ENERGY EVOLUTION

OTTAWA'S COMMUNITY ENERGY TRANSITION STRATEGY – PHASE 1

City of Ottawa
Planning, Infrastructure
and Economic Development

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TO OUR COMMUNITY PARTNERS

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Sounding Board Members

- Arborus Consulting
- Aspen Solar Management
- Building Owners and Managers Association
- Bullfrog Power
- Canada Green Building Council
- Canadian Association for Renewable Energies
- Canada Science and Technology Museum Corporation
- Carbon Impact Consultants
- Carleton University
- City of Ottawa (various departments and branches)
- Chamber of Commerce
- Clean Air Partnership
- Clean Energy Canada
- Domicile Development Inc.
- Eastern Ontario Landlords Organization
- Ecology Ottawa
- Enbridge Gas Distribution Inc.
- Energy Ottawa
- EnviroCentre
- Federation of Canadian Municipalities
- FVB Energy Inc.
- Greater Ottawa Home Builders Association
- Green Communities Canada
- Healthy Transportation Coalition
- Hydro One
- Hydro Ottawa
- Independent Electricity System Operator
- Invest Ottawa
- J. Michael Wiggin Consulting
- Leidos Canada
- Lumos Energy
- Minto
- National Capital Commission
- Ottawa Carleton District School Board
- Ottawa Centre EcoDistrict
- Ottawa Community Housing
- Ottawa Gatineau Hotel Association
- Ottawa Renewable Energy Coop
- Public Services and Procurement Canada
- QUEST
- RND Construction
- Smarter Shift
- Transport Canada
- Tucker House
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- Healthy Transportation Coalition
- Hydraulic Energy and Renewable Energy Technologies
- Hydro Ottawa
- Innovative Hydro Controls
- iSolara Solar Power
- JAZZ Solar Solutions
- Master Group
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Sounding Board gathering in 2016

MESSAGE FROM THE CHAIR

Bad news about climate change and its human and economic impacts on cities is all around us, and signs are it will get far worse in coming years. But action to avoid the worst and alter this trajectory is not only possible it is happening right here in Ottawa already. Efforts by individuals, institutions, businesses and governments at all levels—to conserve energy, adopt more efficient practices and technologies, while generating or purchasing cleaner, renewable energy—are gathering momentum. The trajectory of climate breakdown is not doomed to hit rock bottom. Not when so many people are motivated to change course and to build a city and society that values cleaner, healthier energy sources and that recognizes the inherent opportunities to drive innovation, employment and economic development, all while doing environmental good.

To pursue these opportunities in a comprehensive way, requires a plan. In 2015, City Council adopted, as a term of council priority, the development and implementation of a renewable energy transition strategy. It was to involve all sectors and to engage people from across the city. It was to be not just a plan by the City of Ottawa to shift towards a renewable energy powered future, but one that involved the entire city. A good plan can be written at City Hall alone. An excellent plan requires the insight, expertise and enthusiasm of a much broader group of citizens. It is with that knowledge and philosophy that this strategy—Energy Evolution—came to be.

Energy Evolution is not a final plan. It is a starting point. A springboard to bold and exciting things to come. We need this to be everyone's plan. Everyone's goal. Everyone's vision of "a thriving city powered by clean, renewable energy."

David Chernushenko

Chair, Environment and Climate Protection Committee

PREFACE

In 2015, City Council approved Ottawa's Renewable Energy Strategy project as a 2015-2018 Term of Council priority. The activities related to this strategic priority directed staff to:

> Complete a baseline analysis of energy supply and demand within the City of Ottawa and assess options, in collaboration with community partners, for all such partners to advance energy conservation, energy efficiency and renewable energy generation within their respective areas of control/influence.

Early in 2016 City Council also approved a GHG reduction target for the City:

> That the City continue to work with key stakeholders and community partners to reduce community-wide [greenhouse gases (GHGs)] produced within the geographic boundary of the City of Ottawa and pursue a new long-term GHG reduction target of 80% below 2012 levels by 2050.

These directions are inseparable as they work in tandem to move Ottawa towards a low carbon economy. Energy Evolution: Ottawa's Community Energy Transition Strategy is not just about energy and energy security. It is also about climate protection, ensuring a healthy environment for citizens, building a strong economy and developing an overall resiliency that will enable Ottawa to retain its exceptional quality of life.

INTRODUCTION

Energy Evolution: Ottawa's Community Energy Transition Strategy is a renewable energy strategy designed to manage energy consumption, promote the use of renewable energy and advance local economic development opportunities in Ottawa. Developed in collaboration with dozens of local businesses and organizations, the strategy is intended to be a community-wide initiative with a vision to transform Ottawa into a thriving city powered by clean, renewable energy.

This document represents Phase 1 which delivers a baseline and analysis of current energy consumption, technical notes or **pathway studies** prepared by Leidos Canada or City staff, and a short term, 3 year action plan to 2020, primarily focused on the delivery of renewable energy projects and enabling policy changes.

Renewable Energy Generation (Phase 1)

- Solar Power – Large Scale, Commercial Rooftop and Residential
- Water Power
- Wind Power
- Heat Pumps – Air and Ground Source
- Biogas
- District Energy
- Electrification of Transportation – Cars and Light Trucks

Given the range of energy types currently used within Ottawa and the ways in which these are consumed, realizing Energy Evolution's vision will require concerted efforts and collaboration across all sectors of the community to reduce the city's current dependence on fossil fuels. The approach adopted by the strategy to guide this transition is three-pronged:

- reduce energy use through conservation and efficiency,
- increase the supply of renewable energy through local and regional production, and
- prioritize the procurement of clean, renewable energy.

This supports other actions the City is taking to meet its GHG reduction targets including promoting alternatives to car usage (walking, cycling, transit), energy conservation, and encouraging building renewals to improve energy efficiency.

As an economic development strategy, Energy Evolution also aims to promote Ottawa as a center for innovation, research and technology development. The strategy establishes clear linkages to the City's Smart Cities 2.0 Strategy and aligns with the City's updated Economic Development Strategy in terms of fostering innovation, entrepreneurship and small-business development.

The results of this strategy complement the City's Air Quality and Climate Change Management Plan (AQCCMP) in that increasing renewable energy generation and energy conservation and efficiency efforts will inevitably have the net effect of reducing GHG emissions.

Overall, it is useful to know the energy supply and demand early in the project so we can understand how significant of an impact energy conservation and efficiency measures will need to be made going forward.

A Multi-Year Strategy

Energy Evolution is intended to be a multi-year strategy with specific deliverables for the short (2020), medium (2031) and long term (2050). The year 2020 was selected as a target year for short-term deliverables in recognition of the need identified by stakeholders to advance new policy directions and capital projects within the current Term of Council. It recognizes the significant amount of funding that is currently available through federal and provincial programs to support municipal energy initiatives, and the opportunity to submit competitive project applications before these programs expire.

Target years for the medium- and long-term deliverables were chosen because of their alignment with the City of Ottawa's Official Plan current time horizon (2031) and the City's long-term target to reduce community GHG emissions by 80% below 2012 levels by 2050—two important milestones that will provide an opportunity to evaluate progress towards the Energy Evolution vision.

The Phase 1 action plan does not identify or propose specific actions for longer-term milestones but they will be elaborated

in the subsequent phase of the Energy Evolution strategy as short-term actions are implemented and as new opportunities and trends within the renewable energy sector emerge.

The current document therefore represents Phase 1 of the City's Energy Evolution strategy. It articulates the overall vision and approach for the strategy, provides a baseline and analysis of current energy consumption across the municipality and delivers actions that will move Ottawa towards a low carbon future.

Baseline Analysis

Results from the baseline analysis produced by Leidos Canada indicate that in 2015, Ottawa residents consumed approximately 114,000 terajoules (TJ) of energy at a total cost of $3.0 billion, or roughly $3,200 per person. Natural gas was the most consumed type of energy in the city (39%) followed by electricity (28%) and gasoline (26%). Together, these three energy types accounted for roughly 93% of the total energy used in Ottawa. Despite large and well-tapped hydropower facilities located on the Ottawa River, only 5% of the city's total energy consumption is currently generated or supplied from local, renewable sources.

Phase 1

To advance the strategy's vision and approach, a key component of the Phase 1 document is a proposed short-term action plan that identifies over 30 initiatives that can be undertaken by the City as well as community partners to 2020. The proposed short-term actions were developed in close collaboration with subject matter experts as community partners and were based on a series of focused technical notes or "pathway studies" prepared by Leidos Canada or City staff. A total of nine pathway studies were developed for Phase 1 of the strategy, each outlining the potential uptake and applications of a different renewable energy technology under different circumstances including conservative, moderate and aggressive scenarios.

Aggregation of the nine renewable energy pathway studies developed for Phase 1 suggests these technologies have the potential to displace or reduce roughly half of the energy currently consumed in Ottawa under an aggressive uptake scenario. Meeting the City's 2050 GHG reduction target may therefore require pursuing relatively aggressive uptake scenarios with regards to local renewable energy production while at the same time seeking equally large reductions through energy conservation and efficiency in the buildings and transportation sectors.

Some of the proposed short-term actions recommended in Phase 1 of Energy Evolution require further refinement, but many can be pursued over the course of 2018 using a combination of existing and potentially new City resources, community resources and senior government funding opportunities.

Although Phase 1 actions focus primarily on renewable energy generation opportunities, some also include the promotion of energy efficiency in buildings and the transportation sector. Opportunities related to energy efficiency and conservation are considered equally important in informing the overall strategy and more will be identified through a similar stakeholder engagement and pathway development process in 2018 with the start of Phase 2.

Phase 2

Phase 2 of Energy Evolution will include the development of pathway studies and the identification of short-term, medium and longer term actions related to energy efficiency and conservation, particularly with regards to buildings and the transportation sector. It will also examine other areas associated with renewable energy such as energy from waste and energy storage. A more comprehensive energy modelling component to quantify—to the best extent possible—the potential impacts associated with different actions and approaches will also be developed.

Phase 1 includes preliminary energy modeling for the year 2050 but the analysis is focused primarily on the impact of renewable energy generation opportunities. Completion of the remaining pathway documents during Phase 2 will enable a more robust analysis and will provide the remaining inputs required to undertake more accurate long-range energy modeling. This additional modeling and analysis will help the City and its community partners determine where to prioritize efforts over the medium and long term and will help to chart a more refined path towards a future where Ottawa is a thriving city powered by clean, renewable energy.

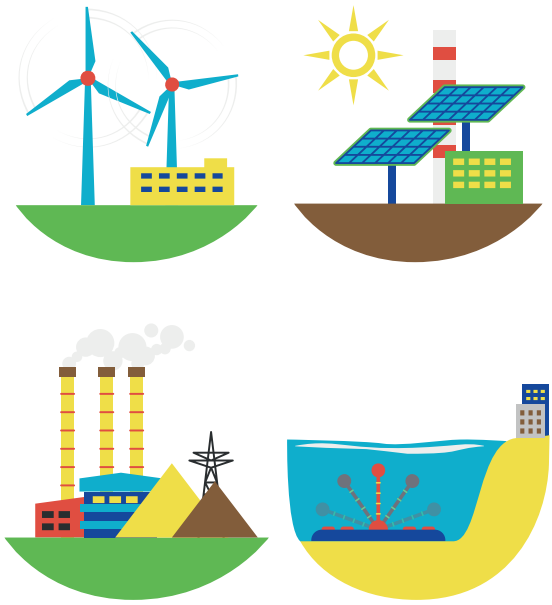
RENEWABLE ENERGY PLANNING

Ottawa is a city that continues to grow and by 2019 is anticipated to reach 1 million in population.[1] While growth can be an important driver of economic development—enabling cities to expand and diversify their local labour force—it can also lead to increased pressures on municipal and environmental resources if not managed sustainably. Growth management and overall City building are integral to defining the ways in which municipal governments examine and address these types of questions. Over the coming decades these decisions will have considerable implications for how resources such as land, water and energy are allocated and consumed within a given community.

Ottawa has considerable strengths to enable the success of renewable energy development in the area:

- The city has significant natural and renewable energy assets including ample sunshine for solar power, a stable water supply for hydro power and ample feedstock for biogas generation.
- Ottawa has the good fortune to be the primary shareholder in Hydro Ottawa including Energy Ottawa Inc. Energy Ottawa is the largest municipally owned producer of green power in Ontario. It owns and operates six hydroelectric generation plants at Chaudière Falls and more elsewhere. Energy Ottawa also holds interests in landfill gas-to-energy joint ventures that convert millions of tonnes of previously flared-off methane gas into renewable energy at the Trail Road landfill site and elsewhere.
- There are dozens of independent renewable energy service providers in Ottawa that can establish large to small scale solar facilities, set up biogas facilities, provide biomass for district energy, set up air or ground source heat pump systems and plan and install EV chargers.
- Although much of Ottawa's vast rural area is either in agricultural production or is a forested or wetland area, there are large areas of land capable of accommodating large solar facilities and other renewable energy facilities.
- Ottawa has post-secondary institutions focused on different aspects of renewable energy. These range from renewable energy engineering degrees and energy management certificates, to chemical and biological engineering research related to bioethanol and biodiesel production that are creating new industrial partnerships.
- As a G7 Capital, Ottawa has a large concentration of federal research agencies and laboratories focused on clean energy and addressing climate change that spin off complimentary industry. These include:
  - The National Research Council (NRC), Canada's biggest research facility
  - The National Sciences and Engineering Research Council (NSERC)
  - Agriculture and Agri-food Canada, supporting research, development and demonstration and the adoption of clean technology in Canada's natural resources sectors
  - Natural Resources Canada, working to support the acceleration and advancement of energy efficiencies. The CanmetENERGY facility is Canada's leading clean energy research and technology organization.
- The city has top notch talent. There are more engineers, scientists and PhD's per capita than any other city in Canada which can contribute significantly to energy innovation and green jobs.
- As a large Canadian city with an established GHG reduction target to 2050, Ottawa has an opportunity to apply for a significant amount of funding from the Province and Federal governments.

1 City of Ottawa. (November 2016). Growth Projections for Ottawa: Prospects for Population, Housing, Employment and Land, 2014-2036. Appendix 6 – Components of Population Growth - Reference Scenario, Page 46.



What is Energy Evolution: Ottawa's Community Energy Transition Strategy?

Energy Evolution is a renewable energy strategy designed to optimize energy consumption, promote the use of renewable energy and advance local economic development opportunities in Ottawa.

Also referred to as a community energy plan (CEP) or a municipal energy plan (MEP),[2] a renewable energy strategy is a tool for identifying community energy priorities and for supporting stakeholders within both the City administration and community at large in the advancement of joint strategies and initiatives. Although renewable energy planning is still a relatively new area of analysis at the municipal level, most large Canadian municipalities have been developing CEPs in one form or another since the mid-1990s. During the 1990s and early 2000s, for example, dozens of Canadian municipalities developed local climate action plans (LAPs) to identify and pursue short-term emission reduction opportunities.[3]

A renewable energy strategy or CEP contains many of the same hallmarks of a local climate action plan. While there is no standard approach for developing these strategies, a CEP generally contains three core components:

1. an inventory of community energy consumption, ideally disaggregated according to the different sectors or uses in the community;
2. a vision, goal or target for reducing energy consumption and GHG emissions within the municipality; and
3. a set of targeted actions that will be undertaken within a specific implementation timeframe.[4]

Despite their shared focus on achieving community-wide GHG reductions, a key difference between CEPs and more traditional LAPs is that CEPs generally contain much more detailed analyses of community energy consumption trends and opportunities. Whereas LAPs tend to focus exclusively on the link between energy consumption and GHG emissions, CEPs examine energy consumption not just in terms of its contribution to climate change but also from the perspective of energy security, local economic development and other community priorities. These benefits are discussed in more detail below.

> A renewable energy strategy is a tool for identifying community energy priorities and for supporting stakeholders within both the City administration and community at large in the advancement of joint strategies and initiatives.

2 'Municipal energy plan' is the term recently adopted by the Ontario Ministry of Energy as part of its Municipal Energy Plan Program. It is considered to be synonymous with a community energy plan.

3 Federation of Canadian Municipalities. (2017). "20 Years of Taking Action." Accessed electronically on August 29, 2017 from https://fcm.ca/home/programs/partners-for-climate-protection/20-years-of-taking-action.htm

4 Quality Urban Energy Systems of Tomorrow. (2017). "Frequently Asked Questions." Accessed electronically on August 28, 2017 from http://gettingtoimplementation.ca/category/faqs/

Why Develop a Community Energy Plan or Renewable Energy Strategy?

There are many benefits of developing a renewable energy strategy including economic development opportunities, job creation, energy security, climate change mitigation, legislative requirements and access to funding.

Local Economic Development

If given the proper signals, markets can play a key role in responding to global challenges such as climate change. Negotiation of the Paris Climate Agreement and its subsequent entering into force in November 2016 is one such market signal—and a powerful one at that. While there is still much to be determined about the scope and speed of international emission reduction efforts, the agreement, now ratified by 160 countries, points unequivocally to a carbon-constrained future.[5] In addition to bringing nearly every large national emitter into a global climate regime, a defining feature of the Paris Agreement is its emphasis on non-state actors—subnational governments, cities and businesses—and their role within the new climate framework.[6]

At the domestic level, one of the most powerful market signals about to enter force is the federal government's commitment to require a price on carbon in all Canadian provinces and territories beginning in 2018.[7] In Ontario, businesses are already working within a framework of limited emission allowances as a result of the provincial Cap and Trade program, a form of carbon pricing that came into effect in 2017. Ontario businesses that import electricity, supply fuel or that emit more than 25,000 tonnes of GHG emissions per year are now required, by law, to purchase annual emission allowances equivalent to what they generate. As the provincial cap on GHG emissions is lowered each year and the amount of province-wide emission allowances is reduced, businesses that take concerted measures to curb their carbon output will therefore see distinct economic advantages.[8]

Supporting Ottawa's local businesses in the transition towards a low-carbon economy will not only help these companies reduce their costs; it also represents an opportunity to create good local jobs, attract investment and to keep a greater share of energy dollars (expenditures) within the local economy. These local economic development benefits are outlined in more detail below.

Job Creation

Reducing energy consumption and promoting the use of renewable energy is already credited with the creation of new green jobs in manufacturing, construction and trades. According to the International Renewable Energy Agency, the global renewable energy sector employed 9.8 million people in 2016. The number of people employed in solar power alone is estimated at 3.1 million—more than double the number of jobs attributable to large hydropower.[9] In Canada, there were an estimated 10,500 jobs related to wind power and 8,100 jobs associated with solar power in 2015.[10] The provincial Green Energy Act, adopted in 2009, has helped to ensure that many of these jobs are located in Ontario. According to Natural Resources Canada, for example, the largest solar-power installations built in Canada to date are all located in Ontario.[11]

5 United Nations Framework Convention on Climate Change. Paris Agreement – Status of Ratification. Accessed electronically on September 6 from http://unfccc.int/paris_agreement/items/9444.php

6 Hale, T. (2016). "All Hands on Deck": The Paris Agreement and Nonstate Climate Action. *Global Environmental Politics*, 16(3).

7 Prime Minister of Canada. (2016). Prime Minister Trudeau delivers a speech on pricing carbon pollution. Accessed electronically on September 6 from: http://www.pm.gc.ca/eng/news/2016/10/03/prime-minister-trudeau-delivers-speech-pricing-carbon-pollution

8 Government of Ontario. (2017). Cap and Trade. Accessed electronically on September 6, 2017 from https://www.ontario.ca/page/cap-and-trade

9 IRENA. (2017). Renewable Energy and Jobs: Annual Review 2017. Accessed electronically on September 7, 2017 from https://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2017.pdf

10 Clean Energy Canada. (2017). The Transition Takes Hold: Tracking the Energy Revolution 2017. Accessed electronically on September 6, 2017 from cleanenergycanada.org/resources/reports/

11 Natural Resources Canada. (2017). Energy Fact Book: 2016-2017. Page 88. Accessed electronically on September 7, 2017 from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/EnergyFactBook_2016_17_En.pdf

The job creation potential associated with energy efficiency is equally well established. Retrofitting existing homes and buildings increases the demand for various low-carbon and renewable energy technologies while also generating a demand for workers who can perform building upgrades, such as adding insulation, installing building automation systems, or replacing old and inefficient furnaces. Between schools, hospitals, apartments and homes, the current Ontario Climate Change Action Plan (2016-2020) has allocated approximately $1.8 billion to $2.6 billion for improving the energy efficiency of Ontario's built environment.[12] The plan earmarks a further $45 million to $70 million to support apprentices, skilled trades and other building professionals in developing green building skills.[13] These investments have the potential to create over 30,000 green jobs over the five-year lifecycle of the plan.[14]

Attracting Investment

While Ottawa has several features that contribute to its overall reputation and image—its designation and history as the capital of Canada, to name one example—it has also managed to cultivate a distinct reputation as a centre for innovation. Home to dozens of federal research agencies and laboratories as well as several post-secondary institutions, in 2010 the city was named one of the top seven intelligent communities in the world by the Intelligent Community Forum.[15] According to the most recent Ottawa Business Growth Survey, Ottawa's reputation as an innovation hub continues to grow, with local business confidence highest among technology-sector companies.[16]

In addition to advancing climate change and sustainability objectives, a local renewable energy strategy can directly support efforts to promote innovation, entrepreneurship and technology development in Ottawa—key objectives of the City's updated Economic Development Strategy and recent Innovation Pilot Program.[17] One direct connection is the contribution of energy efficiency and renewable energy technologies towards the development of Ottawa's clean technology sector. Ottawa is home to an estimated 240 clean technology companies, and the sector is one of six high-growth "Knowledge-Based Industries" local economic development organization Invest Ottawa is currently working to support.[18]

Energy information and technology is also considered to be a key element of smart cities—the concept of using information and communication technology to deliver more effective municipal services and to grow the local knowledge-based economy. With potential applications ranging from

12 See Ontario's Five-Year Climate Change Action Plan (2016-2020), pp.65-69.

13 Government of Ontario. (2017). Ontario Helping Skilled Workers Train for Green Jobs. Accessed electronically on September 6, 2017 from https://news.ontario.ca/maesd/en/2017/08/ontario-helping-skilled-workers-train-for-green-jobs.html

14 Environmental Defence, Blue Green Canada and Clean Economy Alliance. (2017). Building an Ontario Green Jobs Strategy: Ensuring the Climate Change Action Plan Creates Good Jobs Where They Are Needed Most. Accessed electronically on September 6, 2017 from http://environmentaldefence.ca/wp-content/uploads/2017/04/EDEF_GreenJobsPrimer-WebRes-FINAL-FINAL.pdf

15 Intelligent Community Forum. (2017). The Top7 Intelligent Communities of the Year. Accessed electronically on September 14, 2017 from http://www.intelligentcommunity.org/top7

16 Welch LLP and Ottawa Chamber of Commerce. (2017). Ottawa Business Growth Survey 2017.

17 See City of Ottawa Innovation Pilot Program.

18 Invest Ottawa. (2017). Clean Technologies. Accessed electronically on September 14, 2017 from https://www.investottawa.ca/clean-technologies/

smart grids and energy storage to automated electric vehicles and smart mobility systems, community energy planning will support the City as it looks for opportunities to advance the Smart City 2.0 strategy (forthcoming).

Local Energy Dollars

According to the Federation of Canadian Municipalities, medium to large cities spend an average of $2.7 billion per year on energy—large expenditures that typically leave the municipality.[19] Energy consumption data obtained from local utility providers in Ottawa yields a similar but more accurate estimate, with Ottawa residents spending $3.0 billion—or roughly $3,200 per capita—across all energy types in 2015.[20]

By examining the supply and the cost of energy consumed locally, there is an opportunity to keep millions of energy dollars circulating within the local economy, with benefits ranging from business retention and attraction to housing affordability.[21] Hydro Ottawa is one example of a local energy company that aims to create long-term value for its shareholder, the City of Ottawa, and the communities it serves. In 2016 the company yielded a record $20.6 million dividend payment to the City—money that is directly invested into City programs and services.[22]

Low Carbon Cities Canada (LC3)

Another opportunity for Ottawa is establishing a Low Carbon Innovation Centre (LCIC) as part of a new Low Carbon Cities Canada (LC3) initiative with community partners in the region. Recently, Ottawa's community partners were approached by the Atmospheric Fund (AF) (formerly the Toronto Atmospheric Fund (TAF)) seeking to establish LCIC's across Canada.

A LCIC is an organization that helps accelerate multiple stages of the innovation process, whether those are technological, financial, policy, behavior change or combinations thereof. The intention is that LCIC's invest in demonstrating, de-risking, and unsticking relevant, local solutions. In other words, a dedicated capacity to support cities to create, refine and/or develop, eliminate barriers to, and scale up solutions that can achieve significant GHG reductions and the multiple benefits associated with a low carbon urban economy.

The Centre would complement but not duplicate or compete with existing local initiatives to advance clean energy and reduce emissions. It will also target significant co-benefits, including economic development, health, inclusion (e.g., reduced energy poverty), and energy resilience. Ottawa's LCIC will be networked with other local centres to boost knowledge-sharing and accelerate innovation.

Ottawa Skyline

19 Federation of Canadian Municipalities. (2016). Partners for Climate Protection National Measures Report 2015. Page 7. Accessed electronically on September 20, 2017 from https://fcm.ca/home/programs/partners-for-climate-protection/national-measures-report.htm

20 See Baseline Energy Study for Ottawa 2015: Including Supply Origin, Fuel Type, Use by Sector, GHG Impacts and Cost.

21 QUEST – Quality Urban Energy Systems of Tomorrow. (2016). Community Energy Planning in Ontario: A Competitive Advantage for Your Community.

22 Hydro Ottawa Holding Inc. (2017). Annual Report 2016.

Ottawa is one of six participating jurisdictions (including TAF), aiming to submit a proposal to the federal Low-Carbon Economy Fund in Fall 2017. If the proposal is accepted, each centre would receive a substantial endowment, likely in the order of $15 to $30 million. Via both investments (loans) and grants, the funds would directly support key, strategic opportunities in the local community, and leverage additional resources from an array of other sources, including the province, private impact investors, private donors, and other foundations.

The Ottawa Community Foundation is working with a group of about 20 contributors with relevant expertise and connections to develop the proposal, in collaboration with TAF and the other proponents.

Energy Security and Resiliency

Managing the uninterrupted availability of energy sources at an affordable price is fundamental to ensuring sustainable development, as well as protecting the well-being of residents and the bottom line for businesses. However, with a steadily increasing population and high energy demands, the challenge becomes how to manage that upward pressure while providing residents the same uninterrupted level of service.

The City has a key role to play in ensuring energy security through land-use planning and policy development in order to identify local priorities, reduce energy demand, and ensure energy resources are available. Identifying local energy resource opportunities can help to ensure local energy security, increase diversity of energy sources, promote economic competitiveness, and improve reliability of energy systems and resiliency to extreme weather events. Renewable energy technologies play an increasingly important role in energy security. For example, converting vehicles from fossil fuels to renewable fuel sources such as biofuels, or introducing new technology such as electric vehicles, can reduce reliance on a volatile oil supply.23 By diversifying local renewable energy sources, Ottawa decreases its reliance on the unpredictability of energy supply from outside the city boundary while boosting local economic growth.

Climate Change Mitigation

Climate change mitigation refers to actions undertaken to manage and reduce GHG emissions. Tackling climate change is a shared responsibility and residents, businesses, institutions, and senior levels of government all have an important role to play in mitigating emissions. Residents, businesses, and institutions make daily choices that make an impact, from how they heat their homes or buildings, to how they travel around the city. There are many benefits to taking action to reduce GHG emissions, including improved air quality, healthier communities, and sustainable cities for the future.

Flooded residential street after Hurricane Harvey

The FCM estimates that up to half of Canada's GHG emissions are under the direct control or influence of municipalities.[24] This includes control over land use planning, municipal operations (including wastewater treatment), and public transit. Ottawa's GHG emissions are broken down into five sectors: buildings, transportation, solid waste, wastewater, and agriculture. In 2012, buildings an d transportation made up roughly 90% of city-wide emissions, with the remaining sectors making up the other 10%.

The transition to renewable energy generation alone will not achieve Ottawa's target to reduce emissions by 80% by 2050. Directing efforts and actions forwards energy conservation and efficiencies in the buildings and transportation sectors are vital to achieving said target. These sectors, plus waste and energy storage, will be considered as part of Phase 2 of Energy Evolution.

23 International Renewable Energy Agency. (January 2015). Second Ministerial Roundtable: "The Role of Renewable Energy in Energy Security."

24 Federation of Canadian Municipalities Partners for Climate Protection. (September 2015). About Climate Change. Accessed electronically on October 15, 2017 from https://fcm.ca/home/programs/partners-for-climate-protection/about-climate-change.htm

Access to Funding

At all levels of government, achieving energy and emissions targets requires significant resources and investments. Senior levels of government rely on cities to help achieve many of their energy and emissions commitments, whereas municipalities typically do not have the necessary revenues to sufficiently fund local climate action and rely on funding from senior levels of government.

In 2017, both the provincial and federal governments launched a number of funding programs, representing tens of millions of dollars in support for action on climate change (see Appendix B for a list of funding opportunities). These programs are open to the City, the community, or both. In the case of the City, some funding programs require municipalities to meet special requirements in order to be eligible to apply. Ontario's Municipal GHG Challenge Fund,[25] for example, is a funding program that will cover up to 100% of eligible costs and municipalities may request up to $10M per project. However, in order to be eligible for funding, applicants must be an Ontario municipality with a Council-approved:

- Community-wide GHG emissions inventory
- Community-wide GHG emissions reduction target
- Community-wide strategy/plan to reduce GHG emissions
- Up-to-date O. Reg. 377/11 Energy and Conservation Demand Management Plans and annual reporting.

Initiatives such as Energy Evolution are essential to enabling the City to apply and gain access to funding that would otherwise be unavailable.

Legislative Requirements

Strong legislation and regulations are required at all levels of government if plans such as Energy Evolution are to succeed. At the Provincial level, there are a number of regulations that mandate that the City and/or the community monitor and report out on their energy use and GHG emissions.

Ontario Regulation (O. Reg.) 397/11: Energy Conservation and Demand Management Plans[26] requires public agencies, including the City, to report out annually on their energy use and GHG emissions. Also as part of this regulation, public agencies are required to develop a five-year energy conservation plan that is to be updated every five years.

O. Reg. 452/09: Greenhouse Gas Emissions Reporting[27] requires that facilities generating 25,000 tonnes or more of GHG emissions per year must report and verify their GHG emissions annually. This regulation will be revoked after the 2016 data reporting is complete and will be replaced by **O. Reg. 144/16: The Cap and Trade Program**.[28]

Additionally, **O. Reg. 20/17: Reporting of Energy Consumption and Water Use**[29] requires select, privately owned buildings that are 50,000 square feet to report annually on their energy and water consumption and performance data, as well as GHG emissions generated.

The Provincial Policy Statement (PPS) is issued under Section 3 of the Planning Act and all decisions affecting land use planning matters must be consistent with the PPS. **Bill 68, Modernizing Ontario's Municipal Legislation Act,** passed earlier this year, added climate change as a matter of provincial interest for decision makers to address in carrying out their responsibilities under the

25 Government of Ontario. (2017). Municipal GHG Challenge Fund. Accessed electronically on September 26, 2017 from http://www.grants.gov.on.ca/GrantsPortal/en/OntarioGrants/GrantOpportunities/PRDR017538

26 Queen's Printer for Ontario. (2017). O. Reg. 397/11: Energy Conservation and Demand Management Plans https://www.ontario.ca/laws/regulation/r11397

27 Queen's Printer for Ontario. (2017). O. Reg. 452/09: Greenhouse Gas Emissions Reporting. https://www.ontario.ca/laws/regulation/090452

28 Queen's Printer for Ontario. (2017). Report greenhouse gas (GHG) emissions. Accessed electronically on September 27, 2017 from https://www.ontario.ca/page/report-greenhouse-gas-ghg-emissions

29 Queen's Printer for Ontario. (2017). O. Reg. 20/17: Reporting of Energy Consumption and Water Use https://www.ontario.ca/laws/regulation/r17020.?_ga=2.21924219.158894369.1506439035-206449153.1506439035

Planning Act. The changes give broad powers to municipalities to pass by-laws respecting climate change and to participate in long term planning for energy use. The powers also allow municipalities to require green roofs or alternative roof surfaces in certain circumstances outlined in the Building Code.

There are also a number of provincial and federal regulations that are the responsibility of senior government but that can influence or are to be administered at the municipal level. For example, the way in which buildings are constructed and renovated is regulated by the Province through the Ontario Building Code (O. Reg. 332/12)[30], but is administered at the local level. Proposed amendments to the Building Code are now underway that include an improvement for building energy efficiency and are available to the public for review.

Ontario's newly introduced Cap and Trade Program (O. Reg. 144/16)[31] is another example where a regulation is the responsibility of the Provincial government, but that also has influence and impact at the municipal level. Notably, the funds from the Cap and Trade program are being used to fund the Climate Change Action Plan initiatives.

Considerations must also be given to agreements at the international level. Canada committed to the Paris Agreement with the goal of keeping global warming below 2°C, but it's commitment will largely be upheld by climate action initiatives at the local level.

Initiatives such as the Ontario Climate Change Action Plan and the federal Pan-Canadian Framework on Clean Growth and Climate Change will further explore how regulations can be bolstered to further direct or influence the reduction of energy and emissions.

The Role of the City

As a local authority with powers handed down by the Province, the City has direct control over a range of services that touch people's everyday lives and affect how energy is consumed, including housing, transportation systems, water and sewer infrastructure, and waste management. The City controls where and how growth will occur through the designation of land and in the development and enforcement of zoning by-laws. Building construction is also controlled through site plan control measures, urban design guidelines and building code enforcement. In carrying out its duties, the City partners with a number of associated agencies, including utility companies, the development industry, housing authorities, as well as other levels of government and the private sector throughout the National Capital region.

In addition to its regulatory powers, the City also plays a key role in bringing community stakeholders together to facilitate discussions and foster collaboration in planning and strategizing integrated approaches to achieve long term energy sustainability goals. Through education and civic engagement, the City has a responsibility to communicate the basis for and the pathways to take towards a long term sustainable energy future.

Despite the important role that the City plays in mobilizing forces toward a renewable energy future, there are limitations on the extent of power that can be exerted by local government. This is due in part to the limit on financial resources available to the city to take action on key initiatives, and also due to jurisdictional barriers. The City's energy readiness is therefore contingent upon all stakeholders and partners to commit to action within their specific jurisdictions (i.e. utilities, housing, development industry, etc.).


Ottawa City Hall

30 Queen's Printer for Ontario. (2017). O. Reg. 332/12: Building Code https://www.ontario.ca/laws/regulation/120332

31 Queen's Printer for Ontario. (2017). O. Reg. 144/16: The Cap and Trade Program https://www.ontario.ca/laws/regulation/160144

COMMUNITY ENERGY PLANNING IN OTTAWA: WHERE ARE WE NOW?

Energy and City Building

Official Plan and Transportation Master Plan

The Official Plan integrates renewable energy considerations into the broader context of building a sustainable and resilient city and improving the quality of life of citizens. Energy considerations affect many city building priorities, including the supply of roads and sewers, housing and the conservation and protection of the natural environment. Rising energy costs are one of the key considerations in moving towards more sustainable forms of housing and transportation. Ottawa will meet the demands of the 21st Century by planning sustainable, livable and resilient communities which are cleaner and greener and consume less energy for travel and housing. Energy which is supplied from green, renewable sources will help to further this goal.

Complete and compact communities offer the greatest potential for high efficiency energy systems. They have attractive transportation options, including good transit service, well connected streets, good public realm and open spaces and offer a mix of housing with convenient access to services and the workplace. Energy use decreases in this form of development because less energy is required per occupant to heat and cool smaller dwellings, and trip distances and travel times are reduced with viable alternatives to the automobile. The Transportation Master Plan, as well as the Ottawa Pedestrian Plan and Ottawa Cycling Plan are supporting documents to the Official Plan, playing an important role in reducing the city's energy consumption by supporting walking, cycling and transit priorities. The Infrastructure Master Plan also plays a role by enabling Official Plan objectives.

Energy planning also enhances the quality of the natural environment by reducing energy consumption, improving air quality and minimizing the demand for land and resources. Support for energy efficient and green design measures help to reduce the impact of the built environment. This is achieved in the review of new development such as subdivisions by taking into account building orientation for solar exposure, protecting sensitive environmental features in the design of stormwater management areas and giving consideration to alternative energy systems.

Earlier this year, climate change became a matter of provincial interest through amendments to the Planning Act. The City's role in the transition to renewable energy sources is therefore paramount in planning and developing low carbon communities. The transition to a low carbon economy and response to changing climate requires a shift in how people live, work and move. Over the next few years, the City will initiate important steps to strengthen the relationship between land use and transportation as we move towards this goal. We should therefore expect to see some changes in the way our city will look and function on the not so distant horizon, such as the following:

- Climate change mitigation and adaptation to guide and inform the next comprehensive review of the Official Plan and associated master plans.
- A focus on reducing and managing traffic congestion and transportation emissions.
- Bylaws setting out new green development standards.
- Changes to the Building Code with long term energy efficiency targets for new net zero carbon emission small buildings by 2030.
- Low carbon technologies
- Parking reductions (minimum parking requirements)
- An increase in electric vehicle charging stations on surface parking lots.
- Energy audit requirements

While it is difficult to predict the future, there are a number of trends occurring that can help us to predict it. We know that by 2050, 75% of the world's population will be living in cities.[32] As the rate of urban growth increases over time, so too will the demand for energy to support this growth. Citizens and their local leaders will have a better understanding of where their energy comes from when they turn on the switch. Harnessing the natural energy from local sources rather than purchasing it from outside, often polluting sources imposes a recognition of the link between the value of energy and its use.

The greatest development in modern times is the digital revolution, where communication using smartphones and the internet has become second nature. Urban spaces must also reflect the changing patterns of work with telecommuting and home based businesses. Technological tools also have the power to improve the efficiency of city services, find cost savings and streamline tasks. The real-time monitoring of energy use has already been tested in some cities, for example, by installing boxes on municipal light poles with sensors and cameras to capture sound levels, temperature, water levels on streets and storm drains, and traffic, acting as a form of "fitness tracker for the city."[33]

Cities can integrate renewable energy, as well as energy-saving technologies, into the urban landscape. We can therefore expect to see changes in the way we treat the built form. The fabric we create will need to make spaces more comfortable and efficient. The skin of the building will perform differently based on light and temperature to insulate itself while taking carbon out of the atmosphere. For instance, where solar panels have ttraditionally been limited to the roof, researchers have developed transparent solar panels that can be mounted on windows in order to capture more sunlight. This design could allow buildings to generate even more of their own power from solar energy in the future. Renewable energy sources are likely to become more competitive as storage technology improves. The integration of many different technological innovations will likely be necessary for success.

Framing Our Future

The Capital Region's goals for economic prosperity, social well-being, culture and identity and a healthy environment are common to three different governance bodies in the region. In 2012, the City Councils of Ottawa and Gatineau as well as the Board of the National Capital Commission received the forward looking Framing Our Future and its two sub-plans, the Energy and Emissions Plan and Risk Prevention and Mitigation Plan. The ten themes and strategies from Framing Our Future, although high level, now guide both the strategic direction of Ottawa's Official Plan and Corporate Planning Framework. The strategies provide the structure for creating a more sustainable, liveable and resilient region with climate change and renewable energy being two of the City's long term sustainability goals.

Air Quality and Climate Change Management Plan (AQCCMP)

The AQCCMP is a local action plan establishing a framework for how Ottawa will mitigate and adapt to climate change over the next 20 years. It was first completed in 2005 and updated in 2014.

The AQCCMP set new goals and objectives, a GHG reduction target, and performance measures. These elements were informed by the following principles that also support Energy Evolution:

- Everyone has a responsibility to manage energy consumption and to mitigate risks
- Collaboration is needed amongst various levels of government, utilities, stakeholders, and the broader community to effect change.
- Municipal leadership is needed to ensure an integrated and comprehensive approach across the corporation and the community.

To emphasize the need for individuals and organizations to take action moving forward, the AQCCMP set a short-term, community-wide target to reduce greenhouse gas emissions by 12% below 2012 levels by 2024. In February

32 BBC Future. (May 2013). Plugging tomorrow's cities into greener power sources. Accessed electronically on October 23, 2017 from http://www.bbc.com/future/story/20130522-plugging-cities-into-green-energy

33 Futurism. (February 2017). The Cities of the Future Will Be Efficient, Sustainable, and Smart. Accessed electronically on October 23, 2017 from https://futurism.com/how-to-ensure-smart-cities-benefit-us-all/

2016, a subsequent long-term target was set by Council to further reduce emissions by 80% below 2012 levels by 2050.

As part of the AQCCMP, a number of performance measures were set to help reach these targets that also support Energy Evolution:

- Reduce per capita community electricity use by 6% by 2020 (base year 2012)
- Reduce per capita residential natural gas consumption by 15% by 2020 (base year 2012)

In 2015, the AQCCMP was identified as a strategic initiative under the 2015-2018 City Strategic Plan, and a number of initiatives representing close to $1.8B in investments were also identified that support the goals and objectives of the AQCCMP. Highlights of these investments can be found in Section 2.2 of the document.

Notable Energy Initiatives in Ottawa

The energy evolution towards renewable energy generation and conservation efforts is not new to Ottawa and its community partners. Independent actions are already under way that continue to contribute to moving the city towards a low carbon economy. Without a strategy to determine where Ottawa's most impactful areas for change are however, it is difficult to prioritize and lead which long-term actions can have the most effect on move Ottawa towards being powered by clean, renewable energy. Even as this strategy is being developed, both the City and other community partners continue to shift technologies, find energy efficiencies and plan for a clean economy. Below are several larger scale initiatives that demonstrate this shift.

Investments in Light-Rail Transit (LRT)

Ottawa will complete its first phase of LRT (13 stations) by 2018. When the Stage 2 LRT is completed in 2023, passengers travelling on the electric powered Confederation Line will be able to travel emission-free from Trim Road in the east to Moodie Drive in the west. The Confederation Line will be served by environmentally friendly Alstom Citadis Spirit trains able to accommodate up to 600 passengers, with zero emissions and a regenerative braking system that provides power back to other trains on the Confederation Line.

Aligning with provincial and federal priorities on the environment, the first stage of the O-Train Confederation Line LRT project will reduce Ottawa's GHGs by approximately 94,000 tonnes per year by 2031. Once the Stage 1 and Stage 2 LRT projects have been constructed, Ottawa's greenhouse gas emissions will be reduced by at least 204,000 tonnes annually by 2048.

Bird's eye view of Blair Light Rail Station

The economic value of these reductions will total $438 million between 2023 and 2048. Reduction of approximately 110,000 tonnes of GHGs and 3,000 tonnes of CACs (including carbon monoxide, nitrous oxides, sulphur oxides and particulate matter) per year by 2048. The economic value of these reductions will total $32 million annually by 2048 (in 2018).

Municipal Green Building Policy

Approved by Council in 2005, the City's Green Building Policy requires that all newly constructed municipal buildings with a footprint greater than 500 square metres be designed, delivered and certified by the Canada Green Building Council as being LEED (Leadership in Energy and Environmental Design) Certified. In 2015, the City's Environment Committee provided direction to staff to support the targeting of LEED Gold certification for newly constructed corporate buildings where appropriate (e.g., considering the size and type of facility as well as the complexity of the project).

As of April 2017, the City owned 26 LEED certified buildings, including five built to LEED Gold certification and 11 built to LEED Silver certification. Three additional City facilities are currently undergoing LEED certification, and three buildings under development plan to target LEED certification.

Construction is underway at the Ottawa Art Gallery Expansion and Arts Court Redevelopment, and the public component is striving for LEED Silver certification. The private sector component is incorporating sustainability features such as energy recovery and building monitor systems.

Corporate Electric Vehicle Charging Station Policy

In 2017, the City developed a policy for electric vehicle charging stations on City property. The purpose of the policy is:

- To support the use of electric vehicles through the provision of charging infrastructure on City property
- To support the use of electric vehicles in Ottawa to reduce greenhouse gas emissions in the transportation sector.

The policy mandates when charging stations are to be installed at new City facilities and Park and Ride lots, as well as introduces an ownership model, a user fee structure, and accessibility requirements.

In 2016, Electric Circuit, a subsidiary of Hydro Quebec, was awarded funding through the Ministry of Transportation's Electric Vehicle Chargers Ontario program to install Level 2 charging stations on City property, as well as DC Fast Chargers (a first for Ottawa). A total of seven Level 2 charging stations and six DC Fast Chargers have been installed by Electric Circuit on five City sites and are publically available. These charging stations are in addition to the existing Level 1 and Level 2 charging stations already publically available at City sites.

Solar panels mounted on the roof of the City Hall of Ottawa

Municipal Green Fleet Plan

Since 2009, the City's Municipal Green Fleet Plan sets forth initiatives that aim to reduce the City's carbon footprint within the municipal fleet to help reduce fuel use, improve air quality, and decrease GHG emissions. In 2017, Fleet Services established a target to reduce GHG emissions produced by the municipal fleet by 1% per year (using 2013 as the base year) by the end of 2018. Key initiatives undertaken through the Municipal Green Fleet Plan to achieve said target include:

- Purchase of 77 hybrid and/or electric vehicles that are currently in service within the municipal fleet (including four electric ice surfacers)
- Installation of anti-idling devices in the entire fleet of City ambulances
- Launch of a vehicle telematics trial for municipal fleet vehicles
- Researching and piloting the use of alternative fuels (e.g. compressed natural gas and biodiesel)

Additionally, Council recently passed a motion to allow Fleet Services to purchase hybrid and electric vehicles in 2017 and 2018 on behalf of their clients when (a) hybrid and electric options exist in the market, (b) where those vehicles meet operational needs, and (c) where there is available funding to purchase them.

Electric Circuit charging station

Building Engineering and Energy Management (BEEM)

The Building Engineering and Energy Management section was formed in the City's Public Works Department ten years ago and now is part of the Recreational, Cultural and Facility Services Department. The section's core work involves energy conservation retrofits and expanding and improving building automation.

Work in these areas is impressive, as Ottawa's fleet of buildings has expanded, absolute energy consumption has declined slightly and energy consumption per unit of floor space has headed downwards considerably. The identification of conservation opportunities can come from BEEM's auditing, but facilities staff and building trades have also been instrumental in identifying opportunities and coming up with practical improvements. Finally, BEEM co-ordinates closely with the life cycle group to ensure that when equipment comes to end of life, new equipment meets internal specifications and can address any legacy deficiencies in a facility.

With regards to building automation, the City has one of North America's largest web-based building control systems. This tool has been indispensable for conservation initiatives and has allowed facility staff to address building issues without trips to a particular site, thereby saving time, staff call-ins and vehicular travel. The system has many of the components of Smart City infrastructure such as alarming and trending that allow efficient and responsive operation of building heating and ventilation systems. The examples below demonstrate how the system has helped the performance in City buildings.


Complete Street along Churchill Avenue

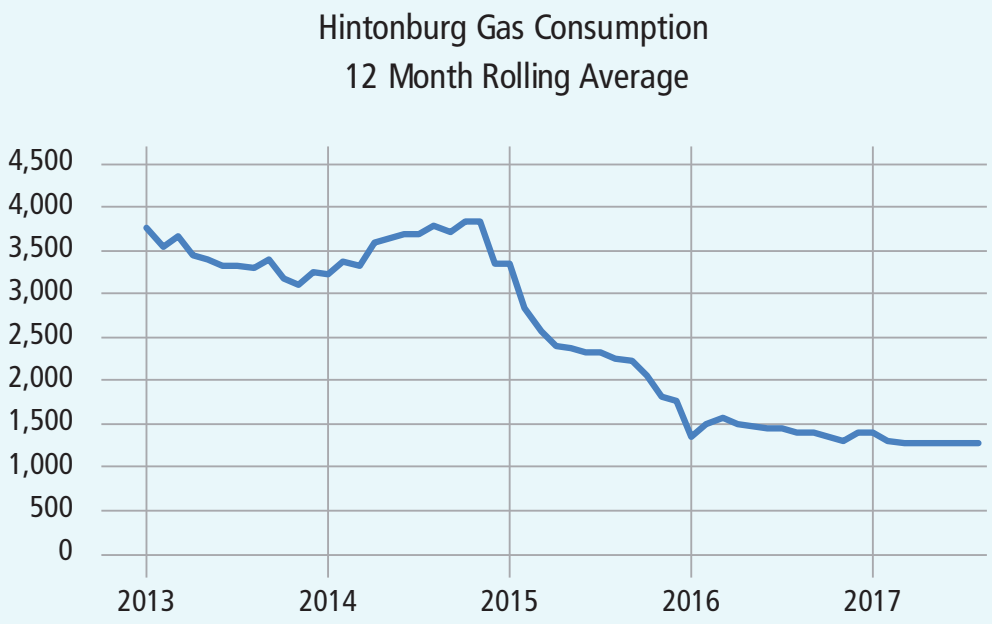


Figure 1: Conservation Project Results

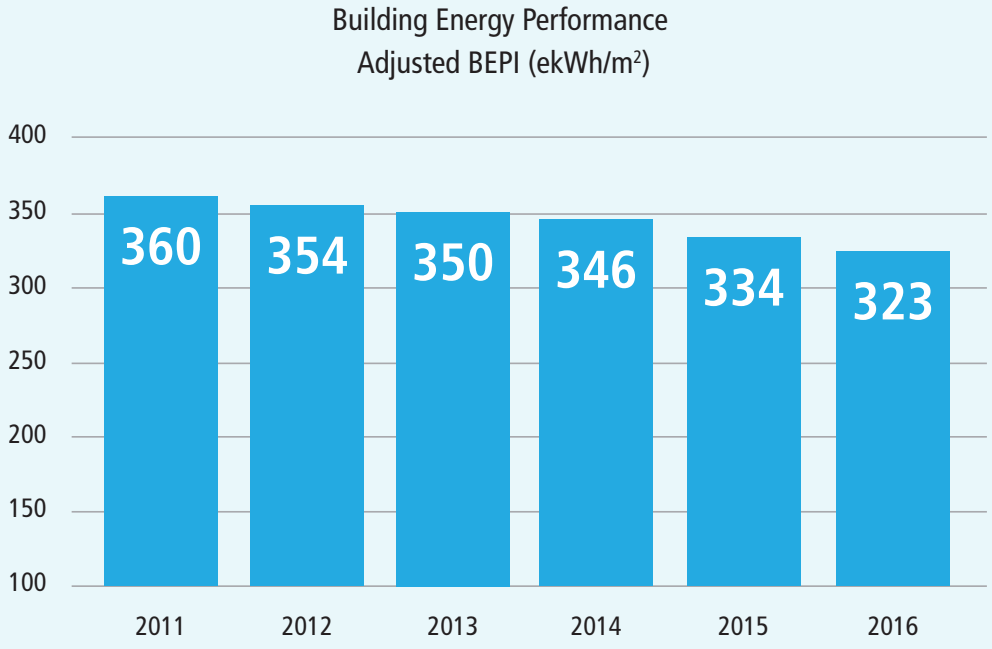


Figure 2: City Facilities Performance – Energy per Unit Floor Space

Complete Streets Implementation Framework

The Complete Street Implementation Framework has been applied on a number of city streets with positive outcomes. The overall intent of the framework is to examine the needs of all people, including those who choose to walk, bike, drive or take public transit as part of the initial street redesign process. Although different design elements are used based on function and geographic location, the goal is to accommodate the needs of all street users early in the review process. Successful projects to date have been carried out on Main Street, O'Connor Street as well as on Churchill Avenue.

A key aspect of the framework is that the measurement of traffic now includes more than just vehicles. Criteria in the new guidelines now requires an assessment of impact on all road users. Changes may include wider sidewalks, narrower intersections and bike lanes that are separated from traffic.

Hydro Ottawa and Energy Ottawa

Energy Ottawa is an affiliate of Hydro Ottawa established in 2000 following restructuring of the Ontario electricity market. At the time, a number of older EB Eddy generating stations at Chaudière Falls came onto the market. Energy Ottawa assumed these and opened their doors. From inception, Hydro Ottawa has been Ontario's largest municipally owned generation company.

A few years after start up Energy Ottawa grew to focus on two key areas: energy generation and energy services. The energy generation division went to work refurbishing its newly acquired assets at Chaudière Falls and then started to work on other generation including the landfill gas-to-energy plant at the Trail Road Waste Facility, as well as rooftop solar at several sites. More recently, Energy Ottawa has acquired ten generating stations in Eastern Ontario and upstate New York and are currently completing a 29 MW expansion of generating capacity at Chaudière Falls. Once the Chaudière Falls expansion is complete, Energy Ottawa's generation capacity will total 120 MW.

The energy services division of Energy Ottawa has also been an area of business growth and includes energy management and analysis which helps consumers identify and act on energy efficiency opportunities and turnkey services. They provide complete energy conservation with a scope of work which includes engineering, procurement and project management. Projects are not limited to electrical savings as Energy Ottawa has developed solid expertise in HVAC equipment. The energy services division is currently in the process of changing over Ottawa's streetlights to energy efficient LED technology. This project will save the City $4 million dollars annually.

A recent addition to Energy Ottawa's work is a division that offers technical expertise in electrical equipment testing and power system analysis. Having such services located in Ottawa is a valuable service to many of Ottawa's larger power consumers.

Ottawa Community Housing Asset Renewal

Ottawa Community Housing (OCH) is striving to achieve the highest financially feasible energy performance in new developments by taking inspiration from leading energy certifications like Passive House[34]. The Ottawa Community Housing ECO2 Plan focuses on piloting green energy technologies and programs as part of their long term commitment to sustainability for the good of the tenants, the city and the environment.

As the second largest housing provider in Ontario and the largest social and affordable property managers in the city, OCH recognizes the significant contribution they are making in implementing energy efficient strategies. "Considering the size of OCH's housing portfolio, with 15,000 homes, even the smallest changes like changing light bulbs or replacing toilets, have a tremendous impact on the environment."[35]

Gradual improvements to OCH's housing portfolio are planned, which will include green building practices, building automation and control systems, retrofits and renovations,

34 Passive House (Passivhaus) is a rigorous energy and building design standard that uses landscaping features (e.g. passive solar) and highly insulated building envelopes to achieve cost effective, low energy consuming homes.

35 Ottawa Community Housing. (August 2016). ECO2 Plan: Leading the social housing sector towards sustainability. Accessed electronically on October 23, 2017 from http://www.och-lco.ca/och-eco2-plan/

and renewable energy installations. To date, OCH has deployed 35 solar projects; 32 solar photovoltaic systems that produce green electricity for the Ontario grid, 2 solar thermal domestic hot water systems and a solar wall which reduces natural gas demand on an air makeup unit.

Federal Government Energy Services and Acquisition Program (ESAP)

The Parliament Buildings and almost 80 other public and privately owned buildings in the city are linked to a district energy system that connects to central plants using over 14 kilometers of underground piping to provide heating by steam and cooling by chilled water. This system is one of the largest public sector energy production and distribution systems in North America and was built between 1915 and 1970. It is now outdated so the Energy Services Acquisition Program will modernize the network of plants that heat and cool the buildings with new technologies that allow the use of low temperature hot water to reduce energy use. The Federal Government will seek opportunities to extend its heating and cooling systems to other partners including the City.

The Federal Government is also pursuing carbon neutral energy sources in order to reduce greenhouse gas emissions. Public Services and Procurement Canada is testing alternative energy sources through a pilot project using wood chips. The results of the project will determine the potential for expanding this option to other heating and cooling plants and will measure energy efficiency and greenhouse gas emissions.

Leading Sustainable Developments

Arcadia (Kanata)

In 2013, with funding from the Federal government, home-builder The Minto Group was one of five production builders selected and tasked with constructing at least 25 Net-Zero Energy (NZE) market-ready homes. The project, led by BuildABILITY, was intended to address the growing need for NZE production housing in order to reduce energy consumption and reduce greenhouse gas emissions in the housing sector. In 2015, Minto unveiled its' first net zero energy model home within the Arcadia subdivision in Kanata. Four net-zero townhomes were also constructed.

Upgrades to the homes includes advanced insulation, triple pane windows, LED lighting, and a heat recovery drain and ventilator system. The home consumes 65% less energy than the average home built that year.

Since 2009, Minto has certified over 1,400 units under various LEED programs and is committed to achieving a minimum of LEED Silver certification on all new high-rise developments.

Zibi

Windmill Developments in partnership with Dream Unlimited Corp., is planning to develop a large 37-acre site with sections along the Gatineau waterfront and two islands along the Ottawa River, approximately 2 kilometers from downtown Ottawa. The development, known as Zibi, will eventually bring 1,200 condo apartments, office space, retail and a substantial amount of new park space.

The developers are committing to the One Planet Action Plan, a set of sustainability goals with the aim of achieving the highest green building standards for materials, water, energy and indoor air quality, and creating a zero carbon sustainability showpiece. This includes creating habitat protection, outdoor recreation, community agriculture and connecting the site with adjacent open spaces. The plan is to also provide local, organic and fair trade products in restaurants and shops, provide cleaner transportation options, creating quality affordable housing and jobs, and promote a healthy lifestyle. Zibi is intended to be Canada's first carbon-neutral master planned community.

Ottawa Renewable Energy Co-operative

Collectively, members of the Ottawa Renewable Energy Co-operative have invested $7 million in the local renewable energy sector through long-term investments. The co-op owns more than 3 MW of solar energy production at over 20 sites across the region, including rooftop solar systems on six high schools. The co-op has also launched an energy retrofit program, financed by co-op members, for tower-type residential buildings.

Energy Consumption in Ottawa (2015)

According to the Baseline Study of Energy Use prepared by Leidos Canada,[36] Ottawa residents consumed approximately 114,000 terajoules (TJ) of energy in 2015. This figure includes all major types of energy used within the city, ranging from natural gas, oil and propane used for space and water heating to gasoline and diesel used in personal and fleet vehicles. As outlined in Figure 3 below, natural gas is the most consumed type of energy in the city, followed by electricity and gasoline. Together, these three energy types accounted for roughly 93% of the total energy consumed in Ottawa in 2015.

Broken down by activity sector, energy consumption in Ottawa appears to be fairly evenly split between the industrial, commercial and institutional sector (39%), the residential sector (34%) and the transportation sector (27%) as shown in Figure 4 below.

Like most cities, energy consumption in Ottawa is therefore primarily influenced by energy consumed in buildings and by transportation activities. Based on this energy consumption profile, Ottawans generated approximately 5,200,000 tonnes of GHG emissions in 2015 through energy consumption.

Wood as biomass was not included in the baseline study and no localized data exists for wood heating in Ottawa. Statistics Canada only gathers data on primary heating systems. Nationally wood is the primary heating source in 3% of Canadian residences and is more often employed as a secondary source of space heating. Applying the 3% to Ottawa suggests that wood as biomass provides approximately the same amount of heating as propane or fuel oil, in a range from 3400 to 3700 TJ. This is factored into the Pathway Conclusions on page 44.

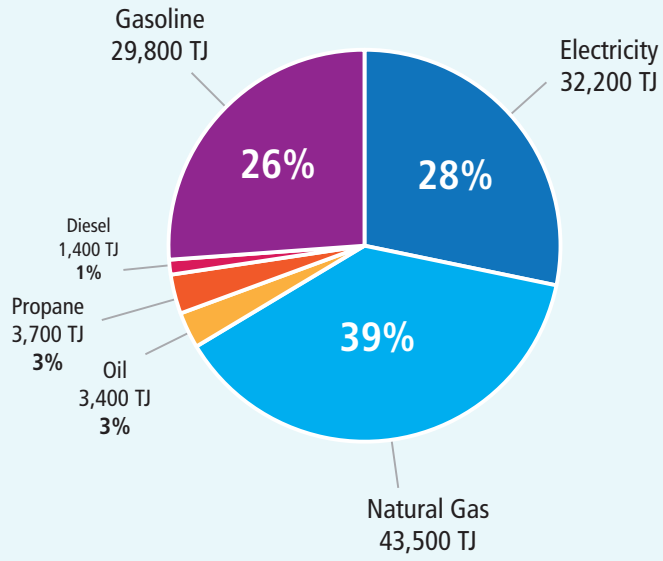


Figure 3: Ottawa energy supply by type in energy units of TJ and as a % of total energy supply (2015)

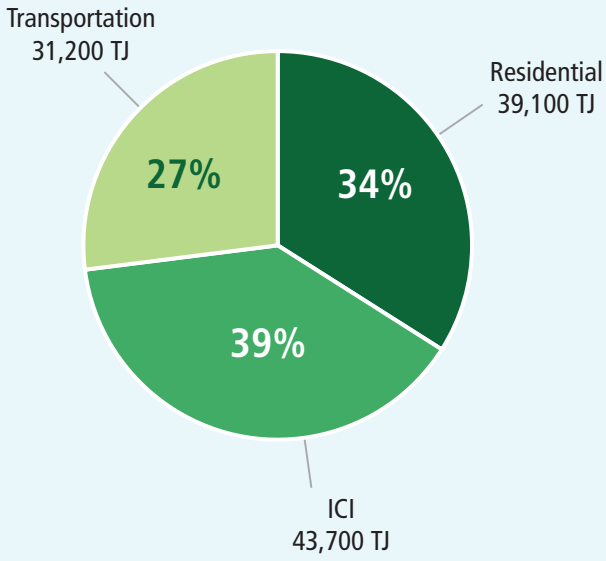


Figure 4: Ottawa energy use by sector, shown in energy units of TJ and as a % of total energy supply (2015)

36 See Baseline Energy Study for Ottawa 2015: Including Supply Origin, Fuel Type, Use by Sector, GHG Impacts and Cost.

Units of Energy Explained

Energy is measured in different units depending on their source (e.g. Kilowatt-hour (kWh) for electricity, Cubic metres (m^3) for natural gas, or Litres (L) for gasoline. A common unit of measurement is therefore required when aggregating energy consumption across the various types.

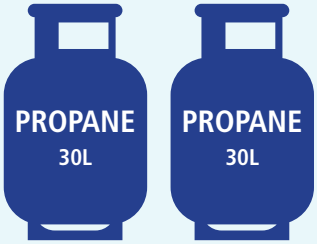
The unit commonly used is the Joule.

Given that the Joule is a relatively small amount of energy, energy consumption is often discussed in terms of Gigajoules (GJ) or Terajoules (TJ). The following is used to illustrate the Joule:

1GJ = 1 Joule x 10^9

1GJ = 277.778 kWh

1GJ =

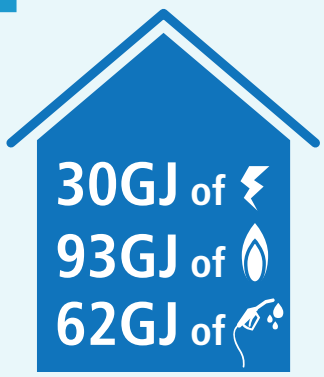


1TJ = 1 Joule x 10^{12}

1TJ =

x 2,200

In one year, the average household in Ontario uses:



Where Does Ottawa's Energy Come From?

Despite relatively large and well-tapped waterpower resources located on the Ottawa River, only a small fraction of the energy consumed in Ottawa is currently generated from local renewable energy sources. Of the 114,000 TJ of energy consumed in 2015, approximately 5% was generated locally within the geographic boundary of Ottawa. The remaining 95% of energy consumed by Ottawa residents was imported from outside the city, which means that Ottawa is heavily reliant on and vulnerable to decisions made in domestic and international energy markets.

Most of the money Ottawa residents spends on energy costs flows to entities located well outside the boundaries of city. In 2015, for example, Ottawa residents sent roughly $2.5 billion in energy expenditures to companies not located within the city. Of the total $3.0 billion spent annually on energy costs, it is estimated that only 17% or $510 million remains in the community as revenue for local businesses.

The Sankey diagram below (Figure 5) illustrates the supply of various energy types from both imported and local sources and their various end uses within the community (residential, industrial/commercial/institutional and transportation respectively).

Demand for energy will almost certainly increase over time as the city grows. In the absence of a concerted strategy to promote energy efficiency and local renewable energy opportunities, businesses and residents of the city will become more reliant on imported energy along with the external factors that determine its price and availability.

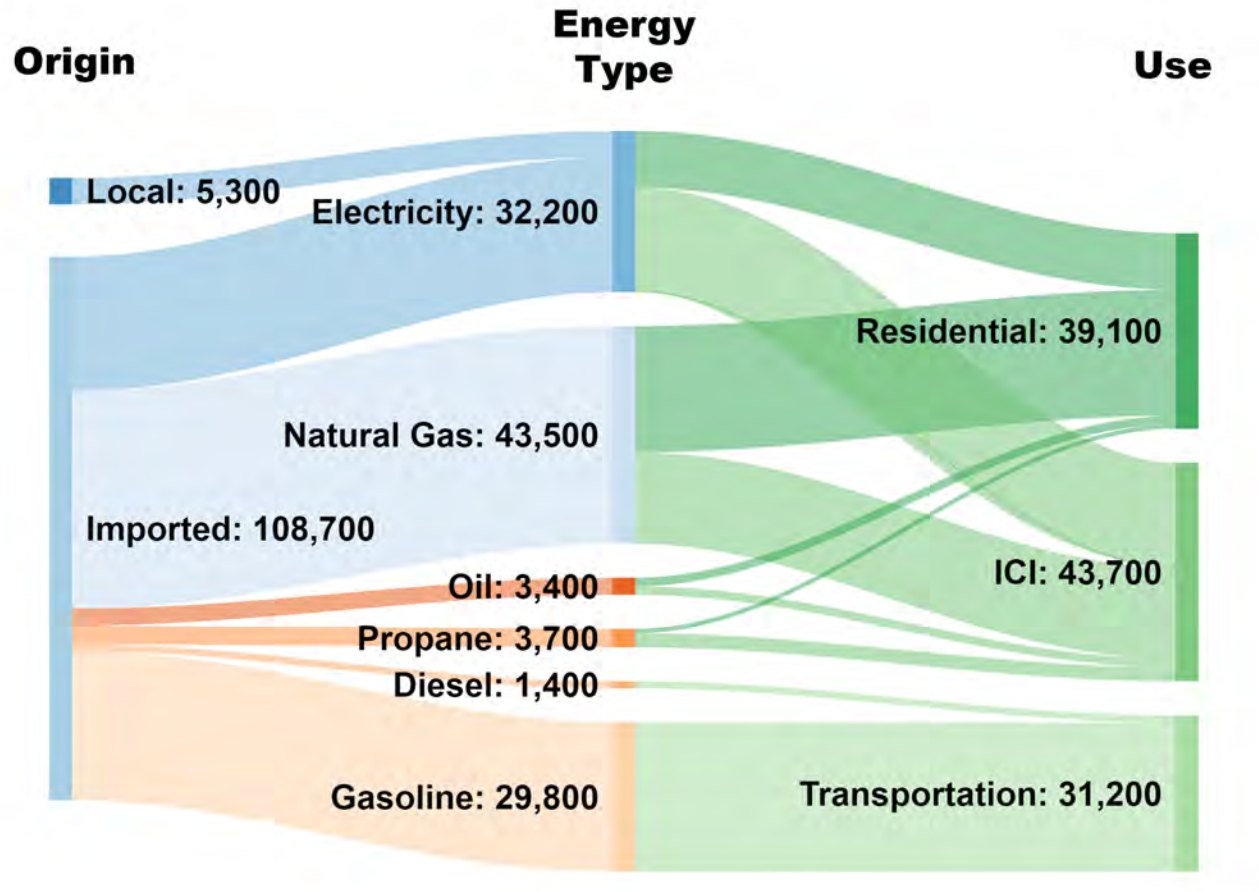


Figure 5: A Sankey diagram showing the flow of energy by supply into usage. Values are in TJ. Diagram created using SankeyMATIC.

DEVELOPING ENERGY EVOLUTION: OTTAWA'S COMMUNITY ENERGY TRANSITION STRATEGY

Energy Evolution is Ottawa's Renewable Energy Strategy designed to manage energy consumption, promote the use of renewable energy and advance local economic development opportunities in Ottawa. It is being developed in collaboration with dozens of community stakeholders to facilitate dialogue and to identify specific projects that can be pursued—either by the City or by local businesses and organizations—within the community at large.

This section describes how stakeholders were engaged throughout the development of Phase 1 and outlines a set of proposed short-term actions that have been identified within each of the specific energy pathways examined. It also explains the seven catalyst projects which received funding from Council and are to be completed in 2017.

These projects are demonstrating how a variety of small scale actions can contribute to clean renewable energy use and production.

Phase 2 will include the development of the remaining pathways for buildings, transportation, waste and energy storage. Once complete, an energy modeling component to quantify—to the best extent possible—the potential impacts associated with different actions, initiatives and all of the pathways will be completed. This modeling will inform an assessment report that will help the City and its community partners determine where to prioritize efforts over the medium and long term and will help to chart a path forward for Ottawa's low carbon future that is powered by clean, renewable energy.

As with Phase 1, Phase 2 of the project will include a significant engagement component with community partners in the development of the strategy. An advisory group will be established to guide the vision of the plan. Targeted Sounding Board members will also be engaged for their subject matter expertise to develop the remainder of the strategy. ESAC members will also be engaged at various stages to ensure their advice and feedback is considered as the project moves forward.

Overview of Stakeholder Engagement

Community partners have been key to the development of the direction and actions for Energy Evolution. Both the Sounding Board and working groups have been key to discovering renewable energy opportunities and actions to move the project forward, from working together to name Energy Evolution, brainstorming ideas, and developing a vision and goals, to landing business cases and policy actions.

The Sounding Board consists of individuals from local utilities, the federal government, the development industry, institutions, academia, the non-profit sector, and the private sector at large. The working groups have included some Sounding Board members but also technical experts from farther afield. A number of consultants were also engaged to provide background information and technical analysis necessary to develop Phase 1.

The Sounding Board was established to facilitate collaboration between various levels of government, City departments, utilities, stakeholders, and the broader community. Their role is to:

- Provide direction, ideas and resources to the development of the Plan
- Build interest within the community
- Participate in the Sounding Board sessions
- Participate in working group meetings, as needed
- Provide timely feedback on draft documents and recommendations

The working groups were originally established to facilitate discussion on specific aspects of the Plan. They included 8 focus areas including visioning, communication and engagement, new buildings, existing buildings, transportation, energy supply and distribution, funding and governance. Although not all were triggered in Phase 1, there will be working groups utilized to formulate Phase 2 of the strategy.

Two Councillor Sponsors groups were also established for the project with the purpose of:

- Providing guidance and political leadership to the Project Steering Committee
- Providing updates to Environment and Climate Protection Committee and the Mayor's Office as needed
- Participating in Sounding Board and Working Group meetings as they choose

Throughout Phase 1 of the Energy Evolution it was evident that one of the significant values of undertaking this project was the forum and match-making that enable the collaboration and coordination for the road forward. This became particularly evident as the Phase 1 energy supply and distribution workshops were being undertaken. In meeting and speaking with each other about opportunities to advance energy generation and conservation, community partners also built ideas and made business contacts with each other which made the value propositions much stronger. Continuing with this format for collaboration will be very valuable in this regard. It is also notable that the foundation and format of the Low Carbon Innovation Centres described above will serve a very similar function. This potential will be explored further in 2018.

With a focus on energy supply and distribution for Phase 1, Phase 2 will re-align more closely with the building, transportation, governance and funding working groups. The Strategy will continue to be completed in partnership between the City and community partners.

Community-Approved Vision and Approach

Early in the process the Sounding Board establish a vision, goals and key measurements for the success of Energy Evolution. These have been key to framing out Ottawa specific parameters. The vision is as follows:

> Ottawa is a thriving city powered by clean, renewable energy.

The vision statement established a future where Ottawa has both clean air and is energy resilient. Energy Evolution is a renewable energy strategy designed to manage energy consumption, promote the use of renewable energy and advance local economic development opportunities in Ottawa.

Working with the Sounding Board and working groups it was determined that to achieve this vision will residents, businesses, organizations and governments would be required to make a sustained transition away from a dependence on fossil fuels by:

- reducing energy use through conservation and efficiency
- increasing the supply of renewable energy through local and regional production
- prioritizing the procurement of clean, renewable energy

The Sounding Board also determined that Energy Evolution should be a multi-year program with short- (2020), medium- (2031) and long-term (2050) deliverables. These were timelines the Sounding Board felt were representative of both moving actions quickly in the shorter term, and being able to plan for longer term results for 2031 and 2050. The outcomes of longer term actions can vary significantly with as-of-yet undiscovered technologies. Short and medium term actions are more predictable in their outcomes so success can be measured easier.

The current document (Phase 1) delivers a 3-year action plan developed with community partners. Although the actions focus primarily on increasing the supply of renewable energy through local and regional production, it also addresses potential actions for conservation and efficiency as some actions inevitably overlap into the buildings and transportation sector.

Eight goals were also established by the Sounding Board for the project. These are important because they explain what is important to Ottawa and where we need to go with Energy Evolution to achieve the vision for the city. They drive the business cases, policies, and collaborative actions of the project and are as follows:

1. Help meet or exceed locally established energy reduction targets;
2. Develop local renewable energy generation opportunities;
3. Improved energy security;
4. Greater opportunities for residents to own or invest in local energy systems and businesses;
5. Reduce environmental impact;
6. Complement long term municipal land use, transportation and infrastructure master plans;
7. Advance economic development objectives; and
8. Bring groups together to facilitate info sharing and development of joint solutions.

2017 Catalyst Projects

In 2016, Council approved a one-time funding of $300,000 to pilot catalyst projects in 2017 that support Energy Evolution's vision and goals. Catalyst projects are initiatives led by Ottawa-based organizations that either serve as demonstration projects or lays the foundation for demonstration projects that could be scaled up in the future. Collectively, these projects will be used to increase energy literacy, pilot emerging technologies, and/or enable innovative approaches.

A total of eight projects were successful in receiving funding. Following the funding announcement, it was determined that one of the projects, the City of Ottawa's Low Temperature Ice Flooding project, would not be pursued further as the technology did not prove to be viable. The project's funding was reallocated to JAZZ Solar Solutions' project as the latter maintained the original intent of the former to make City facilities more energy efficient. All projects must be completed by December 31, 2017.

In 2018, following the completion of the program, a summary report detailing the findings of the program will be prepared. This report will outline the achievements and benefits seen from each project, how they contributed to the goals of Energy Evolution, how they could lend themselves to being scaled up in the future, and lessons learned. Projects that could build off or complement the work completed will be considered as part of Phase 2.

Project Name: OCH Tenant Engagement Project

Lead Organization:
Ottawa Community Housing (OCH)

Description:
This project will combine technological solutions with tenant engagement to reduce energy use in buildings that are bulk metered. OCH will install energy savings equipment in units such as LED lights and programmable thermostats, and install a real time energy display and monitoring system in the lobby of bulk metered buildings. This work will be complemented by a tenant engagement program around how to use the new technology in the building.

Locations: Wards 4, 12, 13, 16

Funding Allocated: $70,000

Project Name: Urban Innovation Pods

Lead Organization: prototypeD TEAM Inc.

Description:
prototypeD will design and construct two solar powered, off the electrical grid "innovation pods" that can be used to demonstrate innovative products and services. Future applications may explore possibilities for sustainable infill (such as Coach Houses) and affordable housing. The pods will be prefabricated, custom designed, and locally built (within the Ottawa valley).

Locations: City-Wide
Specific locations TBD

Funding Allocated: $22,000

Project Name: PV Hot Water at City of Ottawa Facility

Lead Organization: JAZZ Solar Solutions

Description:
JAZZ Solar Solutions will provide and install eight Solar Photovoltaic (PV) arrays at the City's Plant Bath Recreation Centre to heat electric hot water heaters to replace the existing gas-fired water heaters.

Location: Ward 14

Funding Allocated: $92,500

Project Name: Ottawa Business Energy and Efficiency Profile (BEEP)

Lead Organization: EnviroCentre

Description:
The Business Energy and Emissions Profile (BEEP) will provide an online visualization and digital dashboard of business community GHG emissions by sector across the city and identify the areas with the greatest potential for achieving reductions

Location: City-Wide

Funding Allocated: $17,500

Project Name: Ottawa EV Days

Lead Organization: EnviroCentre

Description:
Ottawa EV Days will provide drivers with opportunities to test drive an EV, talk to EV owners and learn about financial incentives provided by the Province of Ontario. EV Days will be held in three locations: Barrhaven, Orleans, and Kanata.

Locations: Wards 1, 4, 9

Funding Allocated: $15,000

Project Name: ClimateWise Retrofit Project

Lead Organization: Canada Green Building Council (CaGBC) and Ottawa Renewable Energy Co-op (OREC)

Description:
CaGBC and OREC will lead the completion of energy audits for five non-profit buildings to catalyst comprehensive energy retrofits. As part of the audit program, residents of the buildings are to receive a two-year membership to EnviroCentre's Carbon613 program, which includes person and online training in energy conservation. Following the audits, the building decision makers will be involved in a design charrette to liaise with sector experts and learn more about energy conservation opportunities.

Location: City-Wide
Specific locations TBD

Funding Allocated: $53,000

Project Name: Supplemental Use of Electric Water Heating for Environmental and Cost Reduction

Lead Organization: Hydro Ottawa Ltd

Description:
This project will develop and pilot a functional device that will determine when to use an electric boiler instead of a natural gas boiler in order to reduce GHG emissions and cost. The project will be implemented at City Hall as it has both electric and natural gas boilers.

Location: Ward 14

Funding Allocated: $30,000

Phase 1 Action Plan 2017 – 2020

Targeted workshops were held with technical experts on the topics of solar power, wind, hydropower, biogas, heat pumps, district energy and electric vehicles (EV's) in the summer of 2017. Many of these experts were Sounding Board members. Others were called upon for their unique experience and knowledge of the subject matter. The intent of these workshops was to gain a better understanding of the barriers, opportunities and options of these pathways being advanced in Ottawa and what business cases, policies or other actions could be taken collaboratively to make this happen.

To support staff and participants of the technical working groups in the identification of potential actions, the City developed a series of Pathway Studies describing how a specific energy technology or initiative could develop in Ottawa. These were developed primarily by Leidos Canada with a staff expert on EV's developing that pathway. The pathways are focused technical notes including a general description of the renewable energy technology examined (e.g., commercial rooftop solar) along with an assessment of its overall potential and the constraints that are likely to reduce its uptake in the region.

A total of nine Pathway Studies were developed for Phase 1 of the Energy Evolution action plan, which is focused primarily on renewable energy generation opportunities in Ottawa.[37] Other opportunities, particularly those related to energy conservation in buildings and the transportation sector, will be explored in Phase 2 of this strategy (see the Next Steps section on page 50).

Working groups discussing Pathway Studies

Renewable Energy Generation (Phase 1)

- Solar Power – Large Scale
- Solar Power – Commercial Rooftop
- Solar Power – Residential
- Water Power
- Wind Power
- Heat Pumps – Air and Ground Source
- Biogas
- District Energy
- Electrification of Transportation – Cars and Light Trucks

The pathway studies were shared with participants in advance of the workshops and were also summarized for use at each workshop as a solid reference point for group discussion and facilitated, action-scoping activities. Participants were also given a list of specific questions by City staff to guide them in the identification of potential actions (see summary in Appendix A). The purpose of these questions was to steer participants toward concrete projects or initiatives they considered to be most "actionable"—that is, projects they perceived would have relatively few barriers to implementation and that could be undertaken within the next three years.

Through workshop exercises and follow-up discussions with participants, staff have identified more than 30 proposed short-term actions.[38] Part of this exercise included the development of an evaluation matrix consisting of several criteria weighted in accordance with each criterion's importance and alignment with Energy Evolution's 8 goals (i.e. reduce energy consumption, increase local renewable energy generation, improve energy security, bring groups together to facilitate joint solutions, alignment with other City plans, etc.). The short-term actions define the projects that scored the highest and are best suited to be further developed into viable actions.

37 The Pathway Study analyses are provided in "Document 3" of the City's November 21, 2017 Environment and Climate Protection Committee report.

38 See Energy Evolution: Summer 2017 Pathway Workshops As We Heard It.

As per the 2015 Council direction (see Preface), the proposed actions outlined below include both City- and community-led projects. In some cases, additional resources will be required to implement them. A more detailed overview of the proposed actions and their implementation considerations is provided below with a summary table in Appendix A.

The below sections summarize the pathway findings and actions discovered at the five workshops, including a spotlight on the most viable project in each section. The spotlights were selected based on the workshop submissions, follow up with community partners, team discussions and putting them through an evaluation matrix to determine the project with the best renewable energy generation potential. All of the projects are valuable but these were considered to have the most immediate impact.

Solar, Wind and Water Power

As shown above, a total of five Pathway Studies were developed to inform the solar, wind and water power opportunity assessments. While each of the five pathways in this category describe a different technology or its application, they are all forms of renewable power generation (i.e., renewable electricity) and were therefore combined for the purposes of the technical working group discussions.

According to the Pathway Studies, solar power represents the greatest opportunity for renewable electricity generation in Ottawa. The high potential of solar relative to other forms of renewable electricity can largely be attributed to two factors: the good solar resource in the Ottawa Valley and the relatively large variety of commercially-viable solar power applications. Three broad categories of solar power generation were considered as part of the pathway analysis: residential rooftop (small-scale systems installed on low-rise buildings with pitched roofs); commercial rooftop (systems installed on flat and low-pitched roofs covering an area 500 m^2 or greater); and large, ground-based systems with a generation capacity greater than 1 megawatt (MW). The key barriers and opportunities for advancing solar power in Ottawa are summarized as follows:

- Due to snow-load requirements historically contained within the provincial Building Code, virtually all buildings in Ottawa—both residential and commercial/institutional—have the structural capacity to support a rooftop solar power system. That said, taller buildings, such as those located in the downtown core, present unique challenges (often wind) and are generally not seen as ideal sites for rooftop solar systems.
- Product innovation and decreases in the price of solar photovoltaic (PV) modules are enabling more comprehensive and economical rooftop systems (e.g., roof modules that can face in all directions rather than just south, systems that cover a greater percentage of a given roof area, etc.).
- Future energy storage opportunities (e.g., batteries combined with residential solar systems) offer the greatest potential for increasing residential solar deployments in Ottawa.
- There are nearly 2,300 buildings—representing 6.85 million square meters of flat or near-flat roof space—potentially suitable for commercial solar power systems in Ottawa. Solar installations on these roofs could add up to 1 gigawatt (GW) of local renewable generation capacity, providing enough electricity to power up to 150,000 homes.
- Solar power systems are particularly well-suited to commercial rooftops whose buildings tend to operate (and therefore draw power) during the daytime. The installation of rooftop systems in these locations could help to alleviate peak demands on the local distribution system, particularly during warm weather when air-conditioning becomes a dominant peak load.
- In Ottawa, the land area of one 18-hole golf course can support a large-scale solar system capable of powering 3,700 homes. An area of 14 km2 (roughly 0.5% of the city's total land area) could host nearly 600 MW of large-scale solar and generate enough power to supply 10% of the city's current community-wide electricity consumption.

- The capacity of the local electricity distribution grid to accept more solar generation is a key consideration and limitation for future uptake. Grid modernization and the integration of storage solutions can help to address these constraints.

There are currently no large scale wind power projects located within the City of Ottawa. Due to the low wind resource in the region, the absence of low-cost rural land, and a lack of transmission-line capacity, there are very few locations within the city boundary that are suitable to hosting wind power installations.[39]

As noted in the baseline energy analysis, there are a number of large and well-developed water power stations owned and operated by Hydro Ottawa along the Ottawa River. Although large-scale waterpower generation opportunities within the city are generally considered to be well-tapped, there are opportunities to develop smaller-scaler or "mini" water power systems, particularly along the Rideau River. These systems do not store water in a reservoir or dam, and rely on smaller height drops, often using a canal or pipe to direct water towards a generator.

Based on workshop discussions, the following five projects and initiatives were identified as priority actions to be pursued within the next three years:

Proposed Actions

1. Develop a framework for virtual net-metering (VNM) in collaboration with Hydro Ottawa.
   Lead(s) and Support: City (PIED), Hydro Ottawa
2. Build an 11-megawatt (MW) solar park at the Trail Road Waste Facility.
   Lead(s) and Support: City (PIED, BEEM)
   Partners: Energy Ottawa, Hydro Ottawa
3. Pilot a small-scale virtual net metering project where the VNM credits can be purchased by one or more organization.
   Lead(s) and Support: Ottawa Renewable Energy Co-op
4. Build a 500-kilowatt (kW) mini-hydropower system at the Burritts Rapids dam.
   Lead(s) and Support: Burritts Rapids Renewable Energy Association (BRREA)
5. Convene stakeholders from the development industry and renewable energy sector to facilitate dialogue and solutions for making grid connections easier (e.g., addressing grid capacity and constraints, identifying opportunities to integrate renewable energy in new developments, etc.).
   Lead(s) and Support: City (PIED)
   Partners: Hydro Ottawa

Large solar panel installation

39 See Pathway Study on Wind Power in Ottawa.

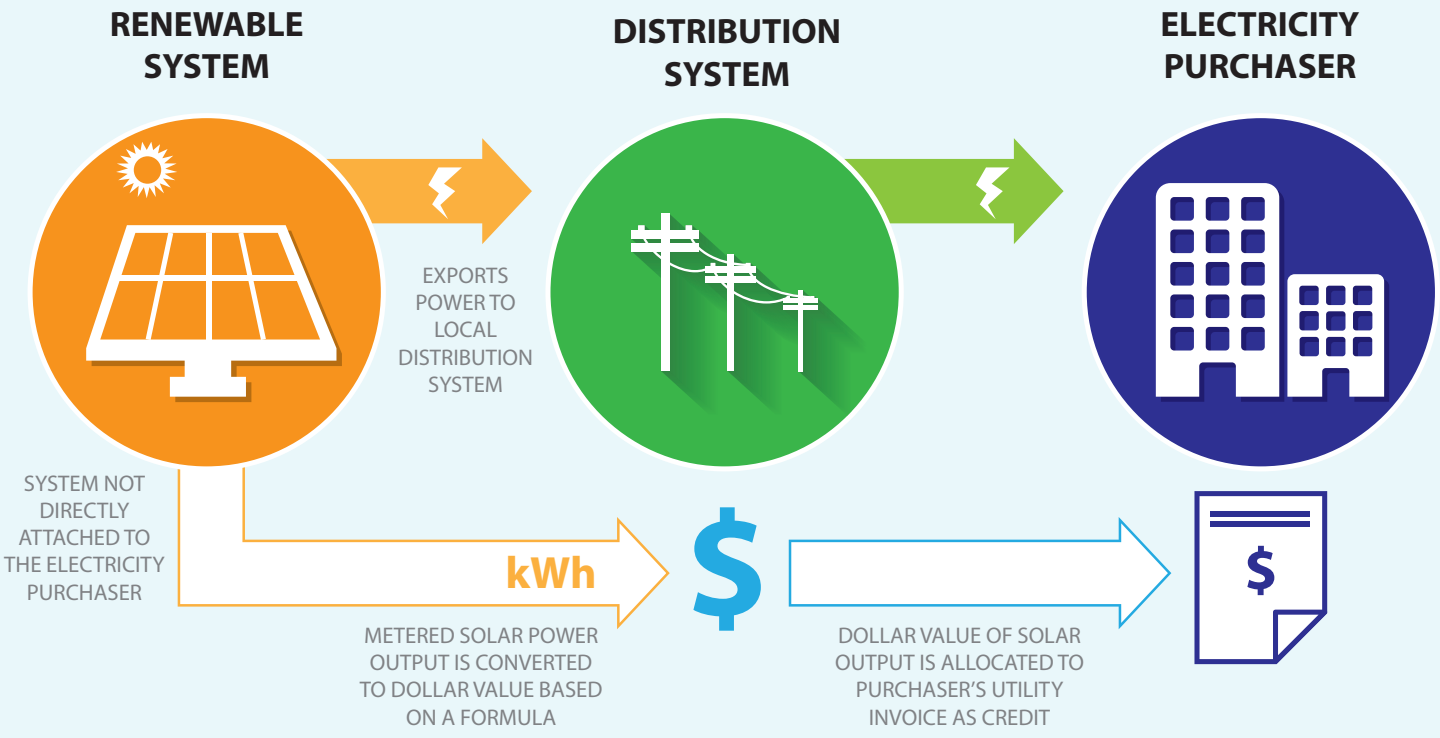
Spotlight on Virtual Net-Metering for Renewable Electricity

In 2016 the provincial Minister of Energy issued directives to the Independent Electricity System Operator (IESO) to end Ontario's flagship Feed-In Tariff (FIT) program and to cancel the second phase of the province's Large Renewable Procurement (LRP), effectively ending the main province-wide procurement model for renewable electricity that had been in place since 2006.[1] The Ministry of Energy is now proceeding with self-consumption "net-metering" rules—a new financial model that compensates electricity consumers at market rates for the renewable energy they can generate onsite to offset a specific building or facility's annual electricity consumption. While the net metering framework will have some uptake, the model is prohibitive for medium- to large-scale renewable energy project developers in that the size of a given project must correspond more or less to the electrical load of the facility where it is built. The current framework does not allow surplus electricity generated by a renewable energy installation to be transferred (in the form of credits) between multiple electricity accounts or facilities located at different sites.

Establishing a framework and billing method for virtual net-metering (VNM) in collaboration with Hydro Ottawa would remove the onsite generation limitations inherent in the current provincial net-metering framework, enabling developers of renewable energy projects to transfer their generation credits between various accounts or locations (provided that the accounts are located within the same service territory of the electric utility). Decoupling the size and location of a renewable energy system from a specific building load would provide greater flexibility and likely more attractive project economics for developers of renewable energy generation facilities. Such a framework would also provide greater opportunities for businesses and organizations in Ottawa to purchase locally-sourced renewable electricity, particularly if the framework enables a third party, such as a renewable energy company or cooperative, to operate the renewable energy system and transfer its generation credits to accounts held by other organizations.

Needs and Opportunities

In 2015, electricity consumption accounted for approximately 28% of all energy consumed in Ottawa, making electricity the second-most consumed type of energy in the city (after natural gas). Despite relatively large and well-tapped waterpower resources located on the Ottawa River, the amount of electricity supplied by local renewable electricity generators in 2015 was approximately 5,300 terajoules (TJ)—equivalent to roughly 16% of total city-wide electricity consumption.[2]



Opportunities exist to significantly increase the amount of renewable electricity generated in Ottawa, particularly given the region's good solar resource and the declining cost of solar photovoltaic (PV) equipment. However, the curtailment of stable, long-term contracts previously offered by the IESO has left many developers of renewable energy systems in Ottawa without a viable mechanism to finance their projects.[3] As noted in several of the Pathway Studies prepared by Leidos, renewable electricity systems in Ontario have traditionally been financed through secure and relatively long-term (e.g., 20-year) power purchase agreements for the renewable electricity the installations are able to generate.[4] A locally-developed VNM framework would enable a form of power purchasing between local renewable energy developers and various users of electricity in the community—schools, businesses, government offices and facilities—in a way that offers greater project flexibility for renewable energy developers and a more robust purchasing mechanism for both buyers and sellers of electricity.

Strategic Alignment

This opportunity would help to advance five of the eight Energy Evolution objectives:

- Develop local renewable energy generation opportunities
- Improve energy security
- Provide greater opportunities for local businesses and residents to own or invest in local energy systems
- Advance economic development objectives
- Bring groups together to facilitate information sharing and the development of joint solutions

Implementation Considerations

- The proposed VNM credit-transferring framework would occur entirely within Hydro Ottawa's local distribution area and therefore does not require the use of provincially owned and regulated transmission infrastructure.
- The IESO is expected to issue a ruling on future VNM opportunities in late 2017.
- Hydro Ottawa is aware of the City's interest in pursuing a VNM framework within its service area and is currently discussing options internally.
- The federal government has made a commitment to use clean power in all federal buildings by 2025.[5] Given the large number of crown-owned buildings in Ottawa (1,558 buildings with a total floor area of 3,177,131 m^2), the federal government could benefit considerably from a locally-developed framework for procuring renewable energy.[6]

Timeframe

It is recommended that existing City resources be used to pursue this opportunity in collaboration with Hydro Ottawa in 2018.

References

1. Although the FIT program was launched in 2009, its precursor—the Renewable Energy Standard Offer Program (RESOP)—offered similar guaranteed price structures to generators of renewable energy; it was introduced by the Ontario Power Authority in 2006.
2. See Baseline Energy Study for Ottawa 2015: Including Supply Origin, Fuel Type, Use by Sector, GHG Impacts and Cost.
3. See Energy Evolution: Summer 2017 Pathway Workshops As We Heard It.
4. See Pathway Study on Solar Power in Ottawa.
5. Government of Canada. (2016). Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy.
6. Information on crown-owned buildings in Ottawa obtained from the Directory of Federal Real Property and confirmed via correspondence with Treasury Board of Canada staff.

Biogas

Biogas is a type of combustible gas derived from organic materials, such as agriculture and forestry residues, food waste, manure or municipal wastewater. As outlined in the Pathway Study on Biogas Energy in Ottawa, biogas can be produced using one of two general processes. The most common and widespread form of biogas production is through a process known as anaerobic digestion, whereby organic material is placed in an oxygen-free container or "digester" to decompose. Starved of oxygen, the decomposing organic waste produces a mixture of carbon dioxide and methane, which can either be burned to generate electricity or cleaned and injected into the natural gas grid as pipeline-grade renewable natural gas (RNG).

Another way to generate biogas is through a process known as gasification, which uses higher temperatures than anaerobic digestion and high pressure to convert organic material into a gaseous mixture called syngas. Although syngas can be used in ways similar to digester gas—either to generate electricity or to produce RNG—gasification of organic material to produce RNG is currently not a well-developed technology.

Key barriers and opportunities for advancing the production and use of biogas in Ottawa are summarized as follows:

- Large quantities of feedstock exist within Ottawa to support biogas energy generation. These include crop and forest residue, manures, municipal solid waste, wastewater, bio solids and landfill gas.
- Due to the low energy density of organic waste streams, feed stocks for biogas must be located in relatively close proximity to biogas production facilities and end energy users. The benefits of biogas as an energy source can be offset entirely if the energy required to transport a feedstock is too great.
- The amount of biogas generated though anaerobic digestion or gasification can be increased by incorporating feed stocks with higher energy densities, such as fats, oils and greases.
- Organic material collected through the City's Green Bin Program is currently committed to Orgaworld for composting until 2029.
- Opportunities exist to expand biogas production and to explore alternative uses at the Robert O. Pickard Environmental Centre (see Spotlight on Municipal Biogas Production and Optimization).
- Although most biogas projects undertaken at landfills and wastewater treatment facilities in Canada use biogas to generate electricity, a small number of facilities have started using biogas to produce RNG. Lessons learned from these jurisdictions can help to inform future RNG development opportunities in Ottawa.
- Development of RNG for injection into the local natural gas grid is highly regulated and also requires proximity to gas pipelines of adequate size. Projects that require connections greater than 5 km in length are not likely to be financially viable; this may limit opportunities for RNG production in parts of the city where the natural gas grid does not have extensive coverage. Alternatively, biogas can be trucked economically distances up to 120 km to sites where it can be purified and injected into the grid.
- When upgraded to RNG and compressed, biogas can be used as a substitute for diesel fuel used in vehicles.

Based on workshop discussions, the following projects and initiatives were identified as priority actions to be pursued within the next three years:

Proposed Actions

1. Undertake a technical and economic analysis to assess current as well as leading-edge practices for the production and utilization of biogas at the Robert O. Pickard Environmental Centre and in other relevant municipal applications (e.g., collection and treatment of household organics, potential for CNG fleet vehicles, etc.). Develop and issue a Request for Information (RFI) or Expression of Interest (EOI) to gather information on commercially-viable products and companies with expertise in biogas and renewable natural gas.
   Lead(s) and Support: City (PIED & PWES)
2. Undertake a scan of propane-fuelled municipal buildings where existing heating equipment is due for replacement. Use Natural Resources Canada's

RETScreen software to assess and identify facilities that can economically be converted from propane to biomass (i.e., wood pellet) heating systems.
Lead(s) and Support: City (BEEM)
Partners: OMAFRA, MNRF

3. Investigate the opportunity to develop a Community Improvement Plan (CIP) in a rural area of the city to promote fuel switching (e.g., propane to biomass) and to stimulate economic development.
Lead(s) and Support: City (PIED)


Robert O. Picard Environmental Centre

Spotlight on Municipal Biogas Production and Optimization

As the level of government responsible for residential solid waste and the treatment of municipal wastewater, the City collects and processes feed stocks suitable for biogas production each and every day. Conversion of these municipal waste streams into biogas and subsequent decisions pertaining to how the biogas is used can therefore be considered as operations over which the City exerts direct control. While opportunities exist to develop biogas using agricultural residues and other by-products, the greatest potential for biogas generation from a municipal perspective—particularly within the context of a growing city—is the organic content contained within municipal wastewater and the residential solid waste stream. Unlike non-organic materials, such as plastics, the organic content of municipal waste streams is not significantly impacted by waste reduction efforts, and therefore represents a consistent, if not growing, feedstock for biogas production.

Two of the largest biogas production facilities currently located in Ottawa are owned or jointly operated by the City.[1] Not surprisingly, these installations are located at the City's Trail Road Waste Facility and the Robert O. Pickard Environmental Centre (ROPEC), the City's primary wastewater treatment plant. A comprehensive landfill gas recovery system has been in place at the Trail Road Waste Facility since 2007. In collaboration with Energy Ottawa, gas produced by the landfill is collected and piped to six on-site generators, which currently produce enough electricity to power 6,000 homes per year. At ROPEC, biogas is used to generate both heat and power in what is referred to as a combined heat and power (CHP) or co-generation application. Given the large energy requirements of the wastewater treatment plant, all of the energy generated from the cogeneration engines at ROPEC is currently used on-site, which reduces the use of natural gas and grid electricity considerably.

Needs and Opportunities

In 2016, the digesters at ROPEC produced approximately 38,130 m^3 of biogas per day, 80% of which was used for onsite electricity generation and heating and 20% of which was flared. By 2040, the forecasted biogas production for ROPEC is anticipated to reach 48,222 m^3 per day, an increase of more than 25% compared to current rates of production.[2] Given the projected growth in biogas production and the percentage of gas that is currently flared, there are opportunities to expand the amount of renewable energy generated at ROPEC. The additional energy could be used to supply a greater percentage of the plant's energy needs, potentially enabling the plant to become energy independent. Additional biogas could also be used to produce a renewable natural gas product for community use.

With the current cogeneration and electrical distribution equipment at ROPEC nearing the end of its lifecycle, City staff have begun implementing an Electrical Master Plan to identify potential electricity savings across the plant's operations and to replace and expand the current cogeneration engines. Once completed, the upgrades to the cogeneration system will increase the amount of renewable electricity generated at ROPEC by approximately 35% while

also providing a greater amount of thermal energy to further offset the plant's natural gas consumption.

The upgrades described above will enable ROPEC to reduce flaring and to use a greater amount of its biogas for onsite energy needs, decreasing the plant's operational costs and improving its electrical redundancy in the event of a grid outage. However, one application that has yet to be explored is the upgrading of biogas for use as a pipeline-grade renewable natural gas (RNG) product. Undertaking a technical and economic analysis to assess current and emerging practices for the production and utilization of biogas would complement the Electrical Master Plan for ROPEC by outlining potential uses for biogas beyond electricity generation and waste-heat recovery. This type of feasibility study could also include an assessment of other municipal feed stocks suitable for biogas production, the importation of biogas from remote sites, and opportunities for incorporating biogas-derived fuels into other municipal operations (e.g., fleet vehicles).

Strategic Alignment

This opportunity would help to advance five of the eight Energy Evolution objectives:

- Develop local renewable energy generation opportunities
- Improve energy security
- Reduce environmental impact
- Advance economic development objectives
- Bring groups together to facilitate information sharing and the development of joint solutions

Implementation Considerations

- Feasibility and operational studies in support of renewable energy projects are eligible for grant funding—up to 80% of total costs to a maximum of $175,000—from FCM's Municipalities for Climate Innovation Program.
- The production of biogas at ROPEC is limited by the capacity of the anaerobic digesters, including the amount of time the wastewater must be held or retained (i.e., a minimum allowable hydraulic retention time of 15 days).

Timeframe

It is recommended that a feasibility study be undertaken in 2018 along with the issuance of a Request for Information on commercially viable technologies and companies with expertise undertaking biogas projects.

References

1. See Pathway Study on Biogas Energy in Ottawa
2. Background information on current operating conditions at ROPEC was provided by the plant manager.

Heat Pumps

Heat pumps are devices that are move heat from one place to another. They are most commonly mechanical devices that are based on the Carnot refrigeration cycle. The intrinsic benefit if heat pumps is that they can move heat using only a fraction of the amount of energy as is required to get heat from a furnace or boiler. The most traditional applications of mechanical heat pumps are in refrigeration: in this application heat is moved from the inside of a refrigerator to the outside.

In building applications there are two common types of heat pumps: air source and ground source. The word "source" simply describes where heat is being pulled from. In the case of air source, the heat pump draws heat from the outside air and in the case of ground source the heat is pulled from the nearby ground, typically by using an intermediary liquid such as glycol or water. Because they employ electricity to power them and because our electricity is low carbon and can become more renewable and local, heat pumps are seen as a good heating technology to replace fossil fuels in space and water heating in Ottawa.

Each of the two heat pump technologies have comparative advantages and disadvantages. Ground source heat pumps are the most efficient but have higher capital costs. They tend to require more specialist knowledge about how to extract heat from the ground source. With good design and installation however, they are very robust and their operation and efficiency are not impacted by the outside air temperature. Some space is required for their installation and in some high density areas there might not be enough heat source available to satisfy all the areas heating requirements.

Air source heat pumps are significantly less efficient than ground source heat pumps but have lower up front costs. For a home planned to have central air conditioning for example, the additional funds required to upgrade to a heat pump is in the order of $2,000. This small incremental cost, along with improvements in air source heat pump efficiency means that they can be competitive with all heating fuels. Payback for such an upgrade varies with many factors and can run from 3-16 years with homes that use more expensive fuels, such as those in rural areas that do not have access to natural gas, seeing the most benefit.

Air source heat pumps are technically less complex than their ground source counterparts but can have an operational cut off as the outside air gets colder (between -20°C and -30°C). As a result, air source heat pumps typically require a back-up system for very cold periods. Also, efficiency decreases as outside air temperatures drop.

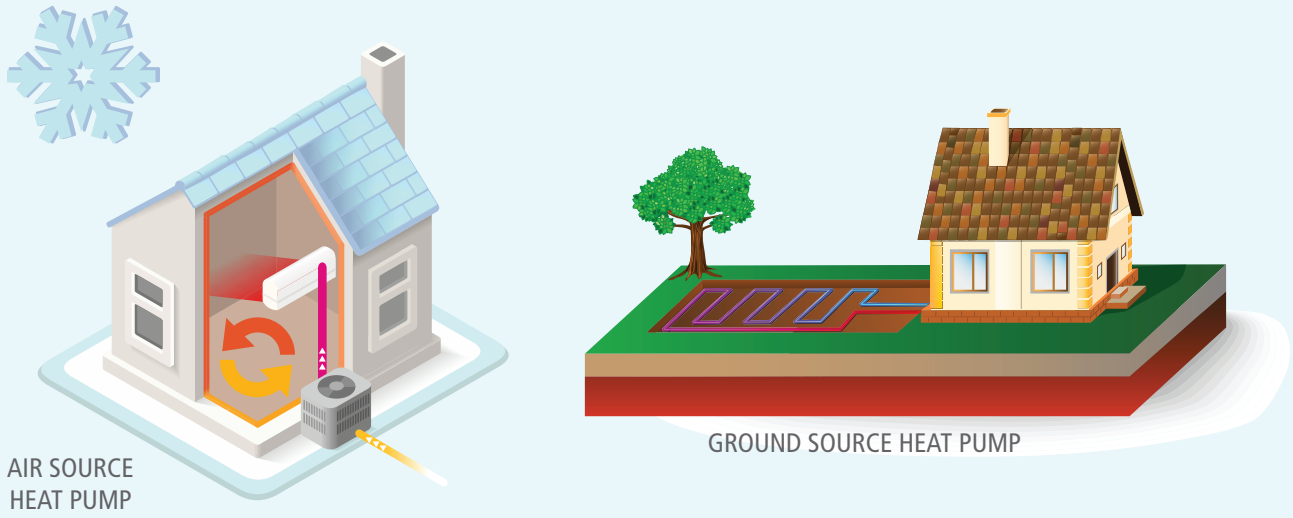


Figure 6: Comparison Schematics of Ground and Air Source Heat Pumps.

Key barriers and opportunities for advancing heat pumps are as follows:

- Familiarity with the technology. As the market penetration of heat pumps is smaller than that other heating systems, consumer and HVAC specialists may be less aware of the opportunities associated with heat pumps.
- Geothermal heat pumps in particular require specialized knowledge to ensure good installations. The Canadian Geo-Exchange Coalition is working on developing a designer and installation certification to ensure good installation project results.
- Areas with higher building densities and buildings that operate high temperature hydronic heating systems are factors that present limitations for the installation of heat pumps.
- Technical advances in heat pumps and their control are increasing the scope for their adaptation. Modern controls can be employed to dispatch heat pumps on an hour by hour basis at a time when they are more economical than a building's fuel based heating systems.

Based on workshop discussions, the following projects and initiatives were identified as priority actions to be pursued within the next three years:

Proposed Actions

1. Seek opportunities to expand rebate programs for air source heat pumps. These could be expanded to include all fossil type heating fuels (natural gas, propane and fuel oil) and could include both retrofits and new builds.
   Lead(s) and Support: City (PIED), Hydro Ottawa
2. Undertake an economic analysis to determine the feasibility of integrating air-source heat pumps into City facilities currently heated by natural gas.
   Lead(s) and Support: City (BEEM)
3. Implement the Ottawa Community Housing ECO^2 Plan to pilot green energy technologies and programs that benefit OCH tenants, the city and the environment. Aim for the highest, most financially feasible energy performance in new affordable housing developments by taking inspiration from leading energy certifications like the Passive House standard.
   Lead(s) and Support: Ottawa Community Housing
4. Develop a training manual or reference document for developers on how to integrate low-carbon thermal energy systems into new buildings.
   Lead(s) and Support: City (PIED, BEEM)
5. Consider opportunities to integrate geothermal systems in the design and allocation of park space in new City parks, and update policies where required.
   Lead(s) and Support: City (RCFS)
6. Work with a developer and possibly a district energy specialist or gas or electrical distributer to develop a ground source heating system in a new subdivision.
   Lead(s) and Support: City (PIED), Developer TBD
7. Advocate for the return of the federal subsidy on ground source heat pumps.
   Lead(s) and Support: City (PIED)

District Energy

District energy (DE) is a framework for providing heating and cooling services using centralized local energy plants and a network of highly insulated underground pipes to deliver energy to several buildings in a neighbourhood or district. Unlike conventional North American heating systems, which rely on in-building boilers or furnaces, buildings serviced by DE systems extract and transfer the thermal energy from a DE system into a building's heating, ventilation and air conditioning (HVAC) system. Centralizing the production of heating and cooling energy in this way offers several advantages compared to the decentralized model of producing heat separately in each individual home, office or building. In addition to their economies of scale and potential efficiencies, for example, DE systems can integrate multiple energy supplies, including a variety of renewable energy and waste heat sources as well as traditional fossil fuels.

As of 2014, there were over 150 DE systems in Canada, including five systems operated by the federal government in Ottawa. Large district energy systems are also in operation at the University of Ottawa, Carleton University, the Ottawa Hospital Civic Campus and the Children's Hospital of Eastern Ontario (see Figure 7 below).

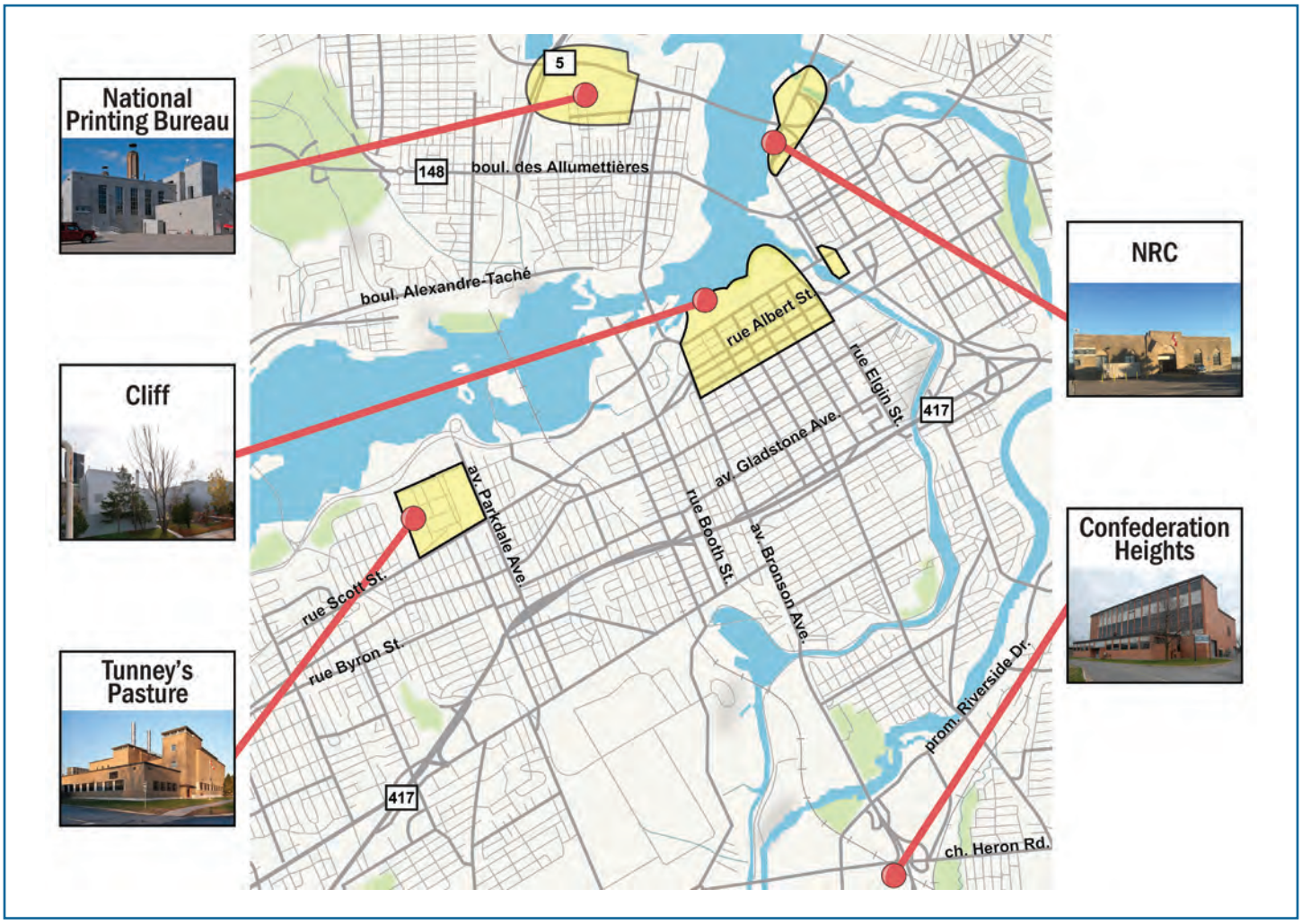


Figure 7: Map of urban Ottawa with approximate locations of existing DE systems and potential regions for expansion

Key barriers and opportunities for advancing district energy in Ottawa are summarized as follows:

- Due to historically low fossil fuel energy prices in North America (e.g., natural gas), DE systems are not yet common in residential and commercial markets.
- DE systems have high upfront capital costs with longer payback periods compared to conventional in-building systems.
- DE systems can provide long-term, financially viable energy services in areas with moderate to high energy use intensities (energy use per square area of land), including many urban neighbourhoods in Ottawa.
- Most DE systems have the capacity to be expanded, allowing for the most economically feasible locations to be developed first, followed by the addition of more commercial buildings, new developments and lower energy intensity areas.
- The federal government is in the process of modernizing and upgrading its DE systems in Ottawa and has expressed interest in expanding these systems to Ottawa buildings and neighbourhoods.
- Though the technologies used in DE systems are well understood, their implementation requires dedicated planning and infrastructure coordination to ensure optimal system designs and economic viability.

- The most opportune time to build or expand DE systems is when new buildings or developments are being planned and built or when an existing facility is replacing end-of-life heating and cooling equipment.
- It is difficult to convince building owners and operators to connect to a DE system once investments in in-building systems have already been made. DE systems that allow new connections to retain existing HVAC equipment as backup or to supply energy to the network could help address these investment considerations. Alternatively, removing equipment following connection to a DE network can create useful building space.
- Modern DE systems that supply medium-temperature hot water (70°C to 90°C) or low-temperature hot water (less than 55°C) can improve system efficiency while also enabling the integration of renewable energy sources and a broader range of building connections.
- Multi-level government funding opportunities can help to address the capital financing requirements associated with DE systems.

Based on workshop discussions, the following projects and initiatives were identified as priority actions to be pursued within the next three years:

Proposed Actions

1. Advocate to provincial government for a low-temperature design standard as part of the Building Code amendments. **Lead(s) and Support:** City (PIED)
2. Develop a Memorandum of Understanding (MOU) between the City and the federal government to explore and encourage district energy connections in both new and existing City facilities. **Lead(s) and Support:** City (PIED, BEEM)
3. Connect City Hall to the downtown district energy network for cooling and use heat recovery technology to heat and cool the building's atrium. **Lead(s) and Support:** City (BEEM)
4. Develop a new low-carbon district energy system that can be promoted as a high-priority economic impact project. **Lead(s) and Support:** TBD
5. Undertake a scan of waste heat sources available for thermal use across Ottawa. **Lead(s) and Support:** City (PIED)
6. Investigate the requirements for access to the City's road right-of-ways for the purposes of district energy infrastructure. **Lead(s) and Support:** City (PIED)
7. Consider opportunities for the installation of underground district energy infrastructure in the design and allocation of park space, and update policies where required. **Lead(s) and Support:** City (RCFS)
8. Advocate for Building Code amendments that require buildings of a certain size and location to be built to be compatible for future district energy connections. **Lead(s) and Support:** City (PIED, BEEM)
9. Pilot a community energy planning process in a high growth node or corridor which includes district energy system installation and connections. **Lead(s) and Support:** City (PIED)

Electrification of Transportation

This Pathway explored the current and potential contribution of the electrification of cars and light trucks both in fleets and privately owned vehicles. Electric vehicles (EVs) are defined as any vehicle that is partially or entirely propelled by electricity and plugs in to recharge. Vehicle types included in this Pathway analysis were cars, motorcycles, e-bikes, SUVs, small vans and pick-up trucks. Electrification of large, heavy vehicles and equipment, as well as vehicle fuel switching and reduced vehicle use (i.e. switching from personal vehicles to transit, cycling or walking) will form the basis for future transportation Pathways in Phase 2 of Energy Evolution. Partial electrification of the City's transit fleet is occurring now through the construction of the LRT.

As EVs are a still a relatively new consumer technology, estimates of possible future consumer uptake abound. However, it is likely that a significant penetration of EVs in fleets is required to meet future targets. Key barriers and opportunities for advancing EV adoption in Ottawa are:

- Range anxiety: Range anxiety is the fear of running out of power in an EV before reaching the next charging station. The fear can be reduced by installing a fulsome network of EV charging stations. In 2016, the Ministry of Transportation created the Electric

Vehicles Chargers Ontario (EVCO) grant program. Once completed, close to 500 publically available charging stations will be installed across Ontario through the program, including 14 in Ottawa. More charging stations at workplaces and next to residential buildings without EV charging infrastructure would also go a long way in reducing range anxiety.

- Charging station availability: As the uptake in EVs grows, one of the concerns will be long waits at high speed charging stations, such as DC Fast chargers. These concerns have already been realized in places that have EV uptake such as Quebec. Monitoring the use of the EV charging stations to determine when additional charging stations need to be installed will be important to continue to encourage EV uptake.
- Model availability: The majority of car manufacturers have been unable to keep up with current EV market demands, causing a delay in EV uptake. Additionally, it has been found that car dealerships do a poor job of encouraging buyers to purchase an EV and instead continue to push combustion engine vehicles.
- Electricity infrastructure: Overall, it is anticipated that a high degree of EV penetration is possible looking at the electrical grid as a whole, but that supply issues at the feeder line level can still present challenges. Cost of a service upgrade for an otherwise ideal site for EV charging can also be cost prohibitive.
- Consumer knowledge: There are still common misconceptions when it comes to EVs, in terms of how the cost, driving range, and the environmental benefits. Dispelling these misconceptions will go a long way in increasing EV adoption.
- Fleet penetration: Fleets present a significant opportunity to integrate EV technology. Examples are popping up across Canada of fleets using EVs, including Canada's first EV taxi company out of Montreal. Opportunities to encourage EV purchases for fleet include offering bulk purchase discounts or vehicle replacement rebates.

Based on workshop discussions, the following projects and initiatives were identified as priority actions to be pursued within the next three years:

Proposed Actions

1. Establish an EV Discovery Centre in Ottawa (see Spotlight on Electric Vehicle Discovery Centre).
   Lead(s) and Support: Plug 'N Drive
2. Continue to host Ottawa EV Day events and educational sessions to engage residents.
   Lead(s) and Support: EnviroCentre
3. Install a 150 kW EV charging station as a pilot/demo project.
   Lead(s) and Support: City (BEEM), Electric Circuit, Hydro Ottawa

Rendering of Tunney's Pasture Light Rail Station

4. Investigate the feasibility of an autonomous vehicle program in Ottawa that integrates EV technology. **Lead(s) and Support:** City (PIED)
5. Run an EV shuttle between the LRT and a large employment and/or residential area. **Lead(s) and Support:** City (PIED)
6. Monitor wait times at high speed charging stations, such as DC Fast Chargers, to ensure adequate availability. **Lead(s) and Support:** City (BEEM)

Spotlight on Electric Vehicle Discovery Centre

In May 2017, Plug 'N Drive, a non-profit organization committed to accelerating the adoption of EVs, opened what is considered to be the world's first Electric Vehicle (EV) Discovery Centre in Toronto. The Centre provides a free-of-charge experiential learning environment for EVs, where visitors can learn more about the environmental and economic benefits of EV ownership, test drive EV models, and learn more about the EV incentives and rebates offered from the Province. The Ontario Climate Change Action Plan set a target to have EVs make up 5% of all new vehicles sold by 2020. To help meet this target, the Province is offering incentives of up to $14,000 for residents to purchase EVs, and up to $1,000 to purchase and install an EV charging station in their home.

The project was funded through a public-private partnership, with $1M coming from the Ontario cap and trade program, and additional funding from TD Bank Group, Ontario Power Generation, Power Worker's Union, Toronto Hydro and Bruce Power.

Toronto's EV Discovery Centre

Needs and Opportunities

Public education and engagement are key to increasing EV adoption as there are many public misconceptions about EVs. In 2016, Plug 'N Drive commissioned a survey of 1,000 gas car owners and 192 EV owners within the Greater Toronto Hamilton Area1. They found that:

- 31% of gas car owners believed that EV are too expensive; only 38% of respondents were aware of Ontario's EV incentive program
- Gas car owners have range anxiety, when in fact EV owners have been found to drive further and more often
- 30% of gas car owners did not believe that climate change and car choice were linked.

The EV Discovery Centre works towards eliminating those misconceptions, and is intended to be a temporary, short term initiative to bridge the gap until there is greater uptake of EVs. Plug 'N Drive had previously cited Ottawa as the next logical city for a secondary location in order to actively engage residents and build consumer knowledge around EVs. The project also creates a unique opportunity for a myriad of local stakeholders to work together (e.g. governments, utilities, businesses), as well as creates a local economic opportunity for car dealerships to showcase their EV stock.

Strategic Alignment

This opportunity would help to advance five of the eight Energy Evolution goals:

- Improved energy security
- Reduce environmental impact
- Complement long term municipal land use, transportation and infrastructure master plans
- Advance economic development objectives, and
- Bring groups together to facilitate info sharing and development of joint solutions.

Implementation Considerations

- The project would ideally be funded in a public-private partnership, similar to how the Toronto location was funded.
- The Centre would need to be in a location with high visibility, easily accessible by the public, and that is cost friendly.
- Plug 'N Drive is based in Toronto and it remains to be seen whether they could operate a satellite office in order to run the Centre. Additionally, it will need to be determined what role local stakeholders have in contributing to the Centre (e.g. EnviroCentre, Electric Vehicle Council of Ottawa, local dealerships).
- As EV technology evolves, the Centre will need to be monitored ensure that it stays current and relevant in the face of a changing EV market.

Timeframe

It is recommended that existing City resources be used to pursue this opportunity in support of Plug 'N Drive beginning in 2017.

References

7. Plug 'N Drive (May 2017). Driving EV Uptake in the Greater Toronto Hamilton Area: How Driver Perceptions Shape Electric Vehicle Ownership in the GTHA. Accessed electronically on September 7, 2017 https://plugndrive.ca/sites/default/files/EV%20Survey%20-%20Report.pdf

Pathway Conclusions

In addition to outlining general opportunities and constraints, each of the Phase 1 Pathway Studies included uptake projections to quantify the potential impact of a renewable energy technology or approach under different scenarios. Three general scenarios were used across each of the Pathway Studies to project uptake between 2015 and 2050. The conservative uptake scenarios relied on relatively pessimistic assumptions with regards to future market conditions, regulatory environments and logistics, whereas the aggressive scenarios assumed more favourable conditions, such as increased carbon pricing or the presence of incentive programs to encourage uptake.

Ottawa currently imports 108,700 TJ of energy annually and produces 5,300 TJ locally in the form of electricity from hydropower, solar and biogas from landfills. Aggregation of the Phase 1 Pathway Studies and their various growth projections suggests that renewable energy technologies have the potential to offset approximately 48,737 TJ or nearly half (43%) of Ottawa's current energy consumption under an aggressive uptake scenario (see Table 1). Moderate uptake scenarios project a potential impact of 19,998 TJ towards energy conservation and local generation by 2050, whereas the conservative uptake scenarios were estimated to offset 8,348 TJ or roughly 7% of Ottawa's current energy consumption by 2050.

As noted above, a key consideration of the Energy Evolution strategy is Council's directive to reduce community-wide GHG emissions by 80% below 2012 levels by 2050. Each of the potential Pathway contributions were therefore assessed in terms of their GHG reduction potential and ability to help meet the City's long-term GHG reduction target (see Table 1).

Table 1: Summary of Energy and GHG Reduction Potential for Phase 1 Energy Evolution Pathways

Pathway	Energy Generation and/or Conservation Potential by 2050			GHG Reduction Potential by 2050 (tonnes CO_2eq)		
	Conservative	Moderate	Aggressive	Conservative	Moderate	Aggressive
Solar Power	2,070 TJ	4,540 TJ	9,330 TJ	31,223	68,478	140,728
Water Power	600 TJ	670 TJ	790 TJ	9,050	10,106	11,916
Wind Power	90 TJ	940 TJ	1,900 TJ	1,358	14,178	28,658
Heat Pumps	3,060 TJ **+ 830 TJ** (increased electricity demand)	9,080 TJ **+ 2,480 TJ** (increased electricity demand)	16,290 TJ **+ 4,450 TJ** (increased electricity demand)	141,645	420,048	753,577
Biogas	80 TJ (electricity) 680 TJ (thermal)	115 TJ (electricity) 2,220 TJ (thermal)	190 TJ (electricity) 5,300 TJ (thermal)	35,466	113,580	269,882
District Energy	500 TJ	2,000 TJ	6,100 TJ	25,190	100,761	307,321
Electrification of Transportation (Cars and Light Trucks)	2,746 TJ **+ 648 TJ** (increased electricity demand)	3,814 TJ **+ 901 TJ** (increased electricity demand)	17,394 TJ **+ 4107 TJ** (increased electricity demand)	173,611	241,118	1,099,667
Total	8,348 TJ	19,998 TJ	48,737 TJ	417,541 tonnes CO_2eq	968,269 tonnes CO_2eq	2,611,748 tonnes CO_2eq

When converted into tonnes of carbon dioxide equivalent (CO_2eq), the energy reductions projected across the aggressive uptake scenarios amount just over 2,600,000 tonnes of reduced CO_2eq—a 48% reduction relative to the City's 2012 GHG emissions baseline of 5,420,000 tonnes. The moderate uptake scenarios yield a combined GHG reduction of 968,269 tonnes by 2050 (an 18% reduction below baseline emissions), whereas the conservative uptake scenarios are attributed with a potential GHG reduction of 417,541 tonnes—a 9% reduction relative to the City's 2012 baseline (see Figure 8).

Based on the information above, meeting Ottawa's 2050 GHG reduction target will likely require pursuit of aggressive approaches in most of the Pathway Studies examined for Phase 1. As shown in Figure 8, a moderate uptake scenario for Phase 1 has the potential to reduce community-wide GHG emissions by 18% below baseline emissions by 2050. In this scenario, the remaining 62% of the 2050 reduction target would need to be pursued through other means, such as energy efficiency, conservation or energy storage. In contrast, if the most aggressive uptake scenario for Phase 1 were pursued, 32% of the City's baseline GHG emissions would need to be reduced through other means. Completion of the Phase 2 Pathway Studies and uptake projections in areas such as energy efficiency, conservation and energy storage will enable a more informed analysis in terms of the most optimal scenarios to pursue for achieving the City's 2050 GHG reduction target.

The Sankey diagram in Figure 9 provides a visualization of what Ottawa's energy transition could look like by the year 2050 if aggressive uptake scenarios were pursued across each of the Phase 1 Pathway Studies. In this scenario, the amount of renewable electricity generated locally from solar, wind, water and biogas sources is projected to grow from 5,300 TJ in 2015 to approximately 12,000 TJ in 2050. Widespread consumer adoption of electric vehicles and use of heat pumps for space and water heating are projected to reduce consumption of gasoline and heating fuels (natural gas, propane, oil) by approximately 13,000 TJ and 18,000 TJ, respectively. These reductions in energy consumption are complemented by an increase in the availability of biomass sources for space and water heating as well as renewable natural gas, which can be used in both thermal and motive energy (i.e., transportation) applications.

As noted above, the Pathway Studies completed for Phase 1 of the Energy Evolution Strategy focus primarily on renewable energy generation opportunities. The data and scenarios projected above are therefore provisional and subject to change pending the completion of the remaining Pathway Studies on energy efficiency, conservation and energy storage (Energy Evolution Phase 2). In some cases, it may not be necessary or practical to pursue the most aggressive uptake scenarios in each of the Phase 1 Pathway Studies. The renewable energy contributions of wind and waterpower, for example, are relatively small due to the poor wind resource in Ottawa and the fact that most good hydropower sties in the city have already been developed. Given these limitations, it is not necessarily critical that these Pathways follow their aggressive scenario uptake projections.

A final point about renewable energy supply concerns electricity. The Phase 1 Pathway Studies considered all sources of potential renewable electricity generation as well as potential new uses (i.e., increased demand) for electricity associated with certain renewable energy technologies. For example, while local renewable electricity generation has the potential to reach approximately 12,000 TJ by 2050, new uses for electricity associated with electric vehicles and heat pumps are projected to increase the demand for electricity in Ottawa by 8,500 TJ. The result is that between 2015 and 2050, under the aggressive scenario imported electricity only decreases slightly from 26,900 TJ to 23,927 TJ. In this regard, Ottawa will still require significant amounts of electricity imported from the provincial transmission grid in all future energy scenarios. To meet Ottawa's GHG reduction goals it will be critical that imported electricity continues to have a low GHG emissions profile.

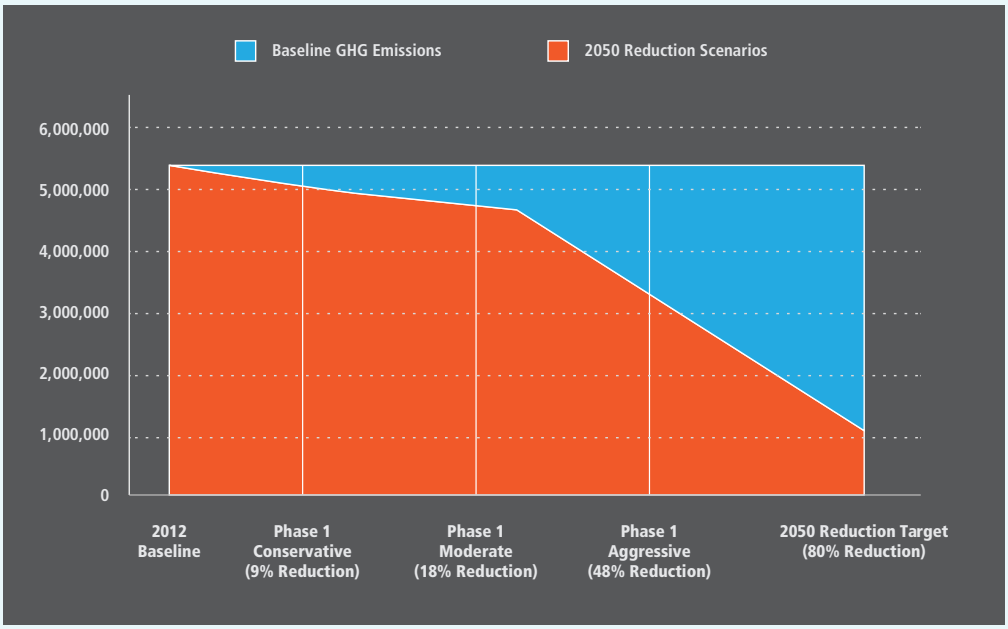


Figure 8: GHG Reduction Potential of Phase 1 Pathway Scenarios

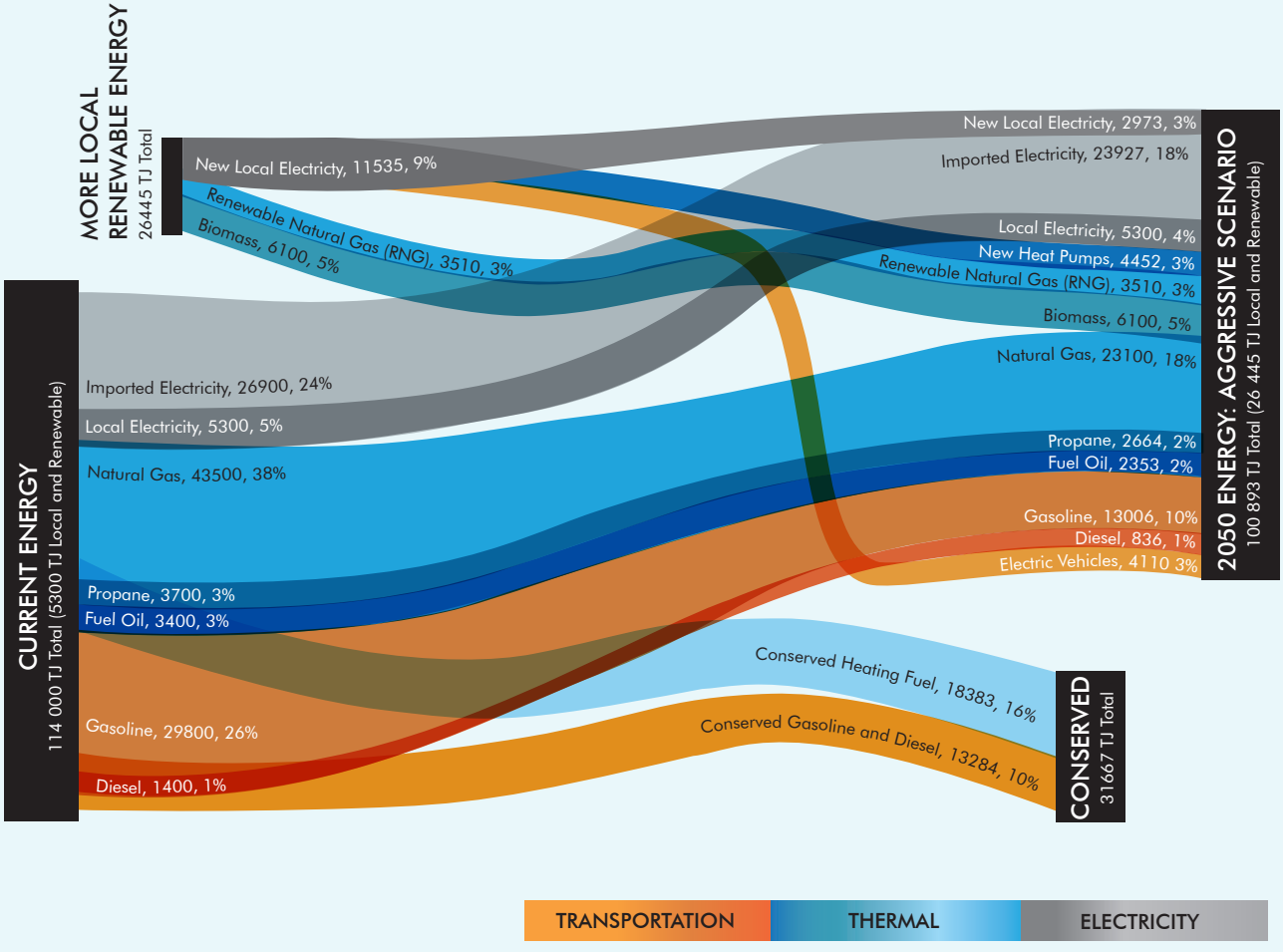


Figure 9: Ottawa's energy transition (2015-2050) under an aggressive Phase 1 uptake scenario (depicts half of the Pathway Studies completed to date)

ADVANCING ENERGY EVOLUTION: OTTAWA'S COMMUNITY ENERGY TRANSITION STRATEGY

Achieving Ottawa's long-term GHG reduction target and the vision of the Energy Evolution: Ottawa's Community Energy Transition Strategy will require ongoing coordination, analysis and collaboration between the City and its community partners over the short, medium and long term. Establishing a governance framework to guide decisions surrounding monitoring, reporting and future action-planning activities will help to ensure that projects are implemented or explored to the best extent possible and that community partners remain active and engaged in undertaking joint solutions. Regular monitoring and reporting will also provide an opportunity to highlight key corporate and community achievements, and to identify potential obstacles or barriers to implementation encountered along the way.

Governance

As the level of government 'closest to the people,' local governments interface regularly with a range of businesses and organizations, citizens and other orders of government. This ability to convene and engage with diverse stakeholders and to pursue senior government funding opportunities are two municipal strengths that can be leveraged to advance and support a governance framework for Energy Evolution. At the same time, it is important to acknowledge the role and potential contributions that other organizations within the community can play in coordinating Ottawa's renewable energy transition.

Long-term governance of municipal energy and climate initiatives typically requires both internal (corporate) as well as external (community) leadership and participation. While there is no "one-size-fits-all" approach—The City of Toronto for example, established an arm's length organization whereas Waterloo Region partnered with two existing community groups—the common element in each of the models examined was a mechanism, structure or set of processes that linked the City to core community partners.

Current Governance in Ottawa

Currently, responsibility for energy conservation and renewable energy planning is shared amongst a variety of city departments as well as external agencies and community partners. City staff, the Sounding Board and working groups contributed valuable expertise in problem solving and delivering on value propositions in the development of Energy Evolution.

A more formalized governance structure would allow for all actors to work together to achieve our common goals. In so doing, active coordination with community partners to collectively research, develop action plans and access funding and resources will move us all towards a low carbon economy.

Permanent Governance for Ottawa

The development of a permanent governance model is recommended for the purposes of maintaining ongoing coordination and collaboration between partners and to serve as a central gateway for pursuing renewable energy and low-carbon development opportunities in Ottawa. Phase 1 of Energy Evolution (Appendix A) includes four short-term actions to support the development of such a framework:

Proposed Actions

1. Establish a Community Energy Innovation Fund to sustain further municipal investments in Energy Evolution that may include dividends from Hydro Ottawa. Use the revenues from this fund for programs in the areas of energy efficiency and the longer term planning for Ottawa's low-carbon future. In 2018, staff will bring a report to Council on the mandate, financing and governance of the Fund.
   Lead(s) and Support: City (PIED, BEEM, CSD), Hydro Ottawa

2. Establish a corporate Smart Energy Office with a dual mandate to find energy savings through both conservation and demand management and to identify alternative local renewable energy opportunities for City facilities.
   Lead(s) and Support: City of Ottawa (BEEM)
3. Develop Phase 2 Energy Evolution in collaboration with community partners, including a long term governance model.
   Lead(s) and Support: City of Ottawa (PIED)
4. Work with community partners to establish a Low Carbon Innovation Centre for Ottawa as part of the Low Carbon Cities Canada (LC3) initiative being led by the Atmospheric Fund (TAF)
   Lead(s) and Support: City of Ottawa (PIED)

Not only will this establish a focused location to move low carbon initiatives but also make Provincial and Federal funding such as the Low Carbon Economy Fund available to the City and its partners. The City will work with community partners in 2018 to identify a structure that can work for Ottawa. It will include discussion with those community partners involved in establishing the Low Carbon Innovation Centre to determine what role the centre can play in establishing a governance model.

In the short term, Ottawa staff has struck an advisory panel with Environmental Stewardship Advisory Committee (ESAC) to received feedback on the proposed actions and direction of the Energy Evolution Strategy. An annual progress report on Energy Evolution accomplishments will also be delivered to Environment and Climate Protection Committee that includes the advice of ESAC.

Funding Partnership with Energy Ottawa

The shift to a low carbon economy for Ottawa includes an opportunity to be innovative and develop opportunities for energy generation and conservation unique to the Ottawa context.

Starting in 2019, the City will establish a Community Energy Innovation Fund to sustain further investments into Energy Evolution. Sources of investment may include dividends from Hydro Ottawa when those fund exceed estimates in the City's Long Range Financial Plan. Attachment 6 of the November 21, 2017 Environment and Climate Protection staff report explains in more detail how this fund will work. In 2018, staff will bring a report to Council on the mandate, financing and governance of the fund.

Next Steps – Energy Evolution Phase 2

Phase 2 will include the development of the remaining pathways for buildings, transportation, waste and energy storage. Once complete, an energy modeling component to quantify—to the best extent possible—the potential impacts associated with different actions, initiatives and all of the pathways will be completed. This modeling will inform an assessment report that will help the City and its community partners determine where to prioritize efforts over the medium and long term and will help to chart a path forward for Ottawa's low carbon future that is powered by clean, renewable energy.

As with Phase 1, Phase 2 of the project will include a significant engagement component with community partners in the development of the strategy. An external advisory group (10 – 12 community partners) will be established to guide the vision of the project to its completion. Targeted Sounding Board members will also be engaged for their subject matter expertise at different stages of the project. The larger Sounding Board will be provided updates as new milestones are achieved. ESAC members will be also engaged at various stages to ensure their advice and feedback is considered as the project moves forward.

Action Items for 2018

In 2017-2020, the City and community partners will move forward with a number of the actions outlined in the Appendix A. The chart includes action items, the goals they correspond to, who is responsible for implementing the action, whether there is Provincial or Federal funding available to implement the action and the year in which it can be implemented.

For 2017 and 2018, the following action items will be undertaken (contingent on staffing levels and available funding) with the remainder to be completed by both the City and Community Partners between 2019 – 2020.

Table 2: Action items for 2018 - Excerpts from Appendix A

Action	Action Items	Lead
1	Develop a framework for virtual net-metering (VNM) in collaboration with Hydro Ottawa	PIED/HO
3	Pilot a small-scale virtual net metering project where the VNM credits can be purchased by one or more organization	OREC
5	Convene stakeholders from the development industry and renewable energy sector to facilitate dialogue and solutions for making grid connections easier	PIED/HO
6	Undertake a technical and economic analysis to assess current as well as leading-edge practices for the production and utilization of biogas at the Robert O. Pickard Environmental Centre and in other relevant municipal applications (e.g., collection and treatment of household organics, potential for CNG fleet vehicles, etc.).	BEEM/ PWES
7	Undertake a scan of propane-fueled municipal buildings where existing heating equipment is due for replacement.	BEEM/ OMAFRA/ NRCan
10	Undertake an economic analysis to determine the feasibility of integrating air-source heat pumps into City facilities currently heated by natural gas	BEEM
11	Implement the Ottawa Community Housing ECO2 Plan to pilot green energy technologies and programs that benefit OCH tenants, the city and the environment	OCH
15	Advocate for the return of federal incentives to support ground source heat pumps, such as those previously available through the ecoENERGY program	PIED
16	Advocate to the provincial government for a low-temperature design standard as part of the Building Code amendments	PIED
17	Connect City Hall to the downtown district energy network (for cooling) and use heat recovery technology to heat and cool the building's atrium	BEEM
18	Develop a Memorandum of Understanding (MOU) between the City and the federal government to explore and encourage district energy connections in both new and existing City facilities	PIED/ BEEM/ PSPC
21	Investigate the requirements for access to the City's road right-of-ways for the purposes of district energy infrastructure	PIED
23	Advocate for Building Code amendments that require buildings of a certain size and location to be built to be compatible for future district energy connections	PIED
26	Continue to host Ottawa EV Day events and educational sessions to engage residents	Enviro
27	Install a 150 kW EV charging station in Ottawa as a pilot/demo project	BEEM/ HO/ Electric Circuit
30	Establish a Community Energy Innovation Fund	PIED/ BEEM
31	Establish a corporate Smart Energy Office with a dual mandate to find energy savings through both conservation and demand management and to identify alternative local renewable energy opportunities for City facilities	BEEM
32	Develop Phase 2 Energy Evolution in collaboration with community partners, including a long term governance model.	PIED
33	Work with community partners to establish a Low Carbon Innovation Centre for Ottawa as part of the Low Carbon Cities Canada (LC3) initiative being led by the Atmospheric Fund	PIED

Indicates the Phase 2 Energy Evolution Strategy team

PIED – Planning, Infrastructure and Economic Development

BEEM – Building Engineering and Energy Management

PWES – Public Works and Environmental Services

HO – Hydro Ottawa

PSPC – Public Services and Procurement Canada

OCH – Ottawa Community Housing

OREC – Ottawa Renewable Energy Coop

OMAFRA – Ontario Ministry of Agriculture, Forestry and Rural Affairs

NRCan – Natural Resources Canada (CanmetENERGY)

APPENDIX A – SUMMARY OF SHORT-TERM ACTIONS, ENERGY EVOLUTION: OTTAWA'S COMMUNITY ENERGY TRANSITION STRATEGY, PHASE 1

Document 2: Summary of Short-Term Actions, Energy Evolution: Ottawa's Community Energy Transition Strategy, Phase 1

The following short-term actions were identified by stakeholders during a series of targeted workshops held at City Hall from June to August, 2017. Stakeholders were invited to participate in these workshops based on their perceived sector expertise as well as their organization's ability to undertake projects or initiatives within one or more of the Energy Evolution "Pathway" analyses (e.g., Solar, Wind and Water Power; Biogas; Heat Pumps; etc.). Workshop participants were given the opportunity to select potential project recommendations from an existing list prepared by Leidos Canada or to propose new actions not featured on the list. In both cases, participants were instructed to identify projects they perceived to be the most "*actionable*"—that is, projects with relatively low barriers to implementation that could be undertaken within the next three years (2017-2020). Each proposed action was then reviewed by the Energy Evolution project team to assess the action's potential contribution to the eight Energy Evolution project goals. The table below therefore represents stakeholder-identified actions that have been assessed and refined by City staff where applicable.

#	Action	Timeframe	Lead	Project Readiness	Contribution to Energy Evolution Goals[1]	Resource Requirements[2]
Solar, Wind and Water Power						
1	Develop a framework for virtual net-metering (VNM) in collaboration with Hydro Ottawa	2017-2018	Hydro Ottawa, City of Ottawa (PIED)	• The Independent Electricity System Operator is expected to issue a ruling on future VNM opportunities in late 2017 • Hydro Ottawa is aware of the City's interest in pursuing a VNM framework within its service area and is currently advancing discussions internally	2, 3, 4, 5, 7, 8	Existing

[1] See Community-Approved Vision and Approach.
[2] Identifies whether *"Existing"* City resources will be allocated or if *"Additional"* City resources are required to implement the Short-Term Action. *"Existing/Additional"* indicates that existing City resources are to be allocated for review, investigation and further development or refinement of the Action, and that additional City resources are required for implementation. *"Existing/Community"* indicates that existing City resources are to be allocated to facilitate dialogue and the sharing of information in support of the Action, and that community resources are required for implementation. "*External Funding"* indicates that funding opportunities external to the community (e.g., senior government funding programs) will be pursued to advance or implement the Action.

2	Build an 11-megawatt (MW) solar park at the Trail Road Waste Facility (to offset the annual electricity consumed by 25 City library facilities)	2019-2020	City of Ottawa (PIED/BEEM), Energy Ottawa	• This project may be contingent upon the establishment of a VNM framework with Hydro Ottawa (Action #1) • Plans for the 11 MW solar park have already been designed and prepared by Energy Ottawa • Construction of a large solar park at the Trail Road Waste Facility has been deliberated and approved by two separate terms of Council • Council has declared three parcels of land required for the project as surplus to the City's needs • Under the current provincial framework, the City may need to finance, build and own the solar energy system itself as opposed to entering into a lease agreement with a third party, such as Energy Ottawa • Costs associated with this project are significant but could be offset considerably through the annual electricity consumption of 25 City library facilities as well as close to 20 fire stations at roughly 18,100,000 kWh of electricity generated by the solar park each year (Source: City of Ottawa BEEM). This project is eligible for up to $10 million in grant funding through the provincial Municipal GHG Challenge Fund, for example	2, 3, 5, 7, 8	Additional/ External Funding
3	Pilot a small-scale virtual net metering project where the VNM credits can be purchased by one or more organization	2018-2020	Ottawa Renewable Energy Coop (OREC)	• This project is contingent upon the establishment of a VNM framework with Hydro Ottawa (Action #1)	2, 3, 4, 5, 7, 8	Existing/ Community
4	Build a 500-kilowatt (kW) mini-hydropower system at the Burritts Rapids dam	2017-2020	Burritts Rapids Renewable Energy	• This project may be contingent upon the establishment of a VNM framework with Hydro Ottawa (Action #1)	2, 3, 4, 5, 7, 8	Existing/ Community

			Association (BRREA)	• A detailed engineering feasibility study conducted at the dam site by Genivar Inc. (now WSP Global Inc.) in 2013 found the project to be feasible from an engineering perspective • BRREA obtained preliminary permission via Survey Permits from Parks Canada to use the waterway and dam for a small hydro generation station as part of a previous submission to the provincial Feed-in-Tariff (FIT) program. Parks Canada has indicated it is open to renewing these permits as part of future project developments • BRREA has partnered with a hydropower project developer, Equinox Hydro Inc., to form Burritts Rapids Hydro Inc. • City Council approved a Municipal Council Support Resolution for the project in October 2016 in the context of the FIT program (version 5.0). • Next steps include completing an Environmental Assessment for the project and finalizing the project design		
5	Convene stakeholders from the development industry and renewable energy sector to facilitate dialogue and solutions for making grid connections easier (e.g., addressing grid capacity and constraints, identifying opportunities to integrate renewable energy in new developments, etc.)	2018	City of Ottawa (PIED) Support: Hydro Ottawa	• There are little or no barriers to implementation for this action	1, 2, 3, 4, 5, 6, 7, 8	Existing

Biogas and Heat Pumps						
6	Undertake a technical and economic analysis to assess current as well as leading-edge practices for the production and utilization of biogas at the Robert O. Pickard Environmental Centre and in other relevant municipal applications (e.g., collection and treatment of household organics, potential for CNG fleet vehicles, etc.). Develop and issue a Request for Information (RFI) or Expression of Interest (EOI) to gather information on commercially-viable products and companies with expertise in biogas and renewable natural gas	2018-2019	City of Ottawa (PIED)	• This project may be eligible for grant funding (up to 80 percent of total costs to a maximum of $175,000) from FCM's Municipalities for Climate Innovation Program. Applications are accepted year-round until January 31, 2020 • A preliminary scope of work has already been prepared for the study • Staff at ROPEC believe it would be worthwhile to examine the feasibility of converting digester gas (biogas) into renewable natural gas	1, 2, 3, 5, 7, 8	Existing/ External Funding
7	Undertake a scan of propane-fueled municipal buildings where existing heating equipment is due for replacement. Use Natural Resources Canada's RETScreen software to assess and identify facilities that can economically be converted from propane to biomass (i.e., wood pellet) heating systems	2017	City of Ottawa (BEEM) Support: Ontario Ministry of Agriculture, Forestry and Rural Affairs, CanmetENERGY	• Staff from CanmetENERGY (Natural Resources Canada) are available to support City staff in undertaking RETScreen analyses • Staff from OMAFRA are available to support City staff in identifying and pursuing relevant external funding programs • There are little or no barriers to implementation for this action	2, 5, 7	Existing
8	Investigate the opportunity to develop a Community Improvement Plan (CIP) in a rural area of the city to promote fuel switching (e.g., propane to biomass heating systems) and to stimulate economic development	2018	City of Ottawa (PIED) Support: Ontario Ministry of Agriculture,	• The provincial Ministry of Environment and Climate Change is expected to announce details of its Wood Stove Exchange Program in October 2017. The program will likely offer rebates or incentives to support rural residents with the replacement of low-	2, 4, 5, 6, 7, 8	Existing/ External Funding

			Forestry and Rural Affairs	efficiency wood stoves and fossil fuel heating systems • Opportunities to promote fuel switching and biomass heating systems in rural areas are likely available through the federal government's Green Infrastructure Phase II – Promoting Clean Energy for Remote Communities program. A Request for Proposals is anticipated in late fall 2017		
9	Seek opportunities to expand rebate programs for air-source heat pumps. Current programs could be expanded to include all types of fossil fuel heating (e.g., propane, oil, natural gas) and could provide rebates for new buildings as well as retrofits	2020	City of Ottawa (PIED/BEEM), Hydro Ottawa or other	• Hydro Ottawa currently offers rebates for electrically heated homes, including up to $4,000 to upgrade electric furnaces or baseboards to air source heat pumps	1, 2, 3, 4, 5, 7	Existing/ Community
10	Undertake an economic analysis to determine the feasibility of integrating air-source heat pumps into City facilities currently heated by natural gas	2017	City of Ottawa (BEEM)	• There are little or no barriers to implementation for this action	1, 2, 3, 7	Existing
11	Implement the Ottawa Community Housing ECO^2 Plan to pilot green energy technologies and programs that benefit OCH tenants, the city and the environment. Continue to aim for the highest, most financially feasible energy performance in new affordable housing developments by taking inspiration from leading energy certifications like the Passive House standard	2017-2020	Ottawa Community Housing (OCH)	• OCH recently partnered with the Carlington Community Health Centre to build a new Health Hub for seniors—a four-storey building with a ground-floor health clinic and 40 units for seniors housing above. Currently under construction, the project is being built to Passive House standards and will use approximately 85 percent less energy compared to a typical building of similar size • OCH intends to apply for provincial funding earmarked for improving energy efficiency in Ontario's social housing sector	1, 2, 3, 6, 7, 8	Community

12	Develop a training manual or reference document for developers on how to integrate low-carbon thermal energy systems into new buildings	2019-2020	City of Ottawa (PIED/BEEM)	• The City has experience developing a variety of guidelines for developers, including urban design guidelines, etc.	1, 2, 3, 6, 7, 8	Existing
13	Consider opportunities to integrate geothermal systems in the design and allocation of park space in new City parks, and update policies where required	2019-2020	City of Ottawa (PIED/RCFS)	• Criteria will be need to be established to determine where and under what circumstances this could happen.	2, 3, 4, 6, 7, 8	Existing
14	Work with a developer and possibly a district energy specialist or a natural gas or electricity distributer to develop a ground source heating system in a new subdivision	2019-2020	City of Ottawa (PIED) / TBA	• There are several developers and home builders in Ottawa with expertise in low-carbon housing. The "Beaver Barracks" located at 464 Metcalfe Street is one example of a sustainable housing development that incorporates geothermal heating. Similarly, the *Arcadia* community in Kanata includes five homes that incorporate air-source heat pump technology	1, 2, 3, 4, 6, 7, 8	Existing/ Community
15	Advocate for the return of federal or other incentives to support ground source heat pumps, such as those previously available through the ecoENERGY program	2018	City of Ottawa (PIED)	• There are little or no barriers to implementation for this action	2, 3, 4, 7	Existing
District Energy						
16	Advocate to provincial government for a low-temperature design standard as part of the Building Code amendments	2017-2020 (Ongoing)	City of Ottawa (PIED)	• Many changes effecting renewable energy and conservation are being proposed.	1, 2, 3, 4, 5, 8	Existing
17	Hook up cooling in City Hall to the district energy network in the short term and make plans for a heating hook-up.	2017-2019	City of Ottawa (BEEM)	• City Hall was built with provision for hook-up with a district energy system • Some City Hall equipment is approaching its end of life and hook-up might avoid a capital expenditure	1, 3, 6, 8	Existing

18	Develop a Memorandum of Understanding (MOU) between the City and the federal government to explore and encourage district energy connections in both new and existing City facilities	2017-2018	City of Ottawa (PIED, BEEM), Public Services and Procurement Canada (PSPC)	• PSPC's Energy Services Acquisition Program is in the process of upgrading the central heating and cooling plants owned by the federal government in the National Capital Area (i.e., conversion from steam to hot water) • PSPC has expressed an interest in working with the City of Ottawa and Ville de Gatineau to expand its district energy systems to other buildings in the downtown area	All	Existing
19	Develop a low-carbon district energy system that can be promoted as a high-priority economic impact project. This will generally be in a high growth node or corridor which includes district energy system installation and connections	2020	City of Ottawa (PIED), Enwave	• This could be considered as part of TOD planning in a high density area of the City.	1, 2, 3, 6, 7, 8	Existing/ Community
20	Undertake a scan of waste heat sources available for thermal use across Ottawa	2019	City of Ottawa (PIED)	• This project may be eligible for grant funding (up to 80 percent of total costs to a maximum of $175,000) from FCM's Municipalities for Climate Innovation Program • This project may be eligible for grant funding from the Ministry of Energy's Municipal Energy Plan Program	1, 2, 3, 5, 7, 8	Additional/ External Funding
21	Investigate the requirements for access to the City's road right-of-ways for the purposes of district energy infrastructure	2018	City of Ottawa (PIED)	• Criteria will be need to be established to determine where and under what circumstances this could happen.	2, 3, 4, 6, 7	Existing
22	Consider opportunities for the installation of underground district energy infrastructure in the design and allocation of park space, and update policies where required	2019-2020	City of Ottawa (PIED/RCFS)	• Criteria will be need to be established to determine where and under what circumstances this could happen.	2, 3, 4, 6, 7	Existing

23	Advocate for Building Code amendments that require buildings of a certain size and location to be built to be compatible for future district energy connections	2017-2020 (Ongoing)	City of Ottawa (PIED)	• Advocacy for a “district energy ready” requirement for new buildings	2, 3, 4, 5, 6	Existing
24	Pilot a local community energy planning process where renewable energy generation and conservation can be integrated into different scales of the community	2019-2020	City of Ottawa (PIED)	• Local community energy plans consider energy early in the land-use and infrastructure planning process for an area, and identifies opportunities to integrate local energy solutions at the building and neighbourhood-scale. • With local, Provincial and Federal GHG reduction targets already set, net zero is also becoming an inevitable reality in Ontario by 2030 (and net zero “ready” even earlier). Low carbon energy solutions will be imperative for new communities to consider energy planning as part of planning for communities at the neighbourhood and building scale. • Energy resilience including back-up power solutions can mitigate vulnerability to area-wide power outages in the case of extreme weather. Improved energy systems will also keep energy jobs and energy dollars in the community.	All	Additional
Electrification of Transport (Cars and Light Trucks)						
25	Establish an Electric Vehicle Discovery Centre in Ottawa	2018	Plug ‘N Drive Support: City of Ottawa (PIED)	• Plug ‘N Drive currently operates an EV Discovery Centre in Toronto. The Centre is the first of its kind in the world and focuses on providing an experiential learning environmental for EVs • Plug ‘N Drive can leverage observations and lessons learned from the Toronto model to inform	5, 8	Existing/ Community

				key decisions with regards to the centre's design, location and services in Ottawa • Plug 'N Drive has expressed an interest in working with the City to undertake this initiative and will seek access to provincial Cap and Trade funds to finance the facility		
26	Continue to host Ottawa EV Day events and educational sessions to engage residents	2017-2020	EnviroCentre	• The former Ottawa Centre EcoDistrict used to host an annual Ottawa EV Day event on Sparks Street. These were one-day community events to showcase the benefits of EVs and allow for test drives in the downtown core • The event is now being led by EnviroCentre and has expanded to three one-day events across Ottawa (i.e., beyond the downtown core)	5, 8	Existing / Community
27	Install a 150 kW EV charging station in Ottawa as a pilot/demo project	2018	To Be Determined	• The City's Building Engineering and Energy Management (BEEM) unit will partner with an external energy provider and operator regarding this opportunity • This project would be the first of its kind in Canada (the technology is currently being piloted in California)	5, 7	Existing
28	Explore an autonomous vehicle program in Ottawa that integrates EV technology	2019	City of Ottawa (PIED)	• A competitive project proposal could likely be developed for this project and submitted to Canada's Smart Cities Challenge, a new $300 million initiative recently announced by the federal government. • Winning proposals (primarily social benefits) from large municipalities will be eligible for up to $50 million in prize funding. More specifics on program eligibility are expected in late 2017.	5, 6, 7, 8	Existing/ Additional

29	Investigate the feasibility of an autonomous EV shuttle between the LRT and a large employment or large residential area	2019-2020	City of Ottawa (PIED)	• The City has prepared a list of the top 150 employers in which to pursue possible partnerships • Funding through Canada's Smart Cities Challenge could be secured once a community partner is identified	5, 6, 7, 8	Additional
Advancing Energy Evolution						
30	Establish a Community Energy Innovation Fund	2018	City of Ottawa (PIED, BEEM)	• Terms of Reference will be brought to Committee and Council in 2018.		Additional
31	Establish a corporate Smart Energy Office.	2019	City of Ottawa	• An expansion of the Building Engineering and Energy Management's (BEEM) function, this group will have a dual mandate to find energy savings through both conservation and demand management and to identify alternative local renewable energy opportunities for City facilities		Additional
32	Develop Phase 2 Energy Evolution in collaboration with community partners, including the development of a long term governance model.	2018 - 2019	City of Ottawa (PIED)	• Phase 2 will include an internal working group, external advisory working group, targeted subject matter experts and an informed Sounding Board.		Existing
33	Work with community partners to establish a Low Carbon Innovation Centre for Ottawa as part of the Low Carbon Cities Canada (LC3) initiative being led by the Atmospheric Fund (TAF)	2017-2018	City of Ottawa (PIED) / LC3	• The Low Carbon Innovation Centre (LCIC) will help accelerate multiple stages of the innovation process, whether those are technological, financial, policy, behavior change or combinations thereof. • LCIC's invest in demonstrating, de-risking, and unsticking local solutions. In other words, a dedicated capacity to support cities to create, refine and/or develop, eliminate barriers to, and scale up solutions that can achieve significant greenhouse gas (GHG) reductions and the multiple benefits associated with a low carbon urban economy.		Existing

APPENDIX B – LIST OF FUNDING OPPORTUNITIES IN 2017 APPLICABLE TO ENERGY EVOLUTION[1]

Table B1: Federal Government Funding Opportunities in 2017 and beyond

Program Name	Fund Administrator	Description	Eligibility	Program Budget	Project Funding Limit	Deadline to Apply
Municipalities for Climate Innovation Program (MCIP) – Plans and Studies	Federation of Canadian Municipalities	Grant funding to develop plans and studies to reduce GHG emissions	Municipalities	Not specified	Up to $175,000	January 2020 (can apply year-round)
MCIP – Capital Project Grants	Federation of Canadian Municipalities	Grant funding to implement climate change capital projects. Funding can be used to upgrade, build, replace, expand, or purchase and install fixed assets or infrastructure.	Municipalities	Not specified	Up to 80% of costs of up to $1M	January 2020 (can apply year-round)
MCIP – Climate Change Staff Grants	Federation of Canadian Municipalities	Grant funding to supplement for new and existing municipal staff to implement climate change programs and projects	Municipalities	Not specified	Not specified	Available starting in 2018.
MCIP – Transition 20150	Federation of Canadian Municipalities	A combination of training and grant funding for a collaborative network of municipalities committed to reducing GHG emissions by 80 per cent by 2050.	Municipalities	Not specified	Not specified	Available starting in 2018.
Green Municipal Fund – Capital Projects and Brownfields	Federation of Canadian Municipalities	Combination of grant and loan funding for capital projects that improve air, water, and soil, and reduce GHG emissions.	Municipalities and their partners	Varies	Capital Projects: Up to 80% of eligible costs. Loan maximum is $5M, and the grant amount is 15% of the loan. Brownfields: Grants are not applicable; no specified loan limit.	Capital Projects: Initial review form must be submitted by March 1, 2018. Brownfields: Can apply year-round

1 This list will be reviewed and updated periodically as necessary.

Program Name	Fund Administrator	Description	Eligibility	Program Budget	Project Funding Limit	Deadline to Apply
Green Infrastructure Phase II – Next Generation Clean Energy Infrastructure	Natural Resources Canada	Two target areas for funding: 1. Driving down the cost and creating market confidence in net zero construction to enable adoption of more stringent codes; 2. Accelerating market entry of next-generation as well as innovative electric vehicle charging technologies to accelerate adoption of electric vehicles.	Canadian organization	Net-Zero Construction: Up to $49.4M over eight years from Apr. 1, 2018 to Mar. 31, 2026. Electric Vehicles: Up to $30M over four years from Apr. 1, 2018 to Mar. 31, 2022	Demonstration projects can receive up to $20M or up to 50% of total project costs. Research and design projects can received up to $1.5M or up to 75% of total project costs.	Accepting letters for expression of interest until September 25, 2017.
Green Infrastructure Phase II – Smart Grids	Natural Resources Canada	Funding to support larger sale demonstrations of promising near-commercial smart grid technologies, and deployment of proven smart grid integrated systems to reduce GHG emissions, better utilize existing electricity assets and foster innovation and clean jobs.	Canadian organization	Up to $100M over four years from Apr. 1, 2018 to Mar. 31, 2022.	Not specified	Accepting submissions of Smart Grid Registration Forms and questionnaires until October 2, 2017.
Low Carbon Economy Fund – Low Carbon Economy Challenge	Environment and Climate Change Canada	Funding to support ambitious projects to reduce emissions and generate clean growth in support of the Pan-Canadian Framework on Clean Growth and Climate Change (more details to come fall 2017).	Provinces and territories; Municipalities; Indigenous governments and organizations; Businesses; Not-for-profit; For-profit	$600M	No details available yet.	No details available yet.

Table B2: Provincial Government Funding Opportunities in 2017 and beyond

Program Name	Fund Administrator	Description	Eligibility	Program Budget	Project Funding Limit	Deadline to Apply
Municipal Energy Plan (MEP) Program	Ministry of Energy	Funding to develop plan that will help your community: • Improve energy efficiency • Reduce energy consumption and GHG emissions • Study the impact of future growth on energy needs • Foster renewable energy production and economic development	Ontario Municipalities	Not specified	Up to 50% of eligible costs up to a maximum of $90,000 to create a new plan and $25,000 to continue work on an existing plan	Continuous intake process until all funds are distributed
Municipal GHG Challenge Fund	Ministry of Environment and Climate Change	Supports community-led action on climate change by funding projects aimed at reducing GHG emissions in any sector, including buildings, energy supply, water, transportation, waste, and organics.	Ontario municipalities with a community-wide greenhouse gas inventory, emissions reduction targets, and a strategy/plan to reduce emissions	Up to $100M	Up to 100% of the eligible costs and may request up to $10M per project	November 14, 2017
School Repairs and Renewals	Ministry of Environment and Climate Change	Supporting the installation of energy-efficient building elements, such as new windows, lights and furnaces.	School boards	Varies per school board	Varies per school board	No deadline provided
Low-Carbon Innovation Fund (LCIF)	Ministry of Research, Innovation, and Science	Supports emerging, innovative technologies in areas such as alternative energy generation and conservation, new biofuels or bio products, next-generation transportation or novel carbon capture and usage technologies. Two funding streams: 1. Technology Validation 2. Technology Demonstration	Companies and entrepreneurs with innovative clean tech solutions; Publically assisted Ontario universities; Ontario colleges of applied art and technology	$25.8M	Technical Validation: Fund full proof of concept or prototype Technology Demonstration: Up to 50% of eligible costs or maximum of $2M	Technical Validation: Details to be released in fall 2017. Technology Demonstration: Accepting letters for expression of interest until September 22, 2017.

Program Name	Fund Administrator	Description	Eligibility	Program Budget	Project Funding Limit	Deadline to Apply
Electric Vehicle Charging Incentive Program	Ministry of Transportation	Encourages increased adoption of electric vehicles and stimulates market demand by providing monetary incentives for personal and fleet electric vehicles.	Residents; Businesses; Municipalities; Non-government organizations; Non-profit organizations	Not specified	Varies	Applications must be submitted within 3 months of vehicle was registered
Ontario Municipal Commuter Cycling Program	Ministry of Transportation	Supports the implementation of commuter cycling infrastructure to encourage people to get out of their cars and onto bikes for their daily commute or other frequent trips.	Ontario municipalities	$50M	Up to 80% of eligible costs	September 8, 2017
Electric School Bus (ESB) Pilot Program	Ministry of Transportation	One-year pilot program to help determine if ESBs can operate reliably and cost effectively across Ontario in all weather conditions	School bus operators	$8M	Maximum of $400,000 per project	October 13, 2017
GreenON	Green Ontario Fund	One-stop shop to access available energy efficiency programs.	Individuals, businesses, and organizations	Varies by program	Varies by program	Varies by program

Table B3: Other Funding Opportunities in 2017 and beyond

Program Name	Fund Administrator	Description	Eligibility	Program Budget	Project Funding Limit	Deadline to Apply
Natural Gas Innovation Fund	Canadian Gas Association	Funding to support cleantech innovation in the natural gas sector, including focusing on improved environmental performance, greater affordability and competiveness, and enhanced safety and resiliency.	Startups and organizations with the right innovation for market uptake and commercial viability	Not specified	Not specified	Continuous intake process; no deadline indicated.
Education and Capacity Building Program	Independent Electricity System Operator (IESO)	Funds projects that help build the understanding and skills needed for managing and generating energy.	First Nation and Métis Communities; Co-ops; Municipalities; Public Sector Entities; Registered Charities; Not-for-Profit Organizations		Up to $100,000	October 2, 2017

GLOSSARY OF TERMS

The following is a summary of the most commonly used acronyms in the document and their meaning.

AQCCMP – Air Quality and Climate Change Management Plan
BEEM – Building Engineering and Energy Management
CEP – Community Energy Plan
DC Fast Chargers – Direct Current Fast Chargers
DE – District energy
DHW – Domestic Hot Water
ESAC – Environmental Stewardship Advisory Committee
EV – Electric vehicles
FCM – Federation of Canadian Municipalities
GHG – Greenhouse Gas
HVAC – Heating, Ventilation and Cooling
ICI – Institutional, Commercial and Industrial
IESO – Independent Electricity System Operator
LAP – Local Action Plan
LCIC – Low Carbon Innovation Centre
LC3 – Low Carbon Cities Canada
LRT – Light-Rail Transit
LED – Light emitting diode
LEED – Leadership in Energy and Environmental Design
PV – Solar Photovoltaic
RNG – Renewable Natural Gas
ROPEC – Robert O. Pickard Environmental Centre
TAF – Toronto Atmospheric Fund
TJ – Terajoules