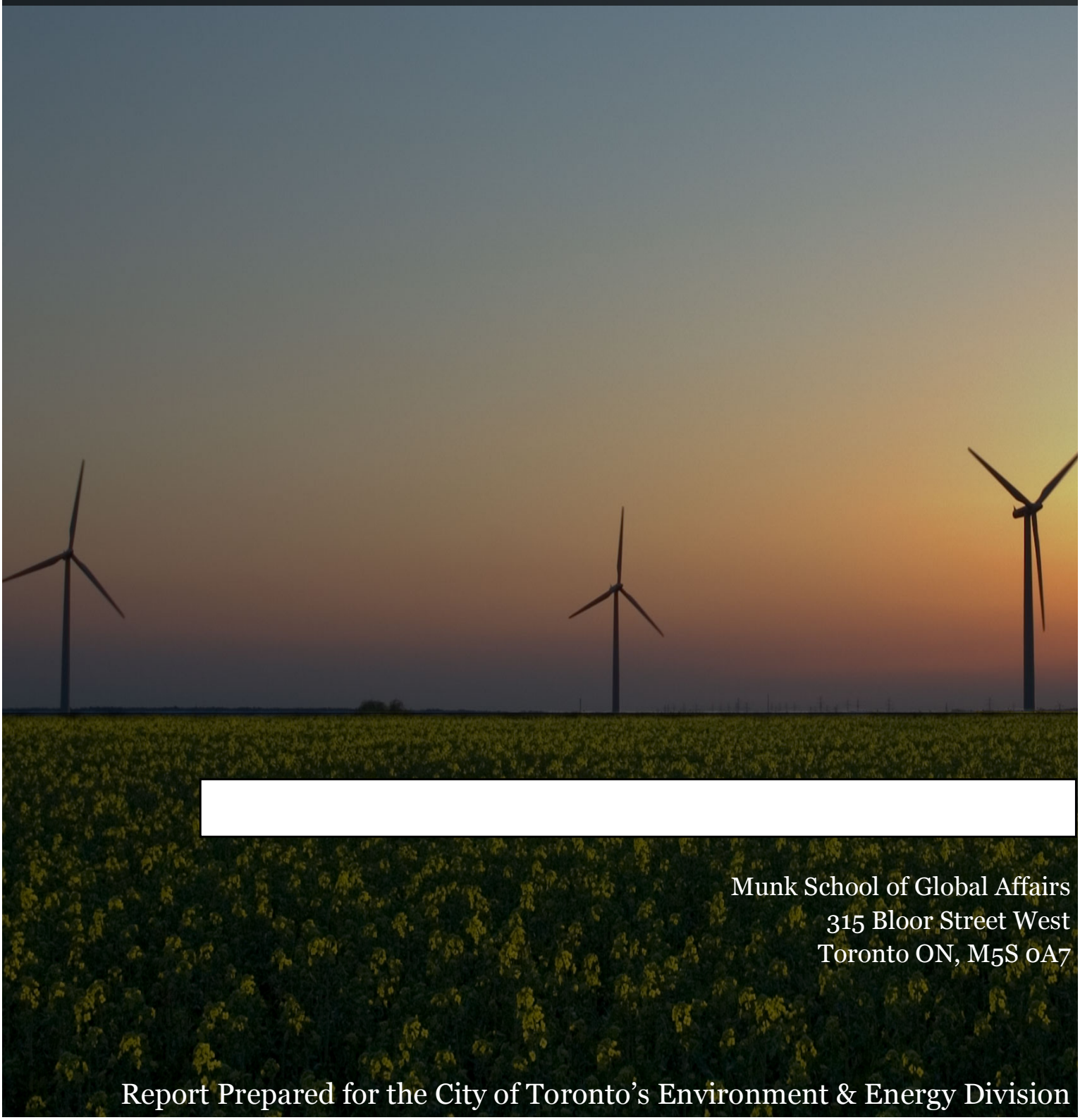

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Table of Contents

Executive Summary **1**

1. Why Renewable Energy **2**

1.1. Renewable Energy and the Energy Outlook in 2050 ..... **3**

1.1.1. Toronto 4

2. Project Outline **7**

3. Toronto's Renewable Energy Challenges and Opportunities **9**

3.1. Framing **10**

3.2. Leveraging Existing Resources **11**

3.3. Community Involvement **12**

3.4. Financing **14**

4. Recommendations and Conclusion **16**

4.1. Obtaining Granular Data **17**

4.2. Upgrading the Infrastructure **17**

4.3. Securing a Champion **17**

4.4. Conclusion **18**

5. Appendix **19**

5.1. Vancouver **20**

5.1.1. Policy 20

5.1.2. Challenges 21

5.1.3. Opportunities and Successes 21

5.2. New York **23**

5.2.1. Policy 23

5.2.2. Challenges 24

5.2.3. Opportunities and Successes 24

5.3. Munich **24**

5.3.1. Policy 24

5.3.2. Challenges 26

5.3.3. Opportunities and Successes 27

5.4. Copenhagen **28**

5.4.1. Policies 28

5.4.2. Challenges 30

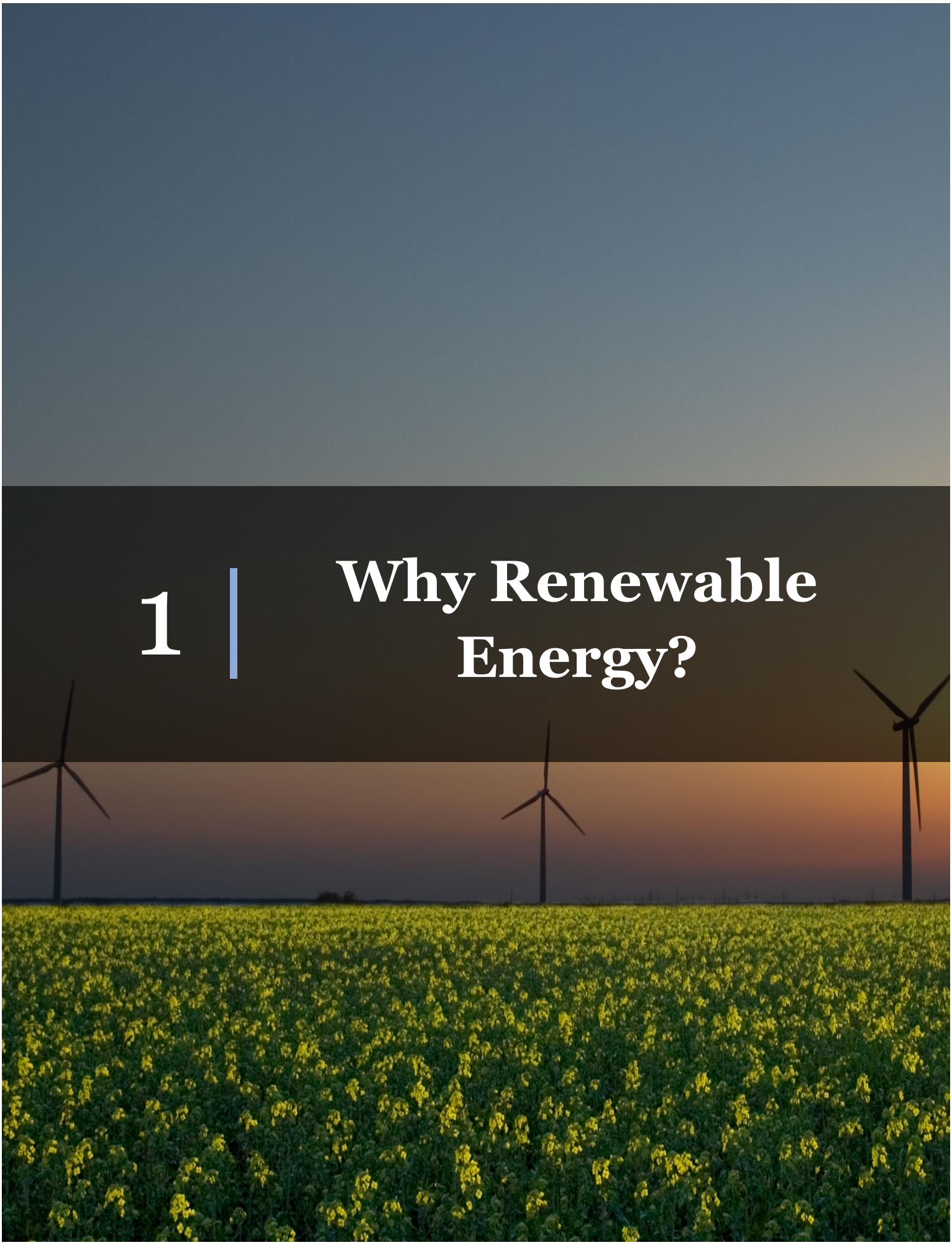
5.4.3. Opportunities and Successes 31

5.5. Oxford County – An Overview **32**

6. References **33**

Executive Summary

The City of Toronto is currently undertaking "Transform TO," a two-year initiative to identify the path towards achieving an 80% reduction in greenhouse gas (GHG) emissions by 2050 through engagement with businesses and residents. With climate change becoming a greater global threat, cities have been identified as major GHG emitters but also areas of great potential for action. As such, several cities around the world are looking to decrease their carbon outputs by making a transition to renewable energy sources, with some committing to 100% renewable energy. In this report, we examine this issue through a broad policy lens, looking into best practices and most effective approaches that could be taken in order to develop a similar strategy for the City of Toronto. This was completed via a comparative jurisdictional scan and benchmarking of other global cities that have made a 100% renewable energy commitment, or have otherwise developed significant new renewables or carbon-lowering initiatives. Our main sources of information were official city documents and interviews with major stakeholders involved in these transitions. Our research allowed us to identify four major challenges that are simultaneously areas of potential opportunity in this endeavor: framing, leveraging resources, community involvement, and financing. Finally, we identified three 'next steps' Toronto could take that would help ease a transition to 100% renewable energy. These include obtaining more granular data, upgrading infrastructure, and securing a champion.



1 | Why Renewable Energy?

1.1. Renewable Energy and the Energy Outlook in 2050

The energy landscape in 2050 will be very different from what we know today. Presently, at any given moment, the roughly 7.4 billion people on earth consume on average 14 terawatts (TW) of energy to fuel vehicles, provide heat, air conditioning, and lights for buildings and residences, and to power the industries that support our economies. Of that 14TW of energy, about 85% is derived from fossil fuels (Chandler, 2011). By 2050, the population will have risen to 9 billion people, global GDP will jump from $9,000 to $20,000 (US$ market exchange rate), and the number of cars on the road will increase by nearly 80% to 220 per 1000 people. The cumulative effect of these trends is a predicted doubling of energy demand (World Energy Council, 2013).

Without a change in the way we consume energy, the most conservative estimates of GHG emissions predict a 50% increase by 2050. The effect of such a rise in emissions would mean that atmospheric concentration of GHGs would reach 685 parts per million (ppm) which, according to baseline predictions, would lead to a global temperature rise of 3-6 degrees Celsius (OECD, 2011). Given the recent commitments made by national governments at the United Nations Climate Change Conference (COP21) in Paris to limit the global temperature increase to below 2 degrees Celsius, and more importantly, the devastating effects of a failure to do so (glacier melt, altered precipitation patterns, sea level rise, etc), finding a solution that meets energy demand while producing fewer GHGs is critical.

Our governments are facing an unprecedented challenge to reform our energy systems, and renewable energy (RE) - energy derived from naturally renewing sources like wind, rain, geothermal heat, and tides - presents a compelling possibility for reducing GHG emissions. With little or no GHG emissions, RE sources hold the potential to meet increasing energy demand without contributing to a rise in atmospheric concentration of GHG. The ability to power homes, businesses, industry, and transportation with RE exists, but requires a shift in human behaviour and agile coordination from all levels of government.

Favourable national policies are essential for regional and municipal actors to set ambitious goals and an overarching framework for energy reform. Policymakers have focused predominantly on the power sector. The most commonly used policy mechanisms for supporting RE are Feed-in Tariffs and Renewable Portfolio Standards (RPS) (see Box 1 for details). Feed-in policies have been enacted in 108 jurisdictions at the national or state/provincial level, while RPS policies are in place in 26 countries at the national level and in 72 states/ provinces. At the same time, the establishment of green banks and issuance of green bonds are becoming increasingly popular policy instruments to increase the share of RE (Renewable Energy Policy Network for the 21st Century [REN21], 2015, p. 7).

Cities must build on the groundwork set by national and regional governments to attain significant emissions reductions. Today, cities are home to 54% of the world's population and emit three quarters of the world's GHG emissions (Renewable Cities, 2015). In 2050, the population living in urban areas will increase by 2.5 billion, totaling 66% of the world's population (UN ECOSOC, 2014). Cities' energy policies therefore stand to have an outsized

environmental impact, and must become the focus of policymakers, civil society actors, and private sector leaders alike. Cities have in fact been identified as one of the most important actors in the fight against climate change. A paper published in the Journal of Cleaner Production outlined two main reasons for this: (1) urban areas in the developed world account for "more than 70% of energy-related global GHG emissions, from a production-based allocation viewpoint"; (2) "cities are the basic units for policies that have significant environmentally beneficial consequences" (Nevens, 2013). For these reasons, it is perhaps unsurprising that major shifts to RE have stemmed from municipal governments around the world. Naturally, the degree of support from other levels of government can help or hinder these efforts.

Box 1: National RE Policy Tools

Feed-in Tariff

Feed-in Tariff proved to become a successful policy instrument in promotion of renewable energy. FIT guarantees access to grid to all eligible projects and a fixed price for the electricity produced. Prices vary by technology. The long-term price guarantee - often from 8 to 15, but sometimes as many as 20–30 years - provides market stability and security for investors. Market demand for RE is ensured by obligating electricity utilities and/or grid operators to purchase it.

Renewable Portfolio Standards (RPS)

RPS is based on free-market approach to renewable energy. Unlike FIT, RPS stipulates only the amount of generation to be purchased but leaves the decision of source and price unregulated. RPS policies usually include a system of renewable energy credits (RECs). RECs can be bought and sold to help electricity providers meet their RPS obligations. Failure to meet these obligations leads to penalties.

In Canada, the recent federal budget demonstrates significant promise for the cleantech sector and municipal GHG reduction efforts. Most relevant to the urban context, it includes a financial commitment of $200 million over 5 years to aid municipal governments in addressing climate change and investing in green infrastructure. Furthermore, a small yet significant commitment of $2.5 million will go to Natural Resources Canada towards studying the potential of energy sharing between provinces. This is important given the federal government's broader commitment of over $1 billion dollars to support a partnership between provinces and territories, known as the Pan-Canadian Framework on Clean Growth and Climate Change (Canadian Ministry of Finance, 2016). Because of their potential impact, cities must develop policies that can integrate within the wider federal and provincial frameworks and at the same time utilize their own unique capabilities to reduce GHG emissions while meeting the inevitable increase in energy demand.

1.1.1. Toronto

The City of Toronto has been actively pursuing energy reduction and efficiency measures through a number of initiatives. Adopted in 2007, the "Climate Change, Clean Air and Sustainable Energy Action Plan" committed city facilities to energy efficiency targets. Subsequently, in 2009 the Council adopted Toronto's Sustainable Energy Strategy - 'The Power to Live Green'. The strategy focuses on a number of actions relating to retrofits, renewable

energy projects, smart grids and sustainable transport (City of Toronto, 2009). Both of these strategies articulated a framework whose major goal was 80% GHG reductions below 1990 levels by 2050. Around the same time, Ontario introduced the Green Energy and Green Economy Act. One of the key features of the act is the 'Feed in Tariff Program (FIT)'. Toronto residents and business owners can benefit from the FIT program which was designed to "encourage and promote greater use of renewable energy sources" for electricity generating projects across the province by providing a long-term guaranteed pricing structure (IESO, 2010). The FIT and microFIT programs allow for both large (10KW-500KW) and small (fewer than 10KW) generation projects from biogas, solar photovoltaic (rooftop and non-rooftop), onshore wind, and water power projects to participate. Projects must meet eligibility requirements and have their applications reviewed before approval, but there is nevertheless a significant financial incentive through the FIT programs for residents and businesses to contribute to the transition to RE by generating energy on a micro scale.

Most recently in 2015, Toronto launched 'Transformation Toronto 2050', a two-year initiative to identify the path towards achieving an 80% reduction in GHG emissions by engaging businesses and residents.

Specific to energy, the City of Toronto has already laid out broad plans for energy conservation and adoption of RE throughout city facilities in the "City of Toronto Energy Conservation and Demand Management Program (2014-2019)". These include:

- Establishing and verifying energy reduction targets for city facilities
- Reducing energy consumption by 30% while generating $17 million in cost savings and avoiding nearly 32,000 tonnes of GHG emissions
- Improving the city's facility infrastructure as well as operating and maintenance practices
- Supporting established GHG emissions reductions goals (City of Toronto, 2014)

35 RE installations currently exist under the City of Toronto's direct management, including solar, geothermal, and deep lake water cooling, while another 64 are planned. The locations are detailed in Figure 1 below.

Figure 1Existing and Planned Renewable Energy Generation Installations for the City of Toronto (City of Toronto, 2014)

1.1.1.1. Toronto's Current Energy Sources

Complete data outlining Toronto's energy supply mix does not currently exist. However, the information for the province is available and since Ontario Power Generation (OPG) is Toronto's major power supplier it can be assumed that the generating mix is largely the same. Ontario's total RE capacity amounts to 36% of the overall energy generation (Independent Electricity System Operator [IESO], 2016). The electrical distribution within the city is operated by Toronto Hydro-Electric System Limited.

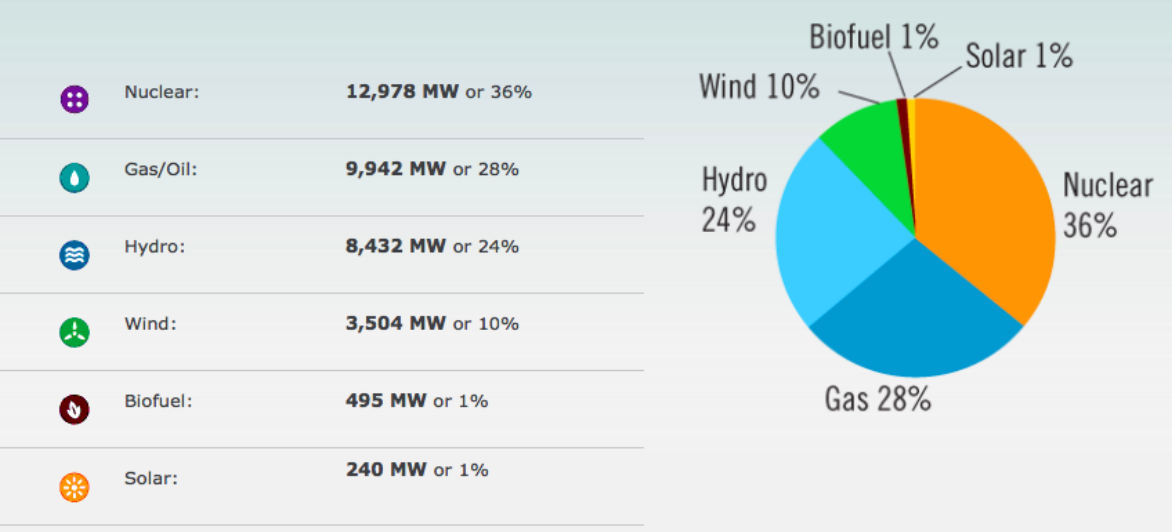
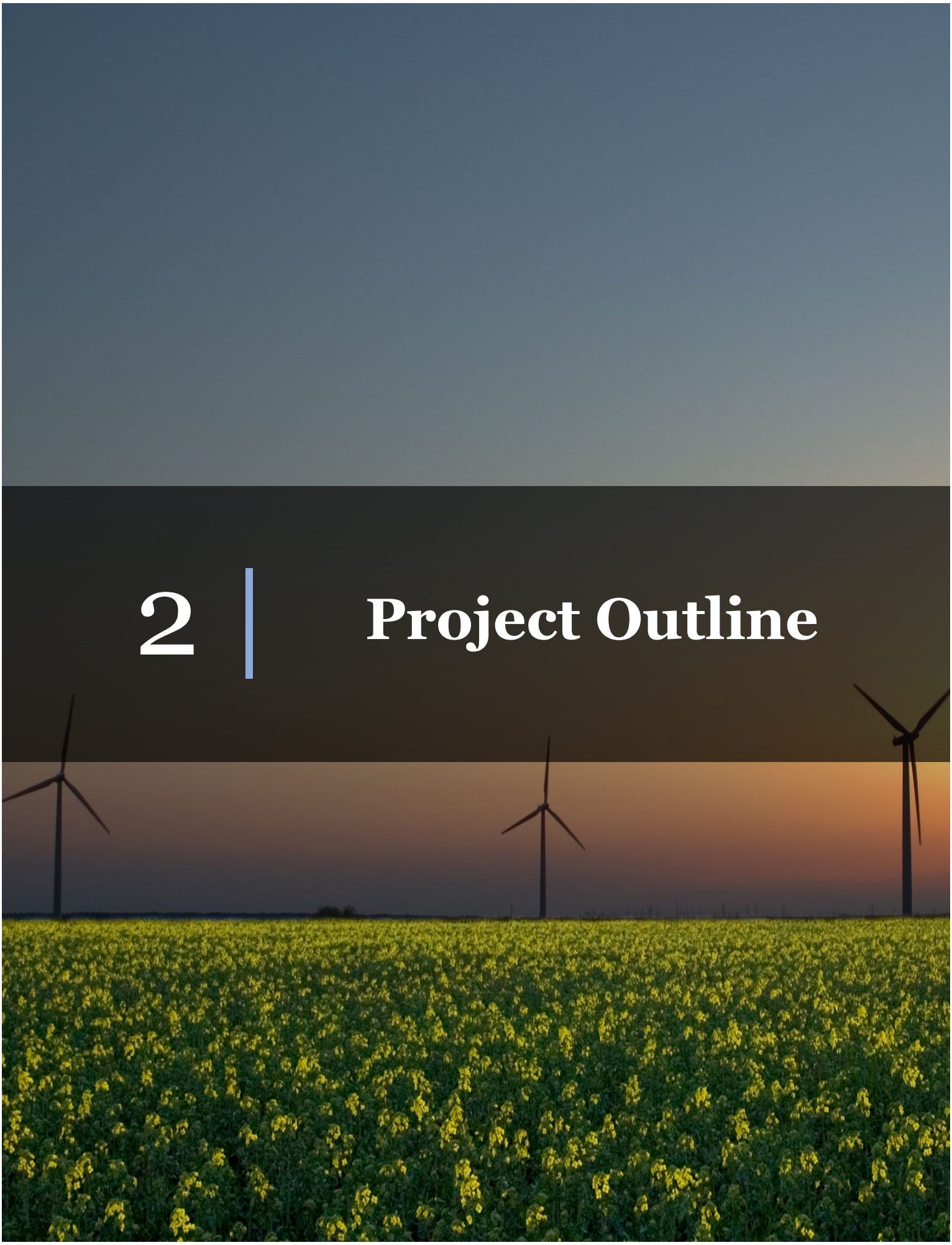


Figure 2: Ontario's supply capacity by fuel type (IESO, 2016)

Wind energy currently contributes 10% to the supply mix. However, in 2011, during the lead up to a provincial election, the Ontario Government placed a moratorium on offshore wind farms, stating the need for a cautious approach given uncertain scientific evidence of the technology's environmental and human impacts (Ontario Ministry of Environment, 2011). Despite other Great Lakes jurisdictions moving ahead with offshore wind farms, such as Ohio's "Icebreaker" project (Milner, 2015), Ontario has not lifted the moratorium six years after it was enacted. This places a severe limitation on the City of Toronto's ability to increase the share of wind energy in the supply mix.

Another source of renewable energy, incineration or waste burning, is also facing problems in the region. The $289 million Durham-York Energy Centre, the first new incinerator opened in the Greater Toronto Area in decades, is more than a year behind schedule. The rising exchange rate with the US dollar added further to already existing concerns about ash, noise, odour and other emissions (Javed, 2016a). Labeled as both ecologically and economically unsound other incineration projects have been cancelled. In October 2015, the Peel region decided not to move forward with the $500 million Peel Energy Recovery Centre which was approved in 2013 (Javed, 2016b).



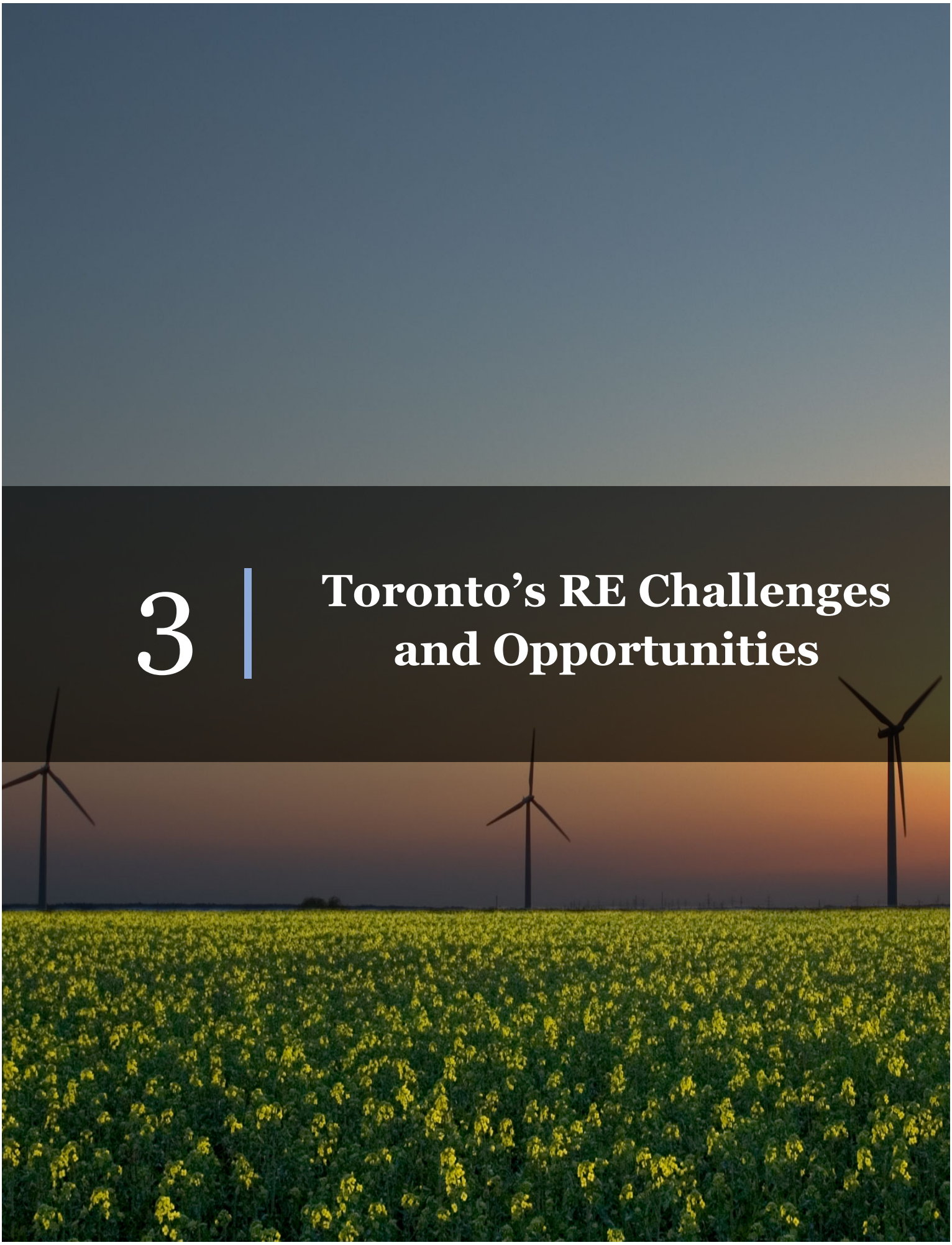
2 | Project Outline

In January 2016, we were asked by the City of Toronto's Environment and Energy Division to identify the policies and programs that would help Toronto move towards becoming a 100% renewable energy city by 2050.

In our project we aimed to achieve the following:

- Identify the policy and program options successfully used to achieve 100% renewable energy goals in other global cities and determine which could be applicable to Toronto
- Understand the challenges and merits of different policy options

To achieve our objectives, we conducted interviews with stakeholders that have experience in the renewable energy field including the Executive Climate Project Director in Copenhagen Jørgen Abildgaard, the Executive Director of Renewable Cities Michael Small, and the Climate Policy Manager with the City of Vancouver Malcolm Shield. We also analyzed the renewable energy plans of six municipalities, which included Copenhagen, Munich, Vancouver, New York, Oxford County, and Burlington, VT to identify best practices. This benchmarking analysis helped us understand how various cities plan to achieve their renewable energy targets, and what could be applied to Toronto. The details of these cities' renewable energy plans and policies can be found in the Appendix.



3 | Toronto's RE Challenges and Opportunities

All cities have unique characteristics, cultures, and metabolisms that dictate the rate at which energy is consumed by their citizens. Toronto is no different. Distinct challenges exist for Toronto in the context of a shift towards renewable energy that must be taken into account when forming policy. Nonetheless, opportunities exist amidst these challenges to exploit Toronto's uniqueness and to develop an approach catered to its politics and potential.

3.1. Framing

The social and political narrative developed around a policy is a key determinant of its success, both in council and with the broader public. The manner in which policy is framed, including the language used to describe it and the points chosen to emphasize its merit, will dictate how the narrative develops over time.

Toronto can be a challenging place to gather support for a new policy. Its municipal council currently consists of 44 councillors and a mayor, and will grow to 51 by 2018. Conversely, New York City, with three times the population, has the same number of municipal councillors. The sheer size of council can significantly stall the development and passing of new policy, without taking into consideration the fact that there are no municipal parties. The result of this is a lack of discipline and expediency in decision making, which only further hampers progress (Urquhart, 2014). For these reasons, a well-crafted framing and narrative that unites councillors must be conceived in order to begin the conversation about a shift to RE from a point of agreement.

Interestingly, none of our comparative cities had made an explicit "100% RE Plan" or strategy. Rather, this commitment was integrated into broader long term climate resilience or energy plans. Furthermore, our focus cities all highlighted the economic benefits associated with RE first and foremost. This framing was identified as being essential to achieving acceptance of the commitment amongst stakeholders.

From its very first page, Vancouver's "Renewable City Strategy" boasts the superior economic benefits of RE. Economic diversity, resilience, affordability, and quality of life are all quoted as byproducts of developing energy infrastructure to support the transition to a 100% RE city. The environmental and climate effects, while not ignored, are mentioned in a second breath. Like many of our other focus cities, Vancouver's RE plan was an integrated piece of the city's "Greenest City Action Plan", a comprehensive approach to urban sustainability.

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*"Imagine a city where **jobs** and businesses are **diverse** and **economically strong**; where homes and offices have clean and comfortable environments, that are **less expensive** to heat and cool; where the transportation system is abundant and efficient; a city that supports a **thriving economy** while **improving affordability**, and provides citizens the opportunity to be*

healthy and mobile. ***Imagine a city powered only by renewable energy****." (City of Vancouver, 2015, p. 2)*

In the same vein, Toronto should look to develop a narrative and framing that fits within its existing green action framework. TransformTO, the plan to engage community in defining the path towards reducing GHG emissions by 80% by 2050, positions Toronto as the "most livable city in the world" (City of Toronto, 2016). This framing includes language about prosperity, equity, health, and enhancing the standard of living. This is a positive frame, and will likely help to encourage stakeholders to see the plan as a gain. However, the focus remains on GHG reduction, which is inherently a negative frame. Convincing people to do less of something is always more difficult, and Toronto should consider altering this framing with a positive spin. Going even further, there is an opportunity to develop a narrative that merges the current concept of livability with the benefits of RE while simultaneously speaking to Toronto's unique cultural and historical values. In doing so, a 100% RE plan will have a fighting chance at surviving the journey through municipal council.

3.2. Leveraging Existing Resources

Cities must take advantage of resources that are most readily available to them. Picking the low hanging fruit is an important step in setting cities on the right track to meeting their targets. Currently, an estimated 24% of Toronto's energy comes from hydro, which confirms a larger Canadian trend that Canada is one of the leaders in hydro energy. However, 10% also comes from wind (IESO, 2016). Due to its geographical location and surrounding environment, wind appears to be the most suitable RE option for Toronto. The large Lake Ontario water area offers many opportunities as offshore wind is steadier and more reliable than onshore (The European Wind Energy Association [EWEA], 2016). However, despite the fact that wind has been identified as the most cost-efficient source of RE (in terms of ratio between capital employed and energy produced(Stadtwerke Munchen [SWM], 2014)), construction of large wind farms has been traditionally facing considerable public opposition and resistance. Toronto is no exception to this trend. In 2011, the province put in place a moratorium banning any offshore wind farm construction until more scientific research is done on their impact (The Canadian Press, 2011). Other technologies, such as incineration, have also faced similar difficulties.

Public opposition can lead to imposition of limits on construction of RE generating plants which subsequently poses severe challenges for cities to meet their RE targets within the set deadline. Generally, there are two ways cities deal with these obstacles. Copenhagen has been able to overcome some negative public perception by giving people a stake in RE projects, specifically in the Middelgrunden wind farm. As a result, it became one of the world leaders in wind energy and the country is currently able to export some of it to neighboring countries (Nelsen, 2015). In the same vein, the City of Toronto should explore its possibilities to repeal the existing moratorium on Lake Ontario. Unlike Copenhagen, Munich still faces similar legislative restrictions on wind farms constructions as Toronto. In 2014 the already limited space available for construction was further curbed when Bavaria put in place the "10H regulation" (SWM,

2014). This regulation increased the distance from residential areas at which wind plants can be built. Instead of fighting the opposition, Munich decided to invest in RE abroad. The utility company, Stadtwerke Munchen (SWM), which is fully controlled by the city, is involved in a large number of RE projects around Europe through its *Renewable Energies Expansion Campaign*. This allows the city to meet its targets through import.

The RE import option is a viable alternative for Toronto. Ontario is already sharing and trading electricity with Manitoba, Michigan, Minnesota, New York and Québec via interconnected grids (IESO, 2016). As the infrastructure is already in place, importing RE from Québec seems to be particularly attractive opportunity. Hydro-Québec is the largest hydro producer in North America and the company derives 99% of its electricity from water (Hydro-Québec, 2016). However, it is important to consider that this takes place on the provincial level and thus cannot be done by the City alone. Nonetheless, importing RE is a great way to compliment already existing local sources and increasing the share of RE in the overall energy mix. When fulfilling the targets, cities have to realize that exposure to a particular resource, such as offshore wind in Toronto's case, is a great starting point, but other challenges may arise. In that case, the solution does not necessarily lie in the immediate vicinity.

Box 2: Opposition to Wind Energy

Sheer size of the wind farms is the underlying reasons for much of the opposition to wind energy. Critics around the world list negative impact of turbines on tourism, the economy, people's quality of life, the value of their properties and, increasingly often, their health as major problems. As of April 2016, 58 groups were part of Ontario Wind Resistance. For Toronto specifically, Toronto Wind Action constitutes the major opposition. Citing negative environmental and economic impact as well as health concerns, the group opposes constructions at "Eastern Toronto waterfront, in particular the environmentally sensitive Scarborough Bluffs (an Ontario Heritage Site), The Beach, and the North Shore of Lake Ontario from Leslieville to Ajax" as well as industrialization of Great Lakes in general (Toronto Wind Action, 2016). In 2011, the group registered a partial victory when Ontario's Liberal government in run-up to elections imposed moratorium on offshore wind farms, until there is more scientific research into their health impact. The moratorium is still in place today while various groups are pressing for similar action on onshore constructions.

3.3. Community Involvement

Broader community involvement is essential for the successful uptake of RE. There are two challenges in relation to community acceptance that the City of Toronto is likely to face if it decides to move forward with adopting a RE plan. The first relates to already mentioned historical opposition to certain renewable energies, specifically offshore wind. The second is Toronto's large size and diversity of opinion of its residents. For comparison, Munich is the largest city in terms of population to date which has made a 100% RE commitment, and their population is 1.5 million, roughly half of Toronto's 2.8 million. If Toronto was to set 100% RE goals it would be the largest city to do so. There are three ways to deal with these challenges.

The first option is through community and stakeholder involvement. In most of the cities we examined, we found the importance of community engagement at all stages of new RE project implementation to be continually highlighted. For example, in Vancouver, 43,000 community members participated in the public engagement process whereby feedback was given on Vancouver's Renewable Energy Strategy (Smith, 2015). Similarly, in the opening letter of 'Copenhagen's Climate Plan 2025', the city's mayor wrote

> *"Most important to our success is Copenhagener's support of the plan and the work leading to its implementation. Without the engagement and understanding of the people of Copenhagen, we will not be able to realise the numerous ambitions.".*

This was credited with increasing public acceptance and understanding of new RE technologies, such as with the building of large scale offshore wind farms in Copenhagen (Middelgrunden). The project initially faced considerable public backlash from local communities, especially due to noise concerns. The government responded to this with a strong multi-stakeholder approach which heavily involved community focus groups through informational events. This included holding special demonstration days where the public was invited to witness a model wind turbine in order to see that noise pollution need not be a concern. Toronto's TransformTO indicates a great first step in regards to community consultations, but these discussions need to be scaled up and continued throughout if a major RE plan is to be adopted.

The second element that we found to help increase acceptance of new RE technologies and overcome the 'not in my back yard' (NIMBY) effect was the promotion of shared ownership models. For example, after consultation and implementation of the shared model, thousands of residents bought shares in the Middelgrunden wind farm in Copenhagen and acceptance grew for the project. Pro-wind residents in the Toronto area feel the case would be similar here. In a 2013 Toronto Sun article, a pro-wind activist was quoted saying 'most Ontarians support wind energy, but concedes "people are well aware it has to be with community participation. That's the key issue." (Martin, 2013)

In addition to consulting with local experts and community members, the third way to overcome the challenge of community involvement is to consult with other cities who have already made significant RE commitments. Vancouver identified this as an important part of their process, receiving feedback on their draft strategy from international thought leaders and peers through the Carbon Neutral Cities Alliance (CNCA) and Simon Fraser University's (SFU) Renewable Cities initiative, which support cities through the transition to 100% RE. Vancouver's Renewable City Strategy was shaped by a common framework for long-term carbon planning shared by CNCA in partnership with 16 global climate leading cities (Smith, 2015). Since the CNCA is a collaboration of global cities working to cut greenhouse gas emissions by 80% or more by 2050 or sooner, Toronto, which currently has the same targets, could feasibly join to learn from and collaborate with other cities.

3.4. Financing

There are two main issues with regards to financing renewable energy plans. The first is the competition for limited funding which many cities have faced and something that plays an equally important role in Toronto. One of the challenges that Toronto specifically faces is in balancing its 2016 budget. This year, Toronto will have to dip into its reserve funds to balance the budget "while leaving out millions of dollars worth of initiatives that had either been promised by Mayor John Tory or approved by council" (CBC News, 2016). This leaves little room for funding new projects and requires a reorganization of the city's top priorities. The other option is for the city to increase taxes to increase public spending, however, taxpayers do not want to pay more than they have to. Lastly, investors such as banks will not fund infrastructure unless it meets their risk reward criteria (Z/Yen Group Limited & WWF, 2015).

The second issue is the lack of investable projects. A study done by World Wildlife Fund (WWF) found that the lack of investable projects seems to be the main issue preventing sustainable infrastructure investment at scale rather than the lack of finance (Z/Yen Group Limited & WWF, 2015). The risk-reward profile of infrastructure projects largely determines the 'investability' potential and thus their attractiveness to private finance investors. The lack of scale is another regularly mentioned issue preventing the financing of sustainable infrastructure at city level.

Given that the City of Toronto will likely have a limited budget to finance a renewable energy plan, they must look to leverage other sources of finance. Other cities have adopted a variety of innovative financing tools including public finance instruments (ex. Infrastructure equities), debt instruments (ex. Green bonds, flexible loans, etc.), and equity instruments (ex. public private partnerships, tax incentives, planning permits, etc.) (Z/Yen Group Limited & WWF, 2015). Although a variety of these options can be pursued, ones that have shown great promise in other cities include tax incentives, green bonds, and public private partnerships.

Tax incentives are providing tax breaks for investments in renewable technology thereby lowering the cost of infrastructure development. Canada already has two tax incentive programs related to renewable energy - Capital Cost Allowance (Class 43.1) & Canadian Renewable Conservation Expense (CRCE), which can provide a starting place for the City of Toronto.

Tax incentives have proven to be beneficial to renewable energy investments. A study conducted by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) demonstrated that tax credit extensions can spur renewable capacity investments and help lower CO_2 emissions from the U.S. electricity system (Mai, Cole, Lantz, Marcy & Sigrin, 2016).

Green bonds - tax exempt bonds to fund projects that have positive environmental and/or climate benefits – are another option. As of June 2015, there were US$65 billion in green bonds issued globally, of which $1.2 billion were issued by Canadian organizations (Brownlee,

Box 3: Class 43.1

"provides an accelerated rate of write-off (30 percent per year, on a declining balance basis) for investments that produce heat for use in an industrial process or electricity by using fossil fuel efficiently or by using renewable energy sources." (Environment & Climate Change Canada, 2013)

2015). Green bonds present an opportunity for a new source of finance for climate resilient projects. These bonds' subscription rates demonstrate the growing appetite for divestment from fossil fuels as seen in the three times oversubscription rate of the GDF Suez green bond and the 1.75 times oversubscription rate of the bond issued by Ile De France (The World Bank, 2015; ManagEnergy, 2016).

Box 4: CRCE

"The CRCE allows certain expenses incurred during the development and start-up of renewable energy and energy conservation projects to be fully deducted in the year they are incurred, carried forward indefinitely and deducted in future years, or transferred to investors through a flow-through share agreement." (Natural Resources Canada, 2016)

Lastly, public private partnerships (PPPs) are often used by cities to develop sustainable infrastructure projects. As the name suggests, PPPs are "a form of project finance where a public service is funded and operated through a partnership between government and the private sector" (Z/Yen Group Limited & WWF, 2015). This allows the private sector to take advantage of the tax exemptions provided to government in purchasing renewable technology while the city can take advantage of lowered energy costs. PPPs in Canada have proven to be quite successful, with 83% of projects completing the goal on time or early (The Conference Board of Canada, 2013).

4 | Recommendations and Conclusion

As demonstrated in the previous section, making a commitment to becoming a city 100% powered by renewable sources is a long and difficult process. There are many challenges along the way that need to be addressed. The better prepared the city is from the outset of its commitment, the easier it is to overcome them and turn them into opportunities. Three specific actions have been identified and are recommended for the City of Toronto to be considered immediately or in the near future. These include obtaining more granular data, upgrading existing infrastructure and securing a champion. All three action points are not contingent upon the city making any commitments. On the contrary, they are necessary steps even if the city decides not to go forward with setting RE targets as they can help to meet the already stated goals, such as GHG reduction and energy efficiency.

4.1. Obtaining Granular Data

In order to design a successful energy strategy, be it uptake of RE or energy efficiency, the City of Toronto needs to obtain more data on current energy trends within its jurisdiction. Currently, the City has limited data that primarily lay out electricity consumption within its own buildings. However, more detailed information is needed. Energy trends have to be broken down into different sectors, including commercial, industrial, residential and transport. This would allow for careful evaluation and setting of priorities. Furthermore, when possible, data should be broken down even further to identify the end use of the energy. For example, in the case of the residential sector, this would mean categorizing the data into lighting, space heating and cooling, cooking, hot water, etc. This inventory would also be useful to get a clearer picture about the current state of GHG emissions.

4.2. Upgrading the Infrastructure

Given that Toronto's energy infrastructure is from the 1950s, transitioning to a RE city will require significant infrastructure upgrades not only in terms of distributing energy but also in terms of storing renewables, which is more difficult than storing traditional sources of energy. 40% of all outages in Toronto are already due to aging infrastructure and 60% of the infrastructure will need to be rebuilt over the next 20 years (Armstrong, 2014). This presents a unique opportunity for the City to optimize the grid for renewable energy.

4.3. Securing a Champion

In our research, we have seen that cities have had help with success or approval of their RE plans through engagement with a 'spokesperson' or champion. Cities that have solidified early support from these key influencers have gained and maintained traction throughout the approvals process. Vancouver's Deputy Mayor, Andrea Reimer was a vocal champion of the City's RE transition plan and helped ensure that it was broadly supported, which even led to her being awarded with the Queen's Jubilee Medal in recognition of her leadership role on this

initiative. (City of Vancouver, 2016) Likewise in New York, Governor Cuomo pushed for the State's ambitious new energy agenda. (NY Governor's Press Office,2016) Similarly, Toronto should also identify who might be a vocal champion for its RE strategy or climate change and energy efficiency strategy in general, to ensure that it is capable of moving through to approval.

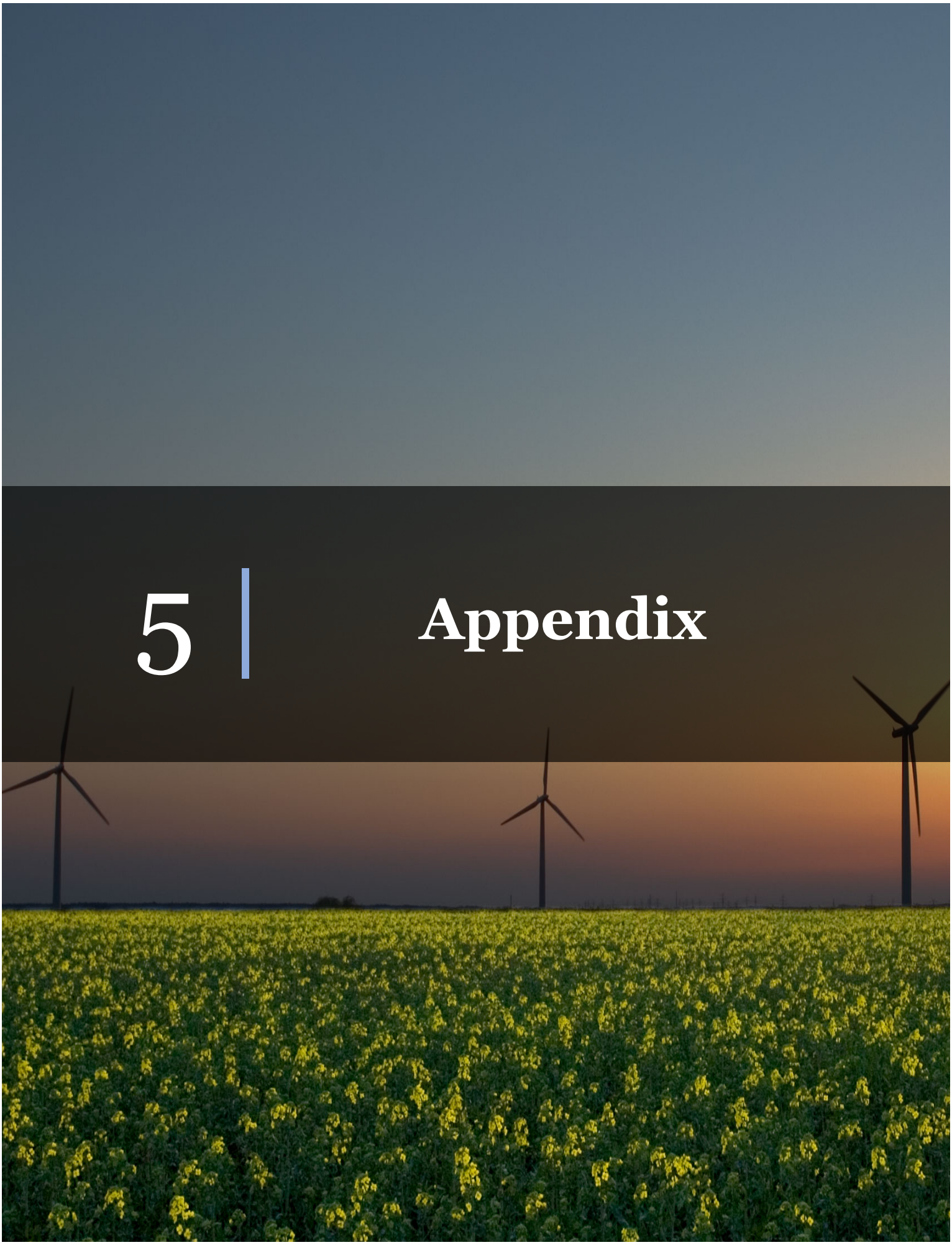
4.4. Conclusion

"Start by doing what's necessary, then do what's possible; and suddenly you're doing the impossible."

It is easy to be overwhelmed by the challenges of a shift to 100% RE, especially for the City of Toronto. The political process, current energy mix, availability of RE sources, and costs are each individually daunting obstacles to overcome. Combined, they are enough to discourage even the most stubbornly optimistic policy makers.

When considering whether or not to pursue this option - and to be clear, the authors of this report do recommend it - it's important to understand the City of Toronto's role in a grander scheme. Urbanization will continue to increase in the near term, and cities will be home to 66% of the global population by 2050 (UN ECOSOC, 2014). As the number of individuals that live in cities increases, so too does the opportunity for municipal governments to have a greater impact economically, socially, and environmentally. Cities that embrace a shift to RE can create new economic opportunities while building diversity and resilience into their systems.

Toronto is the largest city in Canada, and the fourth largest in North America. It is an economic powerhouse, generating 10% of Canada's GDP, and is home to an exceptionally well educated workforce (Toronto Financial Services Alliance, 2016). By all accounts, it has the tools and resources available to become a global leader amongst the other cities mentioned in this report. But in order to do so, it must approach the idea of 100% RE from a lens of possibility and opportunity. Only then will the challenges ahead of this city be outweighed by the potential to make Toronto an even more prosperous, more innovative, and more world class than it already is.



5 | Appendix

5.1. Vancouver

5.1.1. Policy

Vancouver's *Renewable City Strategy* is grounded in two complementary goals: 1) to successfully derive 100% of the city's energy from renewable sources before 2050, and 2) to reduce greenhouse gas emissions by at least 80% below 2007 levels by 2050.

With 31% of its current energy use already derived from renewable sources, the remaining energy is delivered by fossil fuels - natural gas for buildings and gasoline or diesel for personal and commercial vehicles. The *Renewable City Strategy* therefore aims at managing the transition of buildings and transportation to renewable sources of energy.

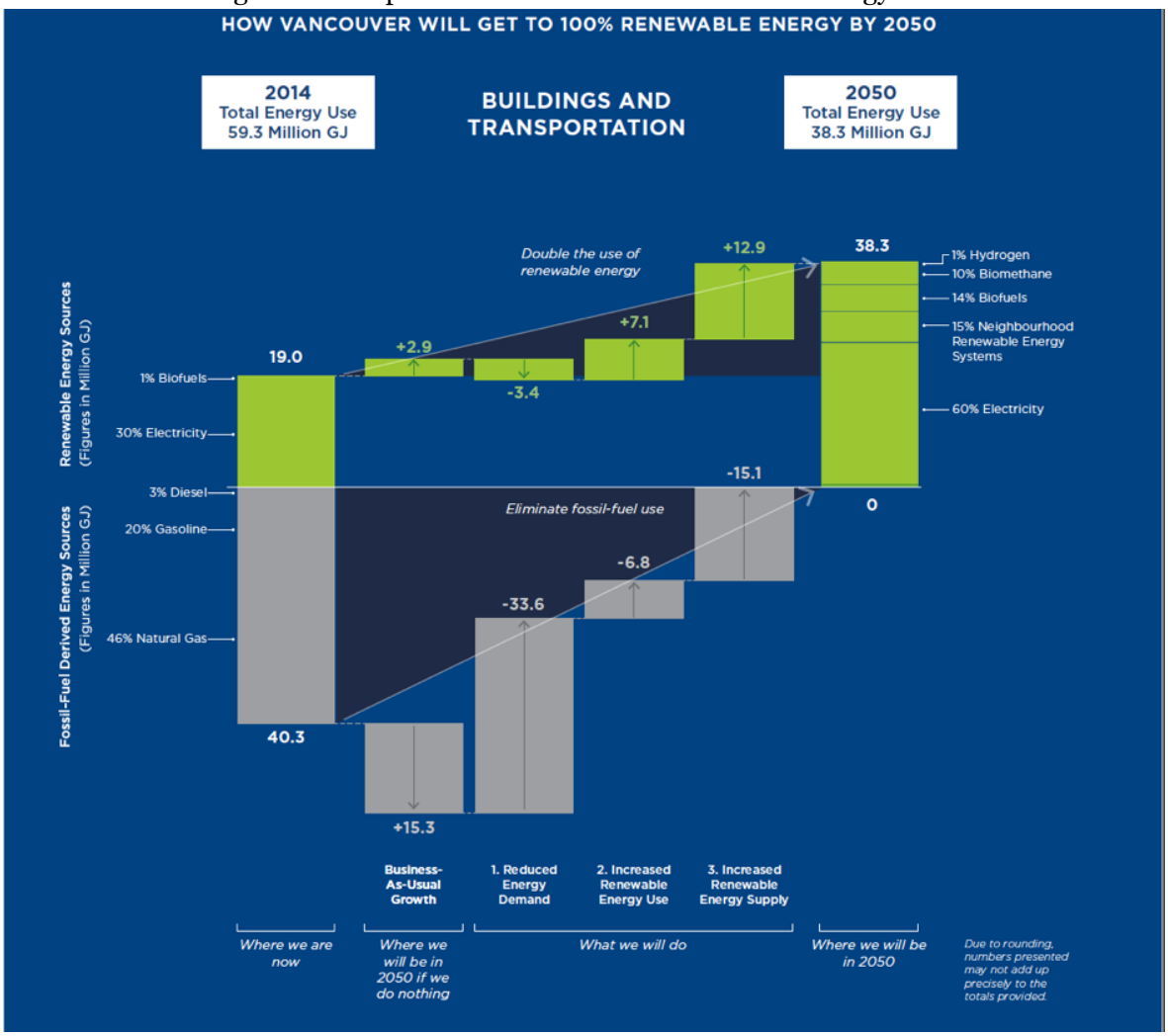


Figure 3: How Vancouver will get to 100% renewable energy by 2050 (City of Vancouver, 2015)

In terms of a framework, the strategy is three pronged and prioritized towards measures with the greatest long term impact and cost efficiency.

1. **Reduce energy use**
   Cost effective conservation and efficiency programs, for example building insulation requirements and promoting active transport

2. **Increase the use of renewable energy**
   Supporting the use of readily available forms of renewable energy and upgrading existing infrastructure to maximize potential, e.g. EV programs, increasing connectivity to neighborhood utility programs.

3. **Increase the supply of renewable energy**
   New builds will expand the renewable energy infrastructure and increase its supply, e.g. increasing the number of rooftop solar panels or the availability of biofuels.

Therefore, reducing overall energy use through conservation and efficiency programs is paramount because it is most cost effective. Incentivizing the switch to renewable sources and improving existing infrastructure to deliver a greater amount of renewable energy comes next. Finally, implementing new builds to increase the supply of renewable energy is the final step given that it is the least cost effective measure.

5.1.2. Challenges

5.1.2.1. Control

The City of Vancouver shares control of policy for key sources of energy use and greenhouse gas emissions with regional and federal partners. Most notably, public transportation decisions are shared with the local transit authority, Translink. Meanwhile, vehicle efficiency and pollution standards are set by the Federal Government. Beyond the design of streets, service delivery, and transportation planning, the City therefore must work in partnership with regional and federal governments, as well as with individual citizens, to influence the transition from diesel or gasoline vehicles. The lack of direct legislative control over transportation therefore significantly influences the scope of the *Renewable City Strategy*.

5.1.3. Opportunities and Successes

5.1.3.1. Framing

"Imagine a city where jobs and businesses are diverse and economically strong; where homes and offices have clean and comfortable environments, that are less expensive to heat and cool; where the transportation system is abundant and efficient; a city that supports a thriving economy while improving affordability, and provides citizens the opportunity to be healthy

and mobile. Imagine a city powered only by renewable energy." (City of Vancouver, 2015)

The focus of the *Renewable City Strategy* is decidedly on improving economic outcomes and quality of life through the adoption of renewable energy sources. This framing was critical to the plan's success in council. Rather than an environmental agenda, the narrative is crafted around economic diversity and resilience. This framing proved acceptable to important stakeholders who were more likely to understand and support the idea of 100% renewable energy instead of alternatives such as carbon neutrality, "clean energy", or "fossil free". Though city staff tested acceptance of a range of options, the final decision of 100% renewable energy with an economic framing set the foundation for broad-based acceptance within city council, and beyond (M. Shield, personal communication, February 11, 2016).

5.1.3.2. Strategic Partnerships

Vancouver was able to receive approval from council for its RE plan with little opposition. It owes a significant portion of this success to sound partnership development with critical stakeholders across three major areas: within council, at the community level, and with the provincial government.

Vancouver's RE plan was championed, from an early stage, by its Deputy Mayor Andrea Reimer. Having a vocal champion with authority in council set the stage for a successful progression of the plan through the approval process. By supporting the plan, the Deputy Mayor delivered immediate credibility to the idea of becoming a 100% renewable energy city, and set a strong signal to other influential members of council to get on board as well.

Not only did Vancouver extensively consult with communities and over 43,000, individuals during the conception of the Renewable City Strategy (City of Vancouver Administrative Report, 24 October 2015) but it also made them a critical partner it its implementation. The Southeast False Creek Neighbourhood Utility is a perfect example of the importance of community level partnerships. Though the utility is owned and operated by the city, developers, residents, and building managers are all involved at different stages.

Finally, the Renewable City Strategy was developed upon a foundation laid by the provincial government in 2008 through the Clean Energy Act and the Clean Energy Plan. By using the provincial leadership as a starting point, instead of beginning from scratch, the basis for a strong partnership with a critical stakeholder was formed.

5.2. New York

5.2.1. Policy

In 2015, New York (NY) State set its most ambitious energy plan to: a) reduce GHG emissions by 40% from 1990 levels; b) raise the percentage of renewable energy generation to 50%; and c) increase energy efficiency in buildings by 600 trillion British thermal unit (BTU) all by 2030 (New York State Energy Research and Development Authority, 2015). As of 2014, renewable energy accounted for 26% of the State's power generation mix (Department of Public Service, 2016). The plan is a roadmap for Governor Cuomo's new energy initiative, Reforming the Energy Vision (REV), which aims to 'create a stronger and healthier economy by stimulating a vibrant private sector market to provide clean energy solutions to communities and individuals throughout New York' (New York State Energy Research and Development Authority, [NYSERDA] 2015).

In order to achieve the 50% renewable energy generation target by 2030, NY has plans to invest in new renewable energy facilities and support existing renewable energy facilities through the $5 billion Clean Energy Fund. Furthermore, the State has plans to train 10,000 employees to fill clean energy jobs, add 150,000 solar panels on businesses and homes, develop offshore wind resources, and implement targeted initiatives (Waldman, 2016). These targeted initiatives are well diversified into a number of target areas including: renewable energy production, building and energy efficiency, clean energy financing, infrastructure modernization, innovation & research & development, and transportation. In transportation, Charge NY is reducing the cost and increasing the convenience of alternative fuel vehicles by providing incentives and installing more EV charging stations. In regards to buildings, Build Smart NY is mandating that all state buildings reduce their GHG emissions by 20% by 2020 (NY Power Authority, 2016). In terms of generating renewable energy, NY has invested $1 billion USD to grow the solar industry. A notable initiative within this plan is K-Solar, a program that enables schools to procure affordable solar energy through free site assessments, technical support and expedited permitting. To date, 950 schools across the State have signed up to receive this service. One of the most innovative initiatives aims to disrupt the current distribution of electricity through a $40 million NY Prize competition which challenges businesses and entrepreneurs to design and implement community microgrids. This shift in utility regulation, transforming the way electricity is used and distributed, has the potential to change the way consumers buy and use their energy. 83 communities were selected for feasibility studies in 2015.

Figure 4: Reforming the Energy Vision goals (NYSERDA, 2015).

5.2.2. Challenges

As this plan was initiated less than a year ago, it is difficult to see what the challenges have been thus far. However, one of the biggest challenges is going to be NY's ability to achieve these ambitious targets especially when a roadmap has not been created. The public is weary of Governor Cuomo's plans as they have seen past energy plans place more of a burden to the economy rather than stimulate innovation (Waldman, 2015). For example, in the late 1990's, Governor George E. Pataki set a plan to deregulate electricity in NY and the free market was supposed to drive rates down. However, given that the State did not have an adequate supply of power, cost of electricity surged and the increase was passed onto consumers (Banerjee & Perez-Pena, 2001). Furthermore, the costs of achieving these targets have not been clearly laid out so that imposes a potential challenge to the plan.

5.2.3. Opportunities and Successes

Since opening in 2015, NY Green Bank has received proposals amounting to $734 million USD for clean energy projects worth an estimated $3 billion USD (New York State Energy Research and Development Authority, 2015). This illustrates the demand for investments in green infrastructure. Solar panels that have already been installed or are currently being installed are set to reduce GHG emissions by 216 tonnes per year while the Charge NY initiative has helped to grow the number of electric vehicles from 1,000 to 12,000 in just one year. It will be important for NY to be cognoscente of the skepticism in the public and private sectors about their ambitious plan and its ability to provide benefits to low-income individuals (Murphy, 2016). While doing so, they should address the concerns of the industry and ensure they are onboard with the roadmap to renewables uptake and GHG reductions.

5.3. Munich

Munich is the third largest city in Germany and the capital of German state of Bavaria. With population of around 1.5 million (and urban area of 2.6 million) Munich is one of the largest cities in the world to commit to 100% renewable energy goal. Considered one of the big European economic and business hubs, it continues to grow fast.

5.3.1. Policy

Increasing the share of energy produced from renewable sources is a Europe-wide debate. However, Munich decided to go beyond the targets set by the European Commission which require at least 20% of total EU energy needs to be produced from renewables by 2020 (Official Journal of the European Union, 2009, art. 8). In 2015, the city has already been able to meet its first target – generate enough electricity from 100% renewable sources to satisfy needs of all Munich's households. In fact, the goal was exceeded. Since spring 2015, Stadtwerke Munchen (SWM), Munich's utility company, has been producing enough renewable electricity to power all of Munich's households, underground trains, trams and electric vehicles. Meeting the first goal is only the start. Future targets include supplying all users, including industry and businesses,

with renewable electricity by 2025. By 2040, Munich plans to have all its heating running on renewable sources as well (SWM, 2014).

Despite its commitments, Munich does not have a 100% Renewable Energy Strategy per se. Instead, most of the City's environmental actions are framed as sustainability or climate protection programs. The main policy document guiding City's actions is the *Integrated Action Program for Climate Protection in Munich (IHKM)*, which aims to cut CO_2 emissions by 50% below the 1990 levels by 2030. More specific sets of actions were subsequently set by Climate Protection Plans of 2010, 2013 and 2015. Generally, they focus on 8 areas:

1. Housing construction – energy-efficient construction in existing and new buildings
2. Urban development, physical development planning, landscape planning
3. Mobility and traffic
4. Energy efficiency in industry
5. Energy generation and distribution
6. Energy management in city-owned properties and electric traffic infrastructure
7. Procurement, company vehicles and business travel
8. Awareness raising (since 2013) (Integrated Action Program for Climate Protection in Munich [IHKM]).

Since the first introduction of the Program in 2008, electricity generation from renewable sources under the area 5 became the cornerstone of the city strategy (Connective Cities).

SWM is the most important partner the City of Munich has in the pursuit of its renewable energy targets. SWM - owned and controlled by the City - provides a broad range of services, most importantly electricity, natural gas and district heating. Through SWM, Munich has a full control over both its energy generation as well as energy distribution systems. Following the introduction of *IHKM*, SWM launched the *Renewable Energies Expansion Campaign* to increase its production of renewable energy in 2008. While the primary focus of the Campaign is currently on electricity, it also contains a district heating expansion project. Public transportation is also under the full control of the City as the Munich Transportation Corporation (MVG) is a subsidiary of SWM. Although MVG is focusing predominantly on emissions reduction it is also how to incorporate use of renewable energy, including prototyping hybrid and electric drive.

Box 5: "Responsible Consumption"
SWM tries to promote renewable electricity uptake among its consumers. The company offers four different electricity tariffs. Their M-Ökostrom tariff guarantees electricity generated to 100% by renewable sources with annual confirmation through auditing. Furthermore, M-Ökostrom aktiv allows customers to contribute to development of renewable energy projects. SWM guarantees to invest customer's surcharge of 1,53 cents/kilowatt (net) in the construction of new facilities and plants for the generation of renewable energies. (SWM, 2016).

5.3.2. Challenges

5.3.2.1. Importing Green Energy

Although SMW prioritizes local and regional projects, the potential of Munich and its surrounding region in terms of green electricity generation is limited. The region is simply unable to satisfy all the energy consumption needs of its population. This limitation is caused by a number of policies and regulations passed by Bavaria. Most recently, the adoption of "10H regulation" in 2014 increased the distance at which wind turbines can be built from residential areas (SWM, 2014, p.7) To address restrictions on construction but still stay on track of meeting the City' targets within the deadline, SWM invests in multiple projects in other parts of Germany and across Europe. The company is currently involve in 7 large scale projects in Spain, France, Belgium, UK, Sweden, Poland and Croatia. Investments abroad form a significant part of SWM's *Renewable Energies Expansion Campaign*. As a result, considerable portion of Munich's RE targets is met through imports. Wind energy – both offshore and onshore – is regarded as the most cost-efficient renewable option and wind farms therefore represent the largest investments in other parts of Germany as well as abroad (SWM, 2014, p. 10).

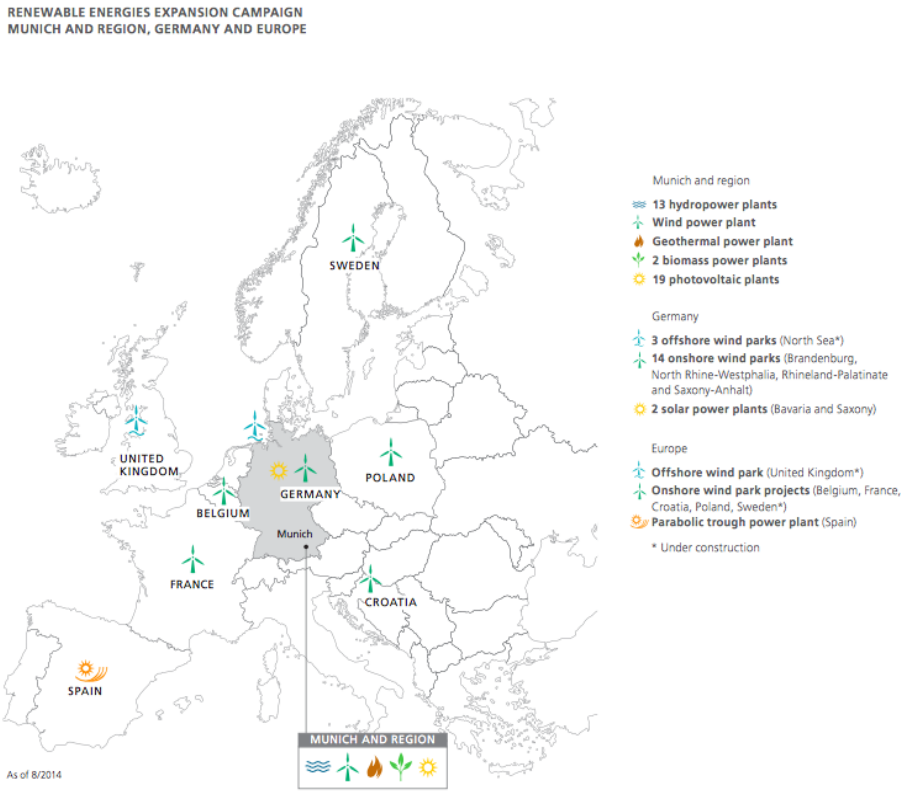


Figure 5: SWM's Renewable Energies Expansion Campaign Projects (SWM, 2014).

5.3.2.2. Energy Storage

Storage of energy generated through renewables is one of the challenges that are slowing down the transition to 100% RE. Because of the lack of technologically sound and economically viable storing options for green energy, SWM continues to keep balanced portfolio of generation capabilities, still heavily relying on natural gas. This allows them to offset imbalances resulting from feed-in of renewable energy. Such a challenge is not unique to Munich or Germany. In fact, it is considered to be one of the biggest barriers to the adoption of RE globally. However, as the reliance on import is higher for Munich, the need for storage becomes more pressing. Existing storage solutions are unable to satisfy both capacity and price requirements.

5.3.3. Opportunities and Successes

5.3.3.1. Redefining the Scope of Public Transportation

Munich realizes that becoming 100% renewable does not depend solely on changing the energy generation mix. Meeting the targets is also dependent on cutting the energy consumption. Initiatives in the area of transportation are aimed predominantly at that. Programs such as promotion of bicycle traffic, reduction of traffic congestion within the city and development of eco-friendly vehicles have a long tradition in Munich. But to make them more effective, the City of Munich decided to redefine the scope of public transportation. First of all, the City has developed a partnership with city's car sharing providers, incorporating them into the public transportation system. Through MVG's "Multimobil" app, passengers can now plan they journey using both public (subway, tram, buses) and semi-public (car share, bike share) means. The app provides both current location and availability of vehicles and allows people to immediately rent a car (MVG). Second, to make this system yet more effective, MVG is building *"mobility stations"*, where different mobility options converge. In November 2014, the city started operating a pilot project at Münchner Freiheit (Munich Transportation Corporation [MVG], 2015) Mobility stations are designed to pool together all available mobility components at one spot: underground, bus, tram, taxi, bicycle parking facilities, car-parking spaces, car sharing and MVG Rad (City's bike sharing program) (MVG, 2015).

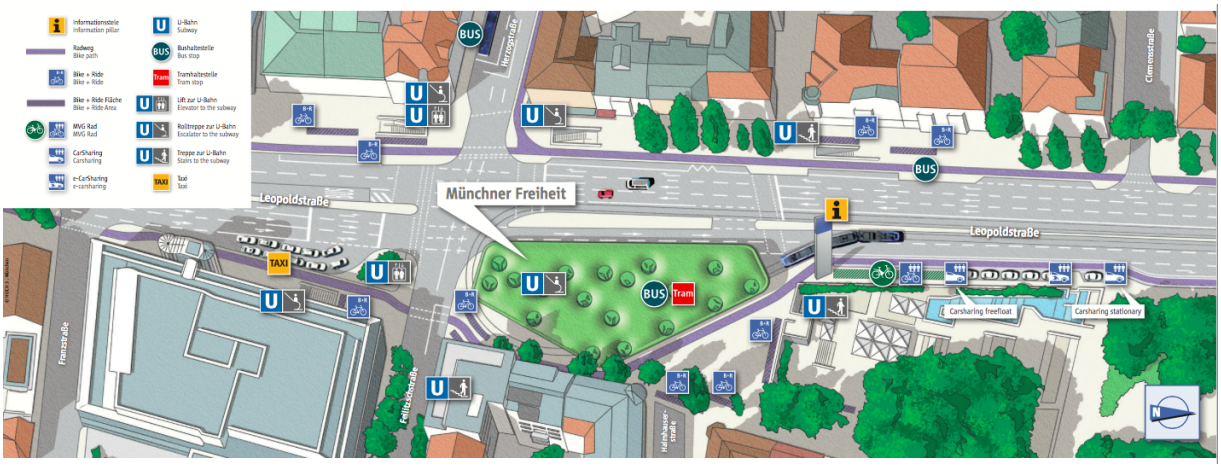


Figure 6: Pilot project at Münchner Freiheit in Munich (MVG, 2015).

5.3.3.2. Businesses as Part of the Solution - ECOPROFIT

As an economic hub, Munich houses many businesses that naturally play an important role in City's pursuit of 100% RE goals. The City of Munich is one of a few cities that try to actively engage businesses in the pursuit of its climate protection strategy. ECOPROFIT (*Ecological Project for Integrated Environmental Technologies*) is simple yet highly effective methodology for cooperation between the municipality and enterprises. It has dual purpose of increasing company's competitiveness and profits through improving its environmental performance. It is based on the consultation model, in which City provides experts in the area of sustainability and eco-efficiency to the company. The individual company is then assessed in terms of possibilities for improvements and savings, is required to attend workshops on specific topics, such as energy savings, and becomes part of extensive network of companies and municipalities, with whom it can share expertise and best practices. After fulfilling all the requirements, such as reducing energy and water consumption, a company becomes member of ECOPROFIT Club and receives a trademark (ECOPROFIT). In 2014, 56 participating companies have been able to save 14.9 million kWh of electricity, heat and fuel, which result in an annual avoidance of about 7,900 tons of CO_2, and translates into expected savings of around €2.1 billion for the companies (EUROCITIES 2014). ECOPROFIT, which originates in Austria, has become increasingly popular in recent years, with projects around the world, including China (ECOPROFIT). While it is designed primarily around sustainability more broadly, renewable energy is beginning to play an increasingly important role.

5.4. Copenhagen

5.4.1. Policies

Denmark as a whole aims to achieve 100% RE status in all sectors (electricity, heat, transport, industrial) by 2050. By 2020, 50% of electricity consumption will be from wind power, and 35% of final energy consumption will be supplied by renewable sources. (Danish Climate and Energy Policy) As Denmark moves to 100% RE across all sectors, they will decrease total energy used and build upon their existing energy sources while incorporating new technologies. Conversely, Copenhagen has committed to being 100% carbon neutral by 2025, also by leveraging RE (primarily wind) while decreasing carbon outputs, such as by switching from coal to biomass in their Combined Heat and Power (CHP) plants (CPH 2025 Carbon Plan, p.9). This commitment came about after 12 months of consultation with universities, businesses, and consultants (J. Abildgaard, Skype interview, March 10 2016).

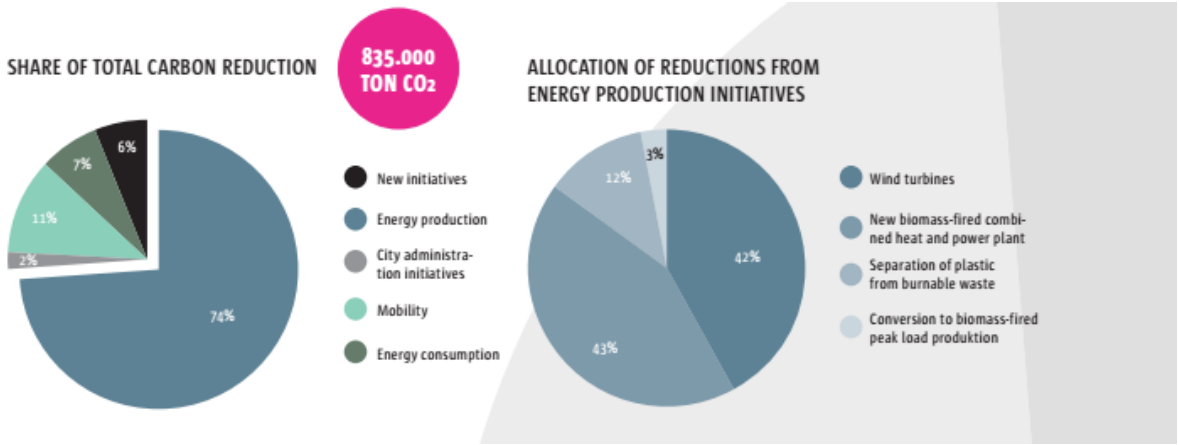


Figure 7: Copenhagen's plan to achieve carbon neutral status by 2025 (CPH 2025 Carbon Plan).

5.4.1.1. Achieving 100% RE – The Path Forward

Moving towards 2050, a reduced reliance on fossil fuels will be achieved by increasing wind-derived energy, maximizing energy generated from waste and biomass, and leveraging technologies such as biomass-fuelled CHP as well as district heating + cooling systems (Danish Climate and Energy Policy). Two strategies employed to ensure public buy-in to these efforts has included:

1) Each national power project is required to set aside 20% of its shares for local buy-in and ownership. (Currently, 22% of Denmark's total electricity generation is through local ownership wind power.)

2) The Danish Heat Supply Act ensures all economic benefits from district heating are returned to consumers

5.4.1.2. Transportation

Copenhagen is world renowned for being a cyclist's paradise. In 2015, the city achieved its goal of having 50% of commuters travelling by bike. According to Denmark's official website, even 63% of Danish members of parliament commute to work by bike (Copenhageners Love Their Bikes). Experts on Copenhagen's cycling culture have commented that this impressive figure is a result not only of Copenhageners' desire to be more environmentally friendly or to stay in shape, but rather because it is often simply the *best way to get around the city* (Copenhagenize). This was a result of strong infrastructure and urban planning to create the best possible bike paths and integrated transit systems, with access to and partnerships with public transportation. A focus on cycling not only drastically reduces CO_2 emissions but also offers health and noise pollution benefits.

5.4.1.3. Buildings

An integral part of the move to 100% RE is a decrease in energy demand. Retrofitting of buildings is one way of achieving this. In the Danish context, this refers to a replacement or renovation of old windows, improved insulation and improvements to ventilation systems. In fact, retrofitting alone is expected to account for a 10% decrease in electricity and 25% decrease in heat consumption from 2010 levels by 2025. Simultaneously, new buildings will take advantage of the latest green technologies such as PV solar cells, green roofs, visual measurements of building water and energy usage, etc. In addition to benefits associated with lower carbon outputs, these changes will also lead to higher value real estate and savings associated with lower energy and electricity consumption (CPH 2025 Climate Plan).

5.4.2. Challenges

5.4.2.1. General

Two related broad challenges identified by Copenhagen city representatives associated with making the 100% RE commitment are:

1) A lack of jurisdictional control: As a large part of the legislative framework for the shift is being made on a national level, there is little opportunity for the City of Copenhagen to exert direct influence. One such example of this is with building codes regulated on a national level. New government in power may loosen these regulations.

2) Varying levels of prioritizing of this issue in the newly elected federal government (J. Abildgaard, Skype interview, March 10 2016)

5.4.2.2. Wind

One challenge that arose in Copenhagen's past was with the city's decision to build a large-scale wind farm along the coast in the 1990s. There was considerable public backlash initially, especially due to noise concerns. The government responded to this with a strong multi-stakeholder approach which heavily involved concerned communities in the area. This included holding special demonstration days where the public was invited to witness a model wind turbine in order to see for themselves that noise pollution need not be a concern. This strategy, combined with the use of local ownership models, was credited for overcoming the all too common NIMBY (Not In My Back Yard) effect and allowed for construction onThe Middelgrunden Offshore Wind Farm.

Copenhagen city representatives raised storage to be a major challenge associated with their high reliance on wind energy, especially as wind is set to make up an even greater portion of their energy mix. The city is looking into ways to develop new, flexible storing methods to decrease risk associated with unstable wind patterns (J. Abildgaard, Skype interview, March 10 2016).

5.4.3. Opportunities and Successes

Copenhagen is one of the world's most prominent examples of green infrastructure and RE. The city wants to retain its title of "Climate Capital"- a global leader in green technology and knowledge (J. Abildgaard, Skype interview, March 10 2016). Copenhagen's climate plan highlighted that investing in sustainability offers not only environmental and quality of life benefits, but economic and financial benefits too. These include business and tourism opportunities, increases in land value, financial savings for citizens, job creation and opportunities for innovation. Therefore, although the city has had to invest financial capital into making their RE and other environmentally-friendly developments, some of this is fed back into the city. Interestingly, this also encompasses providing consultations for other global municipalities looking to 'go green' (J. Abildgaard, Skype interview, March 10 2016). For example, recently the City held meetings with Chinese officials to share knowledge of district heat and cooling for buildings, and helping San Francisco implement new cycling initiatives. (J. Abildgaard, Skype interview, March 10 2016)

A recent report published by the Danish Energy Agency outlines the types of new products and industries that emerge to stimulate local economies through making RE commitments:

> *"Green products and services are defined as products which reduce pressure on the environment, for example energy saving products and the service of installing renewable energy systems. In 2013 Denmark produced green products and services for EUR 22 billion, half of which is related to renewable energy and one sixth to energy efficiency. The green sector employs approximately 58,000 people in Denmark. As an example, the Danish wind energy sector currently employs more than 27,000 workers and the Danish export of wind energy technology in 2013 accounted for more than EUR 6.5bn." (The Danish Energy Model, p. 6)*

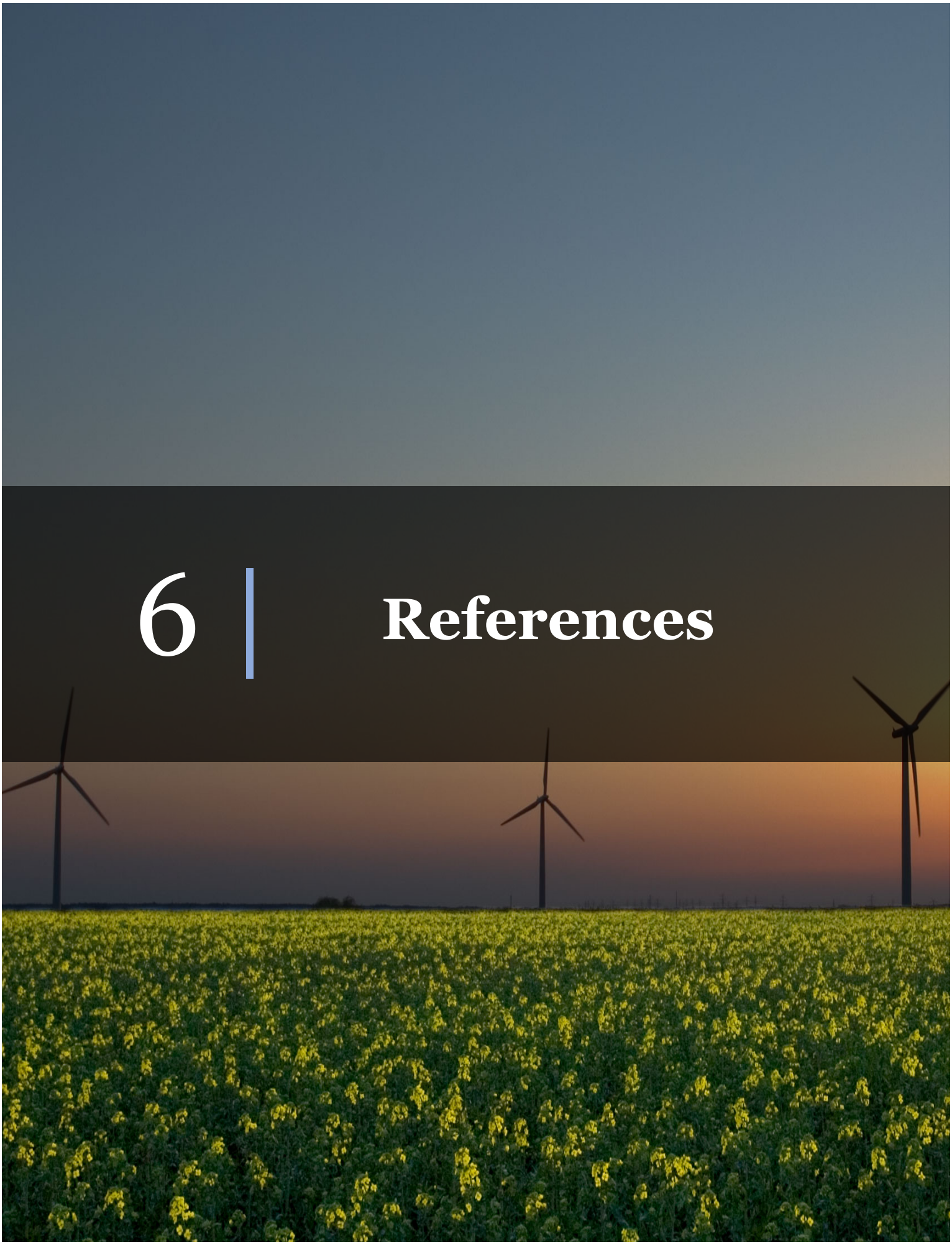
The Copenhagen city representative we spoke to stressed the importance of Danes' self-identification as an environmentally-conscious people. This identity has aided Copenhagen's pledge to achieve 100% RE by 2050 to be widely embraced amongst the general population. In the opening letter of 'Copenhagen's Climate Plan 2025' document, the city's Lord Mayor, Frank Jensen, wrote:

> *"Most important of all is the Copenhagener's support of the plan and the work leading to its implementation. Without the engagement and understanding of the people of Copenhagen, we will not be able to realise the numerous ambitions."*

5.5. Oxford County – An Overview

Oxford County, located in Southwestern Ontario, is an amalgamation of eight municipalities making up a total population of 109,000. In June 2015, this community became the second Canadian district to commit to 100% RE by 2050 after Vancouver. This bold move was part of a broader County Community Sustainability Plan which "aims to improve quality of life for Oxford's current and future generations and to balance Oxford's collective economic, community, and environmental interests." (Oxford County, 2015, p.1) Jose Etcheverry, a York University professor and green energy expert working with the county, said "the plan isn't just about protecting the environment — it also makes economic sense, (due to the non-renewable aspect of traditional energy sources)" (CBC News, 2015). Community involvement in the process of achieving this plan was critical, with several community engagement initiatives taking place before the plan's details were solidified.

The 100% RE portion of the plan will be achieved through a mix of efforts, including the implementation of a localized micro-grid in the City of Woodstock for utility and residential application. This micro grid (Woodstock Hydro) will "match customer loads with renewable energy generation and energy storage technologies," and will be adaptable to emerging technology innovations in the cleantech field. Other efforts will include encouraging local electric utilities to lease solar, subsidising district energy projects, providing incentives for housing retrofits, and even incorporating education on energy conservation initiatives into local primary and secondary school curriculums. (Oxford County, 2015, p. 9) Transportation will also be addressed: A network of bike lanes will be developed throughout the county (including physically separated trails and bike stands), and a "transportation demand strategy" will be implemented which will include programs and incentives for ridesharing and bike sharing, and "workplace mode-shifting with a particular focus on marginalized residents". (Oxford County, 2015, p.10)



6 | References

Armstrong, J. (2014). Toronto hydro says $4B needed over 10 years to upgrade infrastructure. *Global News*. Retrieved from http://globalnews.ca/news/1655441/toronto-hydro-report-says-5-6b-needed-to-replace-aging-infrastructure/

Banerjee, N. & Perez-Pena, R. (2001). A failed energy plan catches up to New York. *New York Times*. Retrieved from http://www.nytimes.com/2001/06/01/nyregion/a-failed-energy-plan-catches-up-to-new-york.html?pagewanted=all

Brownlee, M. (2015). Green bonds in Canada: 2014, 2015, and beyond. *Sustainable Prosperity*. Retrieved from http://sustainableprosperity.ca/blog/green-bonds-canada-2014-2015-and-beyond

Canadian Ministry of Finance (2016). Growing the Middle Class. *Budget 2016*. Retrieved from http://www.budget.gc.ca/2016/docs/plan/budget2016-en.pdf

CBC News. (2016). Latest Toronto city budget plan to hike property taxes 1.3%. Retrieved from http://www.cbc.ca/news/canada/toronto/city-budget-committee-1.3409088

CBC News. (2015, June 3) Woodstock, Ont. wants to run on renewable energy by 2050. Retrieved from http://www.cbc.ca/news/canada/kitchener-waterloo/woodstock-ont-wants-to-run-on-renewable-energy-by-2050-1.3098149

Chandler, David (2011, October). What Can Make a Dent? *MIT News*. Retrieved from http://news.mit.edu/2011/energy-scale-part1-1024

City of Toronto (2014, July). *Energy Conservation & Demand Management Plan*. Retrieved from https://www1.toronto.ca/City%20Of%20Toronto/Environment%20and%20Energy/Action%20Plans,%20Policies%20&%20Research/PDFs/City%20of%20Toronto%20ECDM%20(2014-2019).pdf

City of Toronto (2016). TransformTO. Retrieved from http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=ba07f60f4adaf410VgnVCM10000071d60f89RCRD

City of Vancouver (2015). *Renewable City Strategy 2015-2025*. Retrieved from http://vancouver.ca/files/cov/renewable-city-strategy-booklet-2015.pdf

Vancouver City Council. (2015, October 2015). *Administrative Report: Renewable City Strategy*. Retrieved from (http://council.vancouver.ca/20151104/documents/rr2.pdf

City of Vancouver. (2016). Councilor Andrea Reimer. Retrieved from http://vancouver.ca/your-government/andrea-reimer.aspx

Connective Cities. *Integrated Action Program for Climate Protection in Munich*. Retrieved from http://www.connective-cities.net/en/connect/good-practices/integrated-action-program-for-climate-protection-in-munich/

Conte, T. (2015, June 24). Oxford County commits to 100% renewable energy by 2050. Retrieved from http://www.oxfordcounty.ca/Home/Newsroom/News-Details/ArticleId/4395/Oxford-County-commits-to-100-renewable-energy-by-2050

Copenhagen Environment and Energy Office & The Middelgrunden Wind Turbine Cooperative. The Middelgrunden Offshore Wind Farm. Retrieved from http://www.ontario-sea.org/storage/29/2118_doc1.pdf

Copenhagen Environment and Energy Office & The Middelgrunden Wind Turbine Cooperative. The Middelgrunden Offshore Wind Farm. Retrieved from http://www.ontario-sea.org/storage/29/2118_doc1.pdf

Copenhageners Love Their Bikes. Retrieved from http://denmark.dk/en/green-living/bicycle-culture/copenhageners-love-their-bikes/

Copenhagenize. Retrieved from http://www.copenhagenize.com/

CPH Carbon Neutral 2025 - Energy Production. Retrieved from usa.um.dk/en/~/.../Copenhagen2025 energy production.pdf

Danish Energy Agency. Danish Climate and Energy Policy. Retrieved from http://www.ens.dk/en/policy/danish-climate-energy-policy

Danish Energy Agency. The Danish Energy Model: Innovative, Efficient and Sustainable. Retrieved from https://stateofgreen.com/files/download/1401

Department of Public Service. (2016). Staff white paper on clean energy standard. Retrieved from http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B930CE8E2-F2D8-404C-9E36-71A72123A89D%7D

ECOPROFIT. *Pilot Project in Panzhihua for the Implementation of ECOPROFIT in China*. Retrieved from http://ecoprofit.iclei-europe.org

ECOPROFIT. *Programme Basics*. Retrieved from http://ecoprofit.iclei-europe.org/index.php?id=899&project_id=managing%20urban%20europe%2025%2C

Environment & Climate Change Canada. (2013). Federal government actions to promote renewable energy development. Retrieved from https://www.ec.gc.ca/energie-energy/default.asp?lang=En&n=6766D86C-1

EUROCITIES 2014. *ECOPROFIT Munich: profit with environmental protection*. Retrieved from http://eurocities2014.eu/wp-content/images/pdfs/Ecoprofit.pdf

https://stateofgreen.com/files/download/1901

Hydro-Québec (2016). *Hydropower*. Retrieved from http://www.hydroquebec.com/sustainable-development/energy-environment/hydropower.html

Ian Urquhart (November 19, 2014). Toronto's dysfunctional city hall needs reform. *Toronto Star*. Retrieved from http://www.thestar.com/opinion/commentary/2014/11/19/torontos_dysfunctional_city_hall_needs_reform.html

Independent Electricity System Operator (2016). *Imports and Exports*. Retrieved from http://www.ieso.ca/Pages/Media/Imports-and-Exports.aspx

Independent Electricity System Operator (2016). *Supply Overview*. Retrieved from http://www.ieso.ca/Pages/Power-Data/Supply.aspx

Integrated Action Program for Climate Protection in Munich (2008). Retrieved from http://www.energy-cities.eu/db/Munich_Integrated_Action_Program_for_Climate_Protection_2011_en.pdf

International Energy Agency (2009). *Cities, Towns & Renewable Energy*. Retrieved from https://www.iea.org/publications/freepublications/publication/Cities2009.pdf

Javed, N. (2016, January 5a). Controversial Durham energy-from-waste incinerator a year behind schedule, *The Star*. Retrieved from http://www.thestar.com/news/gta/2016/01/05/controversial-durham-energy-from-waste-incinerator-a-year-behind-schedule.html

Javed, N. (2016, January 5b). Peel Region says no to incineration. *The Star*. Retrieved from http://www.thestar.com/news/gta/2016/01/05/peel-region-says-no-to-incineration.html

Mai, T., Cole, W., Lantz, E., Marcy, C., & Sigrin, B. (2016). Impacts of federal tax credit extensions on renewable deployment and power sector emissions. *National Renewable Energy Alliance*. Retrieved from http://www.nrel.gov/docs/fy16osti/65571.pdf

ManagEnergy. (2016). Ile de France region shows the way for sustainable bonds. Retrieved from http://www.managenergy.net/article/109#.VwR6khMrKRs

Martin, C. (2013, August 16). This blows: Growing list of Ontario municipalities declare 'unwilling hosts' to wind turbines. *Toronto Sun*. Retrieved from http://www.torontosun.com/2013/08/16/this-blows-growing-list-of-ontario-municipalities-declare-unwilling-hosts-to-wind-turbines

Miner, John (30 November, 2015). In contrast to Ontario's moratorium on wind farms, turbine group hopes to make Ohio the Saudi Arabia of wind. *National Post*. Retrieved from http://news.nationalpost.com/news/canada/in-contrast-to-ontarios-moratorium-on-wind-farms-turbine-group-hopes-to-make-ohio-saudi-arabia-of-wind

Munich Transportation Corporation (2015). *The mobility station at Münchner Freiheit*. Retrieved from https://www.mvg.de/dam/mvg/services/mobile-services/mobilitaetsstation/flyer-mobilitaetsstation-muenchner-freiheit.pdf

Munich Transportation Corporation. *CarSharing mit der MVG*. Retrieved from https://www.mvg.de/services/mobile-services/carsharing.html

Murphy, J. (2016). Will new Cuomo energy fund help or hinder low-income New Yorkers? *City Limits*. Retrieved from http://citylimits.org/2016/01/27/will-new-cuomo-energy-fund-help-or-hinder-low-income-new-yorkers/

Natural Resources Canada. (2016). Tax savings for industry. Retrieved from http://www.nrcan.gc.ca/energy/efficiency/industry/financial-assistance/5147

Nelsen, A. (2015, July 15). Wind power generates 140% of Denmark's electricity demand. *The Guardian*. Retrieved from

http://www.theguardian.com/environment/2015/jul/10/denmark-wind-windfarm-power-exceed-electricity-demand

New York State Energy Research and Development Authority. (2015). 2015 New York State Energy Plan. Retrieved from http://energyplan.ny.gov/

NY Governor's Press Office. (2016, January 21). Governor Cuomo Launches $5 Billion Clean Energy Fund to Grow New York's Clean Energy Economy. Retrieved from https://www.governor.ny.gov/news/governor-cuomo-launches-5-billion-clean-energy-fund-grow-new-york-s-clean-energy-economy

NY Power Authority. (2016). Accelerating energy efficiency in state owned buildings. Retrieved from http://www.buildsmart.ny.gov/

Official Journal of the European Union (2009, June 5). *DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL*. Retrieved from http://eur-lex.europa.eu/eli/dir/2009/28/oj

Ontario Ministry of Energy (2011). Ontario Rules Out Offshore Wind Projects. *Newsroom*. Retrieved from https://news.ontario.ca/ene/en/2011/02/ontario-rules-out-offshore-wind-projects.html

Oxford County. (2015, June 24). Future Oxford: A Community Sustainability Plan. Retrieved from http://www.futureoxford.ca/Portals/CommunitySustainabilityPlan/Documents/CSP%20document/Final%20Draft%20Community%20Sustainability%20Plan%2020150624.pdf

Renewable Cities (2016). *Why Focus on Renewable Cities?*. Retrieved from http://www.renewablecities.ca/about-renewable-cities

Renewable Energy Policy Network for the 21st Century (2015). *Renewables 2015 Global Status Report - Key Findings*. Retrieved from http://www.ren21.net/wp-content/uploads/2015/07/GSR2015_KeyFindings_lowres.pdf

Smith, D. (2015, October 24). City of Vancouver Administrative Report on Renewable City Strategy. Retrieved from http://council.vancouver.ca/20151104/documents/rr2.pdf

Stadtwerke Munchen (2014). You Can Rely on Us. *Annual Report 2014*. Retrieved from https://www.swm.de/dam/jcr:54b62e99-8ba0-4b0d-8b9e-3245aa3d9ccb/swm-annual-report-2014.pdf

Stadtwerke Munchen (2016). *M-Strom (Electricity)*. Retrieved from https://www.swm.de/english/m-strom.html

The Canadian Press (2011, February 11). Ontario declares moratorium on offshore wind farms. *CBCNews*. Retrieved from http://www.cbc.ca/news/canada/toronto/ont-declares-moratorium-on-off-shore-wind-farms-1.1063557

The City of Copenhagen. CPH 2025 Carbon Plan. Retrieved from

The Conference Board of Canada. (2013). Experience Pays: The Growing Value Of Public-Private Partnerships In Canada. Retrieved from

http://www.conferenceboard.ca/press/newsrelease/13-08-21/experience_pays_the_growing_value_of_public-private_partnerships_in_canada.aspx

The European Wind Energy Association. (2016). *Wind Energy Facts*. Retrieved from http://www.ewea.org/wind-energy-basics/facts/

The World Bank. (2015). Green bonds attract private sector climate finance. Retrieved from http://www.worldbank.org/en/topic/climatechange/brief/green-bonds-climate-finance

Toronto Wind Action (2016). *About Us*. Retrieved from http://torontowindaction.com/about-us

UN ECOSOC (2014). World Urbanization Prospects: 2014 Revision. *United Nations,* New York.

Waldman, S. (2015). State plan sets aggressive clean energy goals. *Politico New York*. Retrieved from http://www.capitalnewyork.com/article/albany/2015/06/8571025/state-plan-sets-aggressive-clean-energy-goals

Waldman, S. (2016). Cuomo lays out aggressive energy goals with key details pending. *Politico New York*. Retrieved from http://www.capitalnewyork.com/article/albany/2016/01/8588007/cuomo-lays-out-aggressive-energy-goals-key-details-pending

Woodstock Hydro. (Director). (2014, September 24). *Whites Lane microGRID - Sustainable Energy Development in downtown Woodstock* [Video file]. Retrieved from https://www.youtube.com/watch?v=XJbqViobgKY

World Energy Council (2013). World Energy Scenarios: Composing Energy Futures to 2050.Retrieved from https://www.worldenergy.org/wp-content/uploads/2013/09/World-Energy-Scenarios_Composing-energy-futures-to-2050_Full-report.pdf

Z/Yen Group & WWF. (2015). Financing the transition: Sustainable infrastructure in cities. Retrieved from http://www.longfinance.net/images/reports/pdf/Financing_the_transition_March2015.pdf