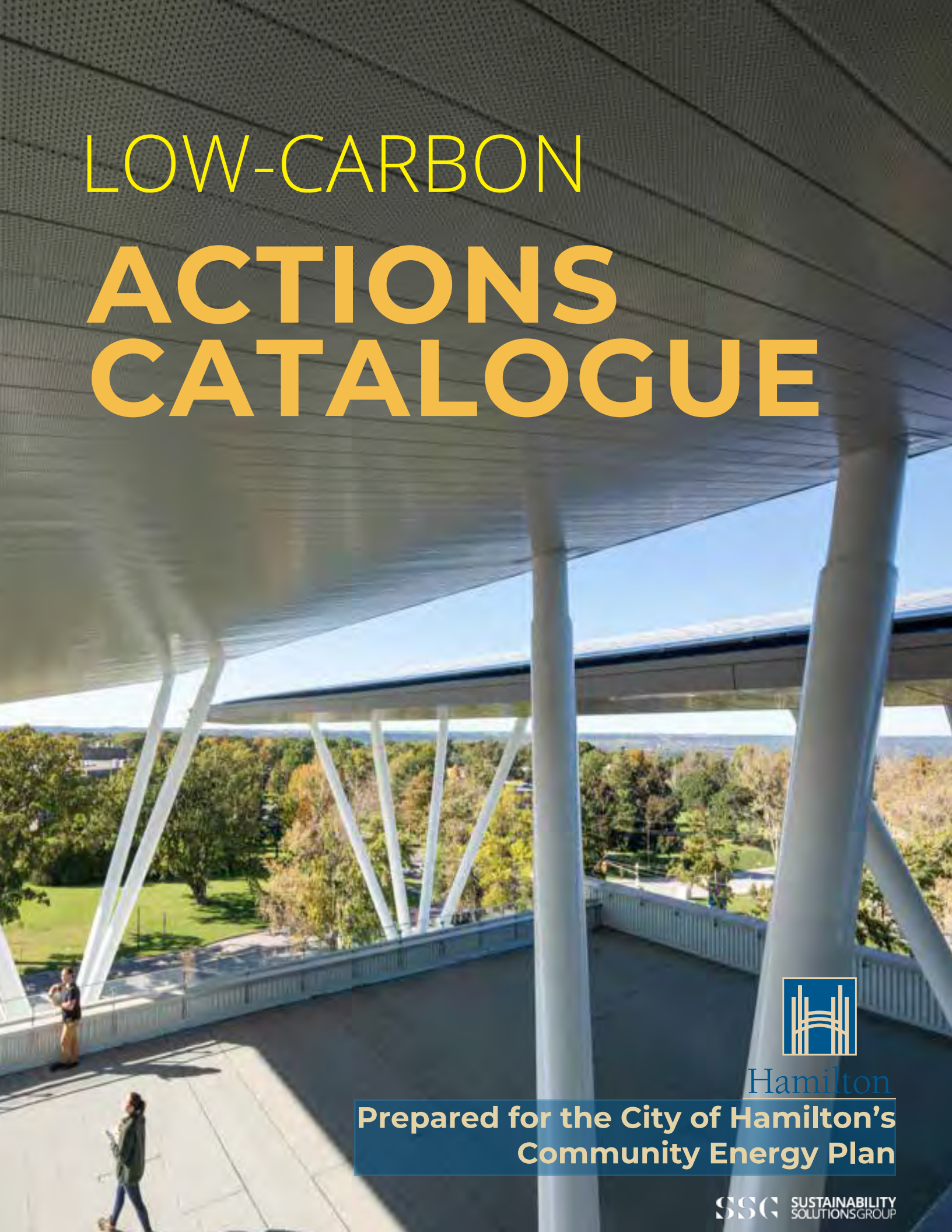

LOW-CARBON ACTIONS CATALOGUE

Hamilton

Prepared for the City of Hamilton's Community Energy Plan

SSG SUSTAINABILITY SOLUTIONS GROUP

Photo on cover: Joyce Centre for Partnership & Innovation photos

Contents

PURPOSE

The Actions Catalogue is a compilation of key low-carbon actions relevant to Hamilton's context. The Catalogue provides examples of implementation policies, programs and technological mechanisms as well as examples of how communities have implemented or are implementing these actions across Ontario, the country, and the globe.

The purpose of this catalogue is to provide information and inspiration to the community as Hamilton's Community Energy Plan (CEP) for achieving net zero greenhouse gas emissions by 2050 is developed. This is important to ensure innovative and emerging approaches are considered in the development of the CEP.

RELATIVE EMISSIONS REDUCTIONS FACTOR

Each action has a relative strength in reducing GHG emissions, but the actions have yet to be modelled for this Community Energy Plan. In place, a general indicator of an action's effectiveness in reducing GHG emissions is provided in near-term increments (2030) and long-term increments (2050). Based on previous experience in the development of Community Energy Plans by SSG in other jurisdictions and through a literature review, a general reading is provided as shown below:

2030	ENABLER	LOW	MEDIUM	HIGH
2050	ENABLER	LOW	MEDIUM	HIGH

Joyce Centre for Partnership & Innovation photos

CONTEXT: HAMILTON'S ENERGY USE & GHG EMISSIONS

Hamilton is home to a large and growing population, a major industrial sector (most notably steel), impressive academic institutions and healthcare services, and an important shipping hub—all of this, and much more, contribute to its current energy use and GHG emissions. These features are also sources of potential energy savings, renewable energy and other climate solutions. For example, Hamilton's universities and colleges offer opportunities for climate research and skills training. Hamilton's downtown district energy system has the potential to be expanded and run on renewable energy.

When it comes to achieving net zero before 2050, the largest challenges and opportunities for Hamilton include its:

- reliance on coal (for powering industry);
- reliance on natural gas (for heating buildings); and
- reliance on gasoline and diesel (for personal and commercial vehicles as well as transit).

To tackle these, Hamilton will need to focus its climate actions on

1. Improving energy efficiency for homes, buildings and industry.
    - This not only saves money on energy bills but helps reduce the cost to switching to fossil free energy sources.
2. Switching from fossil-fuelled energy sources in homes, buildings, industry and in transportation, first to local renewable energy sources, and secondly to the provincial grid.
    - The provincial electricity grid is secondary because it is projected to increasingly rely on natural gas.

Hamilton has already undertaken actions that support a pathway to net zero carbon emissions. Actions have included:

- building retrofits to improve energy efficiency in municipal buildings;
- transitioning city fleet and transit vehicles to lower emission energy sources;
- capturing gases at municipal landfills;
- initiatives to shift to more sustainable modes of travel including walking, cycling, transit and carpool/carshare;
- planning for higher density development to support active transportation and transit use;
- protection of natural areas and the urban tree canopy through policy framework and partnerships; and
- partnering with local organizations to foster sustainable actions across the community.

There are many examples of other communities undertaking climate actions addressing all of these areas. These examples help show a path forward and highlight the many co-benefits that climate mitigation offers a community. The most common co-benefits include: improved air quality, local economic development, energy resilience, and improved community wellbeing.

BUILDINGS

SAMPLE PAGE

Building performance rating and reporting

This is the STRATEGY under which several mechanisms to reduce emissions are grouped.

RELATIVE GHG IMPACT

2030	ENABLER	LOW	MEDIUM	HIGH
2050	ENBLER	LOW	MEDIUM	HIGH

This meter will show the relative impact the strategy can have on GHG emissions.

DESCRIPTION

Building performance monitoring, reporting and benchmarking measures are critical enablers in achieving emissions reduction goals. They allow the city to compile building data from a range of uses and track energy performance (and therefore GHG emission reductions) year by year, enabling cities to understand where to target their continued efforts.

A brief description of the strategy.

SAMPLE MECHANISMS

- Advanced metering (smart, net and sub-metering)
- Benchmarking
- Energy performance certification
- Mandatory audits and advice

These are MECHANISMS that are associated with the sub-category. They can be made up of plans, policies or programs. The actual implementation of these (considered ACTIONS) contributes to reducing emissions.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

This is a classification of what type(s) of levers can be used to implement the mechanism.

This highlights potential co-benefits associated with the strategy.

POTENTIAL CO-BENEFITS

The icons at the foot of each page indicates potential co-benefits of the low-carbon strategies. Co-benefits may be defined as secondary benefits from climate policy action, or the combination of climate and non-climate benefits that are targeted under an integrated policy program. **Highlighted icons indicate that the co-benefit could be realized as a result of employing the corresponding strategy.**

REDUCED AIR POLLUTION

ECONOMIC PROSPERITY

IMPROVED INDOOR AIR QUALITY

RESILIENCE

SOCIAL EQUITY

INCREASED PHYSICAL ACTIVITY

REDUCED NOISE POLLUTION

HEALTHY DIET

REDUCED RISK OF INJURY

Joyce Centre for Partnership & Innovation photos

Joyce Centre for Partnership & Innovation photos

BUILDINGS

Building codes and standards for new construction

RELATIVE GHG IMPACT

2030	**MEDIUM**	**2050**	**HIGH**

DESCRIPTION

Energy codes and/or standards seek to encourage or mandate energy efficiency in buildings through either prescriptive or performance methodologies. Prescriptive methodologies require developers to meet minimum thresholds for key energy drivers, such as insulation, HVAC efficiency and lighting. Performance methodologies are more focused on how the building performs overall, rather than on the individual actions (though these can still be identified). Performance methodologies can require developers to meet minimum thresholds for energy use intensity (EUI), on a per square metre basis (eg. GHG/m2, or thermal energy demand intensity (kWh/m2)), or a percentage reduction from a baseline. These can also be adopted through minimum energy performance rating systems, such as Passive House, Net Zero or Energy Star for the various categories of building types.

SAMPLE POLICIES AND PROGRAMS

- Green development standards
- Energy consumption/GHG emissions cap for new construction
- Mandatory energy performance rating or green community rating system (LEED, Energy Star, Passive House, Net-Zero, etc.)
- Renewable energy installation requirements or incentives
- District heating/cooling connection capabilities

POTENTIAL CO-BENEFITS

BUILDINGS

Building codes and standards for new construction

WHAT OTHER CITIES ARE DOING

- **New York City, NY**: In order to reach the City's GHG emissions reduction goal, a more stringent building code (Energy Conservation Code) has been adopted for new residential and commercial buildings and major renovations. The code was phased-in with consumption reduction targets of 20% below 2016 consumption in 2019, 40% below 2016 consumption targets in 2022, and Zero-Net-Energy by 2030. The City is also providing monetary incentives to encourage voluntary adoption of stretch codes, with targets of 40% below 2016 consumption by 2019 and Zero-Net-Energy by 2022.
- **Toronto, ON**: The Toronto Green Standard (TGS) is Toronto's sustainable design requirements for new private and city-owned developments. The Standard consists of 4 increasingly stringent tiers of energy performance with supporting guidelines that promote sustainable site and building design. Tier 1 of the Toronto Green Standard is a mandatory requirement of the planning approval process. Financial incentives are offered through a Development Charge Refund Program for planning applications that meet higher level voluntary standards in Tiers 2 to 4. The mandatory tier becomes increasingly stringent over time, achieving near-zero by 2030.
- **Halton Hills, ON**: Its Green Development Standard is a flexible set of criteria that are designed to produce more sustainable and efficient development. The Standards are organized into three Checklists, based on development type: 1) Low-Rise Residential (four+ lots); 2) Low-Rise Non-Residential 3) Mid- to High-Rise. The Standards apply to applications for a Zoning By-law Amendment, Official Plan Amendment, as well as Subdivision/ Condominium and Site Plans. Allocation of water capacity is based on, among other things, demonstrating compliance with applicable Official Plan policies which can be demonstrated through the successful completion of the Standards Checklist(s).

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

BUILDINGS

Building performance rating and reporting

RELATIVE GHG IMPACT

2030	ENABLER	**2050**	ENABLER

DESCRIPTION

Building performance monitoring, reporting and benchmarking measures are critical for achieving emissions reduction goals. They allow the city to compile building data from a range of uses and track energy performance (and therefore GHG emission reductions) year by year, enabling cities to understand where to target their continued efforts.

SAMPLE POLICIES & PROGRAMS

- Publicly displaying building energy performance
- Benchmarking against other similar buildings
- Energy performance certification
- Mandatory audits and advice

SAMPLE TECHNOLOGICAL MECHANISMS

- Advanced metering (e.g. smart and sub-metering)
- Streamlined computer software (e.g. Energy Star Portfolio Manager)

WHAT OTHER CITIES ARE DOING

- **Cambridge, MA**: Requires non-residential buildings larger than 25,000 sq ft and residential buildings of over 50 units to report on their energy use annually.
- **New York City, NY**: Requires sub-metering in non-residential tenant spaces larger than 5,000 sq ft. The 2009 Greener, Greater Buildings Plan requires benchmarking and disclosure for public buildings greater than 10,000 sq ft, and commercial or multifamily buildings greater than 50,000 sq ft.
- **European Union**: Energy Performance Certificates (EPC) were introduced in 2002 as part of the Energy Performance Buildings Directive (EPBD), then updated in 2010. All properties (homes, commercial, and public buildings) must obtain an EPC when built, sold, or rented. The EPC details building information, energy performance data, calculation methods, inspector qualifications, and recommendations for improvement.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

BUILDINGS

Energy efficiency and retrofit measures for existing buildings

RELATIVE GHG IMPACT

2030	**HIGH**	**2050**	**HIGH**

DESCRIPTION

If cities are to achieve carbon emissions reduction targets, it is not enough to build new energy-efficient buildings. Existing buildings will need to be retrofitted. Most current buildings will still be around in 2050 and currently contribute a large portion of emissions. Retrofitting, energy auditing and re-commissioning of existing buildings provide opportunities for achieving significant energy savings and emissions reductions.

SAMPLE POLICIES & PROGRAMS

- Mass retrofit program allowing for economies of scale
- Increased participation in and breadth of demand response programs
- Building operations staff training
- Mandatory deep energy retrofit studies with audits
- Minimum performance standards for existing buildings
- Renovation threshold requirement to meet codes and standards
- Create retrofit incentives
- Local improvement charges

SAMPLE TECHNOLOGICAL MECHANISMS

- Building energy management systems
- High-efficiency air conditioners
- Efficient lighting, appliances, HVAC, and other plug loads
- Improved insulation (windows, wall, roof)
- Building recommissioning

WHAT OTHER CITIES ARE DOING

- **New York City, NY**: Requires owners of older mid-sized buildings to upgrade lighting in non-residential areas to meet current standards by 2025; requires buildings over 50,000 sq ft to undergo periodic energy audit and recommissioning measures; and has tailored energy standards for historic buildings, which are currently exempt from compliance.
- **Newmarket, ON**: Newmarket Energy Efficiency Retrofit is a major initiative to significantly scale up retrofits of existing homes. The business case developed for the program analyzes the many facets of scaling up a large retrofit program. The program aims to increase residential efficiency by 35%, lower carbon emissions by 60%, and increase water efficiency by 20%.
- **Windsor, ON**: A business case was presented to Council in February 2020 for a City-sponsored retrofit program to cover 80% of Windsor's 60,000 homes by 2041, without the need for government subsidies. The retrofit program would reduce the city's emissions by 235,000 tonnes. A similar program for institutional and commercial buildings could reduce emissions by another 70,000 tonnes.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

BUILDINGS

Industrial carbon emissions reduction

RELATIVE GHG IMPACT

2030	**HIGH**	**2050**	**HIGH**

DESCRIPTION

The industrial sector consumes a significant amount of energy to produce the goods and raw materials that we use every day. Energy efficiency measures are challenging due to the sheer range of production mechanisms and technologies. The industrial sector, and particularly steel production, represents over half of Hamilton's emissions. Industry is an important part of Hamilton's economy and will hopefully continue to be so long into the future. In order to meet the community-wide target of net zero before 2050, increased energy efficiency, fuel switching, and potentially the use of carbon capture technologies will be necessary.

Currently the Hamilton Chamber of Commerce is spearheading a two-year industrial waste heat recovery potential study, which has the potential to lead to important energy efficiencies in the sector.

SAMPLE POLICIES & PROGRAMS

- Voluntary carbon budgets and targets
- Engagement and peer support programs
- Harmonize corporate sustainability plans with community-wide carbon reduction targets
- Increase utility-run demand side flexibility programs
- Utility partnership with local industry to support increased energy efficiency (e.g. increase industry's waste heat capture, increase water reuse)

SAMPLE TECHNOLOGICAL MECHANISMS

- Energy efficiency or waste energy recovery in industrial processes
- Increase use of biomass in combined heat and power systems
- Employ carbon capture technology

WHAT OTHER CITIES ARE DOING

- **Berlin, Germany**: In late 2019, Agora Energiewende, the think tank supporting Germany's clean-energy transition, developed a detailed policy paper on how Germany's major carbon intensive industries, including steel, can achieve net-zero carbon emissions by 2050. Key technological solutions considered to be ready for implementation by 2025 include replacing fossil-fueled blast furnaces with hydrogen powered electric arc furnaces, and CO2 capture and utilisation of waste gases from integrated blast furnaces.
- **Saint-Félicien, Que**: Resolute's Saint-Félicien pulp mill is capturing up to 30 metric tons of CO2/day from Resolute's softwood kraft pulp mill, the majority of the CO2 is transported to a 34-hectare neighboring world-class vegetable greenhouse. This C$100 million project is the result of a partnership between Resolute, Saint-Félicien and local investors.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS


McMaster University

TRANSPORTATION

Fuel switching - private transport

RELATIVE GHG IMPACT

2030	**MEDIUM**	**2050**	**HIGH**

DESCRIPTION

Improvements in vehicle fuel efficiency and switching to cleaner fuels reduces emissions, improves local air quality and reduces noise. Fossil fuel consumption by private vehicles can be reduced through a number of technological, infrastructural, behavioural and management mechanisms. For example, increasing the supply of electric vehicle (EV) recharging stations supports greater uptake of electric vehicles, especially for urban travel. Financial incentives and disincentives can influence travel behaviour including trips taken and total vehicle kilometres travelled.

SAMPLE MECHANISMS

- Incentives/rebates/mandates to switch personal and commercial vehicles to electricity/hydrogen/biofuels
- Registration fees tied to vehicle GHG emissions
- Switch City's fleet of vehicles to electric/hydrogen/biofuel (including waste vehicles, if appropriate)
- Incentive programs to support commercial fleets (taxis/rental and carshare services/delivery service) to fuel switch

SAMPLE TECHNOLOGICAL MECHANISMS

- Electric vehicle charging infrastructure
- Electric, hydrogen, and bio fueled vehicles

WHAT OTHER CITIES ARE DOING

- **Montreal, Que**: The provincial government has introduced Canada's first public charging network, The Electric Circuit, for plug-in electric vehicles. The network is a collaborative effort between Hydro Quebec, regional and municipal governments, and partners from the private sector.
- **Oxford, UK**: the City is supporting its Black cabs to transition to electric, by setting up 19 fast-charging stations throughout the City (some able to charge more than one car at a time), requiring that all newly licensed cabs meet low-emissions standards, and lobbying the national government for subsidies to help taxi drivers purchase electric vehicles.
- **Singapore**: Through the Carbon Emissions-based Vehicle Scheme (CEVS), all new and imported used cars, as well as taxis, are assigned to categories based on their CO2/ km performance data. Low-emission cars owners are given incentives, while higher emission cars incur a penalty in the form of a registration surcharge. The aim is to encourage consumers and taxi companies to choose lower-emission car and taxi models.
- **Toronto, ON**: In 2019, Toronto introduced its EV Strategy, which includes plans to increase EV charging infrastructure and set targets to be 5% of registered personal vehicles to be EVs by 2025, 20% by 2030, 80% by 2040, and 100% by 2050.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

TRANSPORTATION

Fuel economy - public transport

RELATIVE GHG IMPACT

2030	LOW	**2050**	LOW

DESCRIPTION

The emissions of transit operations can be reduced by decarbonizing the fleet, this presents many important co-benefits, including improved air quality and reduced noise levels.

SAMPLE POLICIES & PROGRAMS

- Set a transit decarbonization target

SAMPLE TECHNOLOGICAL MECHANISMS

- Electric, hydrogen or biofuel buses

WHAT OTHER CITIES ARE DOING

- **Copenhagen, DK**: The City is targeting to have carbon neutral public transport by 2025 through a combination of electrification and using biogas as a fuel source. This includes all harbour buses/ferries.
- **Oslo, NO**: All public transport in Oslo is required to only use renewable energy by the end of 2020; it is anticipated that transit will be supplied by a mixture of bio diesel, bio gas, hydrogen and electricity.
- **British Columbia**: BC Transit has committed to making its entire bus fleet fully electric by 2040, which includes replacing more than 1,200 existing buses and adding another 350 over the next ten years. The first heavy duty battery electric buses will be launched in 2021, and BC Transit will begin buying electric-only buses starting in 2023.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

TRANSPORTATION

Public transport - infrastructure, services and operation

RELATIVE GHG IMPACT

2030	LOW	**2050**	MEDIUM

DESCRIPTION

Improving bus infrastructure, service and operations encourages residents to use public transport more frequently, resulting in significantly lower transport carbon emissions per capita. Introducing higher orders of transit, such as LRT.

SAMPLE POLICIES & PROGRAMS

- Introduce bus rapid transit
- Increase bus service density, coverage, and frequency
- Introduce higher orders of transit, such as LRT
- Introduce a free Central Area Transit Zone (CATZ)
- Increase transit priority within mixed traffic environments to improve journey speed and reliability
- Make all transit free

SAMPLE TECHNOLOGICAL MECHANISMS

- Construct bus rapid transitways or partial priority facilities for bus services
- Modernize bus fleet to improve passenger comfort and experience
- Allow bikes to be carried on transit
- Introduce e-scooters
- Improve design and accessibility of transit stations

WHAT OTHER CITIES ARE DOING

- **Olympia, WA**: Starting on January 1, 2020, the City began a 5-year free-transit pilot. After just one month of the program, Olympia saw a 20% increase in ridership compared to the previous year — an equivalent of over 60,000 more riders.
- **Connecticut, US**: The Fastrak Bus Rapid Transit Program started in 2015 and includes dedicated bus-only roads, travel times comparable or less than a car, modern low-floor buses, modern bus stations with rising platforms, fare payment pre-boarding and WiFi. Ridership has doubled within the first year.
- **New York City, NY**: 7 Downtown Connection buses offer free transportation routes in New York's financial district to reduce taxi use in the area.
- **Copenhagen, DK**: Bikes were integrated into the wider transport network, so passengers could easily transfer between cycling and public transport. Carriages on trains were upgraded to accommodate bikes, including travel at peak times.
- **Calgary, AB**: The Calgary CTrain light rail system has a Free Fare Zone downtown, where rides taken solely within the downtown are free.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

TRANSPORTATION

Freight systems

RELATIVE GHG IMPACT

2030	LOW	**2050**	LOW

DESCRIPTION

Fuel consumption and emissions from the freight transport sector can be reduced through freight traffic planning (mode, route, distribution and timing), pricing models, route/area restrictions and application of low-carbon fuels and fuel efficiency measures in vehicles.

SAMPLE MECHANISMS

- Preparation of a Freight Master Plan (or equivalent function plans) that designates freight routes, intermodal transfer locations, load break-down locations and freight traffic management (e.g. restricted travel hours via selected routes)
- Incentives/rebates/mandates to switch freight trucks to electric/hybrid/low-carbon
- Low emissions zones/congestion charges
- Real-time digital information for logistics
- Registration fees and/or road-user charges (e.g. tolls or congestion charges) tied to vehicle efficiency and VKT/VMT
- Restrict truck access to particular areas (time-based or permanent)
- Decarbonize port operations via efficiency and fuel switching

WHAT OTHER CITIES ARE DOING

- **Montreal, Que.**: In Montreal's Downtown an old bus depot was re-purposed to allow heavy trucks to drop off their goods in one central location. Zero-emissions vehicles such as electric cargo bikes and electric light trucks would then provide the second wave of deliveries and limit heavy truck traffic and the associated pollution.
- **Region of Peel, ON**: The Region developed a Freight Master Plan which both supports economic development and addresses climate change through the promotion of alternative fuels and fuel efficiency in the sector. The Plan includes the development of a public recognition program that acknowledges businesses that are making changes to mitigate climate change impacts. This increases green program visibility and incentivizes more companies to participate.
- **Florida**: The "AV/CV/ITS Freight Applications" pilot project is exploring the feasibility of using autonomous trucks in the perishable freight industry. It is a three-phase project in which Connected Vehicle (CV) technology will be used to study truck traffic patterns (phase 1), then connected to street signals (phase 2), then given street signal priority for travel time optimization (phase 3).

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

TRANSPORTATION

Active transportation

RELATIVE GHG IMPACT

2030	**MEDIUM**	**2050**	**HIGH**

DESCRIPTION

Improvements to and expansion of walking and cycling infrastructure increase the amount of people that choose to walk and bike. This can encourage more transit trips (especially for commutes) as people are more willing to walk or cycle between transit stops. In less dense and more suburban environments, it can increase the incidence of short task-oriented walking and cycling trips that might otherwise be taken by private vehicle (e.g. to local shops and schools). Increased walking and biking also has significant health benefits.

Hamilton currently has a bikeshare system, Sobi, as well as a Cycling Master Plan and Pedestrian Master Plan. Theese are important initiatives that can be built upon.

SAMPLE MECHANISMS

- Expand bike share programs
- Reduce road space for motorized modes (chiefly, single-occupancy vehicles) and reallocate to active transport (walking and cycling)
- Improve pedestrian crossings; install better-connected, generous and comfortable walking routes; and provide walking maps and signage.

SAMPLE TECHNOLOGICAL MECHANISMS

- Introduce additional (ideally separated) bike lanes and bike traffic lights
- Build bike parking and storage facilities

WHAT OTHER CITIES ARE DOING

- **Copenhagen, DK**: Intelligent transport systems optimize the city's traffic signals to the benefit of bicyclists and buses. The Danish have also invested significantly in cycling priority infrastructure, including separated cycle lanes along many streets. In 2017, 41% of all trips to work and study to/from Copenhagen were by bike and 62% of Copenhageners chose to bike to work and study in Copenhagen. In total, 1.4 million km is cycled in the city on an average weekday.
- **Montreal, Que**: BIXI Montreal is North America's first large-scale bike sharing system. The BIXI network has 7,250 bikes and 600 stations spread across Montreal, Longueuil and Westmount. In 2018, approximately 5.8 million bicycle trips were made on the BIXI system.
- **Edmonton, AB**: Edmonton is one of the first northern Canadian cities that is set to introduce bike, e-bike, and e-scooter sharing systems.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS


ELECTRIC
VEHICLE
PARKING
CHARGING
STATION

ENERGY SUPPLY

Local low- or zero-carbon energy generation (community scale)

RELATIVE GHG IMPACT

2030	**MEDIUM**	**2050**	**MEDIUM**

DESCRIPTION

Energy generation to power and heat homes and buildings is a major source of GHG emissions for cities across Canada, due to the reliance on fossil fuels for heating (mostly natural gas) and the continued reliance in most provinces (to varying degrees) on natural gas to generate electricity. Ontario's electricity grid has become significantly less carbon intensive since the 1990's, but a portion (between 4-10%) of Ontario's electricity supply is still generated from natural gas, and this portion is projected to increase through to 2050. The grid's reliance on natural gas occurs most at peak electricity demand, when natural gas 'peaker' plants generate electricity to ensure adequate supply.

The path to net zero is clear: increased fuel efficiency, then fuel switching to renewable energy sources. Cities and residents can influence utility providers to decarbonize and/or seek to develop local community-scale renewable energy generation. Local renewable generation, especially when combined with energy storage, has the added benefit of increasing a community's self-sufficiency and resilience and creates local economic development.

SAMPLE POLICIES & PROGRAMS

- Large-scale purchases of renewable energy on behalf of the community
- Explore and support provincial regulatory requirements for renewable energy generation
- Community-owned renewable energy projects
- Require energy strategies as part of new development applications

SAMPLE TECHNOLOGICAL MECHANISMS

- Solar electricity (photovoltaic, concentrating solar)
- Waste heat recovery systems
- Anaerobic digestion of organic wastes
- Biogas / landfill gas capture
- District energy with renewable energy source (e.g. biomass)
- Large-scale heat pumps (water, ground)
- Wind power

WHAT OTHER CITIES ARE DOING

- **Seattle, WA**: The Solar Market Transformation project uses American Reinvestment and Recovery Act funds to 1) develop a financial and ownership model that addresses all legal, technical and logistical requirements for community-owned solar; 2) install the first community solar project in Seattle (estimated 30-60 kW); 3) market the program and enroll participants; and 4) establish a Solar Revolving Fund that will re-invest revenue generated by the first project into future projects.
- **Okotoks, AB**: Drake's Landing, a 52-home housing community, receives 90% of its space heating from solar thermal technology, and makes use of seasonal underground energy storage.
- **Toronto, ON**: Toronto has a policy that requires developers in Community Energy Plan (CEP) areas to submit an energy strategy as part of a complete development application. The energy strategy addresses opportunities for embedding energy solutions within the development. The City provides the scope, reviews the strategy, and works with the developer on implementation.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

ENERGY SUPPLY

On-site (building-scale) energy generation

RELATIVE GHG IMPACT

2030	LOW	**2050**	LOW

DESCRIPTION

On-site renewable energy, such as solar, is a way to supply some of the required energy for a building or facility while reducing its reliance on fossil fuels. There has been an increased deployment of on-site renewable systems in recent years, by both residential and non-residential energy consumers. The increased availability of tax incentives, credits, and grants for renewable energy, as well as financing mechanisms, such as the residential power purchase agreement and leasing options for solar, have contributed to this growth.

SAMPLE POLICIES & PROGRAMS

- Local improvement charges
- Net metering
- Green development standards
- Education and awareness programs

SAMPLE TECHNOLOGICAL MECHANISMS

- Biomass heating
- Combined heat and power
- Fuel cells
- Heat pumps (water, ground, air)
- Micro wind power technology
- Solar electricity
- Solar heating / hot water

WHAT OTHER CITIES ARE DOING

- **London, UK**: The Mayor's £34m Energy for Londoners program aims to make London's homes warm, healthy and affordable, and workplaces more energy efficient, in addition to supply London with more local clean energy. It includes a Solar Action Plan to maximize solar power in London and achieve one gigawatt of installed solar capacity by 2030 (ten times more than 2018 levels), and two gigawatts by 2050.
- **Berlin, Ger.**: Berlin's Solar Atlas website shows precisely whether a roof is suitable for using solar energy and whether the investment will pay off.
- **Basel-Stadt, Swz.**: When new buildings are erected or existing heating systems are renovated, 50% of the energy requirements for hot water must come from renewable sources. This point can be met by installing a thermal solar energy system, a ground source heat pump or a wood pellet heating system. The building can also be connected to the district heating network.
- **Toronto, ON**: The Toronto Green Standard requires all new City-owned buildings to generate at least 5% of total energy load from renewable sources.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

ENERGY SUPPLY

Smart grid

RELATIVE GHG IMPACT

2030	ENABLER	**2050**	ENABLER

DESCRIPTION

Smart grid refers to a modernization of the electricity delivery system so it monitors, protects, and automatically optimizes the operation of its interconnected elements (including the distributed generator, distribution system, industrial users and building automation systems, energy storage installations, end-use consumers and their thermostats, electric vehicles, appliances, and other household devices). Benefits include reductions in electricity demand, integration of disparate renewable energy sources and plug-in vehicles and greater grid reliability.

SAMPLE POLICIES & PROGRAMS

- Demand-responsive pricing (time-of-day pricing)
- Residential demand response programs
- Green development standards

SAMPLE TECHNOLOGICAL MECHANISMS

- Energy storage
- Smart meters/controls

WHAT OTHER CITIES ARE DOING

- **Houston, TX**: CenterPoint Energy is Houston Electric's smart grid project. It involves deployment of a fully integrated advanced metering system and web portal access to over 2.2 million customers, along with installation of advanced monitoring and distribution automation equipment.
- **New York City, NY**: Con Edison and New York State Energy Research and Development Authority offer financial incentives for both thermal and battery storage, with bonus incentives for projects larger than 500 kW. To demonstrate viability, New York Economic Development Corporation, in partnership with Con Edison, developed a smart grid demonstration project at the Brooklyn Army Terminal (BAT) in Sunset Park. The smart grid system at BAT integrates three main components: a 100 kW solar photovoltaic array; a building management system; and a 720 kWh battery for on-site energy storage capable of delivering 100 kW for 4 hours.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS


HOLLYWOOD


"BUTTRUMS"
GARDEN FRESH VEGETABLES
WE GROW OUR OWN

LAND USE

Low-carbon zones and Eco-districts

RELATIVE GHG IMPACT

2020	ENABLER	**2050**	ENABLER

DESCRIPTION

Low-carbon zones are specialized zones that aim to lower the carbon footprint of the industrial operations within the zone and provide a testing ground for pilot projects and policies for reducing the environmental footprint of industrial operations. Eco-districts, whether existing or new developments, take a masterplan approach to sustainability where key resources (such as energy, waste and water) are best optimized, instead of at a building scale.

SAMPLE POLICIES & PROGRAMS

- Zone land to encourage low carbon industries
- Support sustainable infrastructure parks
- Eco-district development strategies/framework

WHAT OTHER CITIES ARE DOING

- **London, UK**: RE:CONNECT - This program consists of ten low carbon zones in London, each of which has signed-up to deliver a 20% reduction in CO2 emissions.
- **Stockholm, SE**.: Sustainable Järva is an investment in ecologically, socially and economically sustainable development in the districts surrounding Järvafältet. With new technology, information and education, Järva intends to become a model for the sustainable rehabilitation of areas that formed part of Sweden's Million Homes program.
- **Birmingham, UK**: Tisley Energy Park is an innovative partnership between the City, the University of Birmingham and wire manufacturers Webster and Horsfall. The park is showcasing how novel energy technologies can power industry from low-carbon sources, including waste, energy storage and clean transport fuels. The park's distributed energy system will help Birmingham's industry shift away from fossil fuels. The park will also feature an incubator for businesses developing low-carbon technologies. This hub will be a centre for training associated with state-of-the-art energy, waste and low-carbon transport systems.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

LAND USE

Compact Cities

RELATIVE GHG IMPACT

2020	ENABLER	**2050**	ENABLER

DESCRIPTION

The continued growth of urban populations calls for a response that optimizes land resources and reduces the carbon footprint on a per resident basis. The compact city is an urban planning and design concept that promotes relatively high residential density with mixed land uses and effective connections with transit.

SAMPLE POLICIES & PROGRAMS

- Encourage mixed use development via live/work targets
- Promote or have minimum density requirements
- Strategic refurbishment/reuse of unused buildings for new purposes

WHAT OTHER CITIES ARE DOING

- **San Diego, CA**: The City of Villages growth strategy which directs growth into compact, mixed-use, walkable centers linked by transit, which reduces the need to travel and makes alternative modes of transportation easier to use.
- **Washington, D.C.**: The 115-acre "SW Eco-district" planned for 2030, includes office, residential, and cultural space. The area will be heated, cooled, and powered with a district energy system using co-generation. A number of other sustainable design measures will be implemented.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

LAND USE

Transport Oriented Development

RELATIVE GHG IMPACT

2020	LOW	**2050**	MEDIUM

DESCRIPTION

Transit- or transport-oriented developments are activity-intensive development areas characterized by excellent walkability and cycle access, and anchored by higher-order transit (typically a train or major bus station or interchange). They provide integrated land use and transport outcomes facilitated by appropriate policy and incentivization. They are also environments where private vehicle and freight vehicle traffic are limited by design, regulation and restrictions on parking.

Hamilton has already started down this path. The City has set a target for 40% of new growth to take place around areas supported and facilitated by existing and planned transit.

SAMPLE POLICES & PROGRAMS

- Prioritizing development in areas well connected by transit
- Creating pedestrian plazas
- Minimum affordable housing targets near transit hubs
- Priorities access and circulation for pedestrians, cyclists and transit users
- Minimize roadway capacity and severance (i.e. barrier) effect for pedestrians and cyclists
- Define and apply station typology framework to prioritize modal interchange and/ or land development

WHAT OTHER CITIES ARE DOING

- **San Francisco, CA**: By concentrating new development along existing transit corridors, San Francisco has decreased GHG emissions and vehicle miles traveled.
- **Perth, AU**: In 2004, the State Government of Western Australia enacted Network City, which was an urban growth policy targeting 60% of new growth on land currently zoned as urban, with a focus on established centres served by higher-quality transit services. In 2009, this was replaced with State Planning Policy 4.1: Activity Centres for Perth and Peel with revised requirements including a reduction in infill to 53% of the total.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

WASTE

Waste-prevention policies and programmes

RELATIVE GHG IMPACT

2030	ENABLER	**2050**	ENABLER

DESCRIPTION

A holistic waste management strategy focuses on a waste hierarchy that prioritizes waste reduction, then its reuse and recycling/composting and energy recovery, followed by final disposal as a last option. Numerous cities are striving for zero waste goals (i.e. 100% diversion rates). Opportunities include outreach programs, strict separation policies, incentives/ disincentives to promote recycling/organic composting and bans on certain waste streams.

SAMPLE POLICIES AND PROGRAMS

- High-level zero-waste goal
- Expand City by-laws and diversion requirements to private waste contractors
- Outreach programs (awareness and minimization)
- Incentives for organics treatment
- Incentives for recycling
- Industrial waste bans (e.g. styrofoam, chemicals)
- Non-organic and organic waste separation policies
- Organic waste separation policies
- Stricter regulations for construction waste, recycling, waste management plans, deconstruction requirements (to reduce demolition)

WHAT OTHER CITIES ARE DOING

- **Los Angeles, CA**: Zero Waste LA was established in 2017 to reduce landfill disposal by 1 million tons per year by 2025 and reduce waste by 65% in all 11 of the City's new service zones.
- **Chicago, IL**: As part of Sustainable Chicago 2015's Goal 20, the City partnered with Recyclebank to trial a unique incentive program for recycling. Selected blue carts were retrofitted with an ID chip that tracks the weight of the recycled materials collected by that household. Points are earned for every pound of recyclables diverted from the waste stream and can be redeemed for discounts at local and national businesses.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

WASTE

Energy recovery & landfill management

RELATIVE GHG IMPACT

2030	LOW	**2050**	MEDIUM

DESCRIPTION

Energy recovery from waste involves the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion and landfill gas recovery. This practice is common in Central and Eastern Europe and Scandinavian countries and has shifted the paradigm towards waste and methane gases being seen as valuable commodities to create energy.

Methane emitted by landfilles can be reduced through the installation of landfill gas capture and combustion technology to convert the methane to carbon dioxide. Combustion with energy recovery can further reduce GHG emissions by replacing fossil fuels used to generate heat and electricity.

Since 2008, City-owned Hamilton Renewable Power Inc. has been operating an energy recovery system at Hamilton's Glanbrook Landfill, converting methane to electricity via gas generators and selling it to the grid for a profit. This is a successful Hamilton initiative that could be built upon.

SAMPLE POLICES & PROGRAMS

- Price mechanisms to discourage landfill (e.g. landfill levy)

SAMPLE TECHNOLOGICAL MECHANISMS

- Landfill gas to energy, with the potential of combined waste heat recovery

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

WATER & WASTEWATER

Energy recovery

RELATIVE GHG IMPACT

2030	LOW	**2050**	LOW

DESCRIPTION

Wastewater can be harvested to provide energy through harnessing the waste thermal energy to provide space heating and domestic hot water to buildings in the nearby area. It can also be used to create electricity, and also sometimes heat, by harnessing the biogas created by the breakdown of organic matter at the waste facility. Additional organic waste can be brought in to improve economies of scale.

Since 2006, City-owned Hamilton Renewable Power Inc. has been running a 1.6 MW cogeneration system fueled exclusively with digester methane at its Woodward wastewater treatment plant. In 2011, the City began upgrading some of this biogas into renewable natural gas for injection into Enbridge's pipeline.

SAMPLE POLICIES & PROGRAMS

- Bring in additional organic waste from other municipal sources to improve economies of scale

SAMPLE TECHNOLOGICAL MECHANISMS

- Methane/biogas recovery for reuse
- Wastewater heat recovery
- Refining the biogas to RNG and using as a fuel for local fleets, buildings, or district energy systems

WHAT OTHER CITIES ARE DOING

- **Stratford, ON**: Stratford is moving forward with a renewable natural gas project at its Water Pollution Control Plant. The project will involve the addition of new equipment to allow for large quantities of organic matter, including food waste, to be processed. The goal is to reduce greenhouse gas emissions by diverting organic waste from the City's landfill site and elsewhere, and "co-digesting" that material at the Water Pollution Control Plant, along with sewage sludge already generated at the site. The methane gas produced through that process would be refined into natural gas, and then distributed through the existing natural gas distribution system for use.
- **Vancouver, BC**: The South East False Creek Facility is meeting 78% of heating and domestic hot water energy needs for 3.5 million sq ft of the surrounding neighbourhood by recovering heat from wastewater.
- **Oslo, NO**: In February 2010, a biogas plant was opened at the Bekkelaget wastewater treatment plant. Here, biogas is produced from sewage sludge and upgraded for use as transport fuel. The plant's output is already being used to fuel more than 100 heavy vehicles, mainly refuse trucks and 36 buses.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

WATER & WASTEWATER

Water recycling and reclamation

RELATIVE GHG IMPACT

2030	LOW	**2050**	LOW

DESCRIPTION

A reduction in overall water consumption by cities and residents has the potential to significantly impact the energy and emissions footprint of water, as well as ensuring sufficient water supply during warmer and/or dry periods. Using less water results in reductions in the amount of energy that is required to clean and pump water and wastewater around a city. Improving the efficiency of water treatment and pumping also provides additional energy and emissions reduction potential.

SAMPLE POLICIES & PROGRAMS

- Building-level greywater and blackwater recycling requirements
- Education or campaigns to promote water efficiency
- Mandatory / standards for connection for reclaimed water (purple pipe infrastructure)
- Targets to reduce water usage

SAMPLE TECHNOLOGICAL MECHANISMS

- Wastewater and water pumping efficiencies
- Automatic leak detection
- Real-time water supply risk monitoring
- Water recycling or reclamation

WHAT OTHER CITIES ARE DOING

- **Copenhagen, DK**: To increase water efficiency, the City has made significant efforts to minimize water loss in the city's infrastructure through leak detection technology, regulation of water pressure and other mitigation measures. Water losses in Copenhagen are around 6-7%, whereas the figure in other cities is as high as 40 to 50%.
- **New South Wales, AU**: The BASIX program requires all new residential buildings and renovations to complete an assessment using the BASIX online tool. Residential development must be designed and built to use 40% less drinking-quality water and produce 25% less greenhouse gas emissions than average NSW homes of the same type.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

GREEN & BLUE INFRASTRUCTURE

Natural Sequestration

RELATIVE GHG IMPACT

2030	LOW	**2050**	LOW

DESCRIPTION

Natural carbon sequestration, for example via trees and no-till farming practices, help communities capture greenhouse gases they could not otherwise eliminate. Natural sequestration is unlikely to provide a significant overall reduction to a city's GHG emissions, but provides significant co-benefits, such as improved local health and wellbeing and improved soil health.

SAMPLE POLICIES & PROGRAMS

- Set an urban canopy coverage target
- Identify strategic locations for tree-plantings within city boundaries
- Incentives and grants for homeowners and organizations to plant trees

WHAT OTHER CITIES ARE DOING

- **Wellington, NZ**: Has been planting a tree every five minutes, on average, for the past 15 years–more than 1.5m in total. Wellington is New Zealand's greenest city, and one of the few cities in the world where biodiversity is increasing. About 40% of the city's emissions are now mitigated by land use change and forestry activities.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

FINANCE & ECONOMIC DEVELOPMENT

Instruments to fund low-carbon projects

RELATIVE GHG IMPACT

2030	ENABLER	**2050**	ENABLER

DESCRIPTION

Financing is one of the key challenges for municipalities seeking to meet ambitious climate action commitments. To create new economic opportunities and spur investment in the green economy, new funding strategies, from the public and private sector, are needed. These strategies can include public initiatives such as revolving funds with low interest for entire projects, funds for early stage projects, loan guarantees, community bonds and tax rebates. Private sector strategies have included the creation of specially tailored energy service agreements where initial costs are paid back through energy savings on the building utility bills.

Financing energy efficiency improvement and fuel switching stands to benefit low-income segments of the population the most. In Hamilton, pre-COVID19, about 25% of the population is low-income.

SAMPLE POLICES & PROGRAMS

- Establish a revolving fund for low carbon or green projects (public entity)
- Provide loan guarantees or insurance packages for energy efficiency projects
- Property tax exemption for energy efficiency projects
- Local improvement charges (in the US 'Property Assessed Clean Energy')
- Enlist or promote energy services agreement
- Establish green bonds
- Community-owned renewable power
- Group purchasing

WHAT OTHER CITIES ARE DOING

- **Toronto, ON**: Launched in January 2014, the Home Energy Loan Program (HELP) offers low interest loans of up to $75,000 to homeowners to cover the cost of home energy improvements. The program offers low fixed interest rates, terms of up to 15 years, and access to rebates offered by the Province of Ontario and utility companies.
- **Ottawa, ON**: In one 14-week period in 2017, the Ottawa Renewable Energy Cooperative raised nearly $2 million in financing for local solar projects.
- **United Kingdom**: The Green Investment Bank was created by the UK Government and capitalized with public funds. They then use this finance to back green projects on commercial terms and mobilize other private sector capital into the UK's green economy.
- **New York City, NY**: In 2019, NYC launched a Commercial Property Assessed Clean Energy (C-PACE) program to finance clean energy and energy efficiency retrofits and upgrades at more favorable terms, allowing New York City building owners to access finance for such projects through an assessment on their property tax bills. Paired with a building energy performance mandate, the PACE program has the potential to finance $100 million annually in energy efficiency and clean energy projects.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

FINANCE & ECONOMIC DEVELOPMENT

Enabling green industries

RELATIVE GHG IMPACT

2030	ENABLER	**2050**	ENABLER

DESCRIPTION

In transitioning to a low-carbon economy communities have the opportunity for local economic development as a result of:

- return on investments made into energy efficient and renewable energy projects,
- local ownership of renewable energy production, and
- new jobs in the green economy.

By helping to create a supportive environment for new low-carbon industries, communities can help capitalize on the clean energy sector's projected growth.

SAMPLE POLICES & PROGRAMS

- Define the growth and startup of green businesses as a key objective of the City's economic development service
- Establishment of green enterprise zones/labs
- Tax incentives/grants/subsidies for green businesses
- Green procurement
- Competitions and challenges
- Ensure local colleges and trade schools are providing the requisite training (incl. bridging courses)

WHAT OTHER CITIES ARE DOING

- **London, UK**: The Green Enterprise District, covering six boroughs in east London, will promote clusters of low-carbon businesses and will draw in large-scale investment for innovative low-carbon technologies ranging from energy generation to low-carbon transport.
- **Boston, MA**: The City is supporting small businesses going green through a matchmaking service for small businesses that pairs them with sustainability services.
- **Buenos Aires, AR**: In 2013, the Green Economy Centre worked on a green job registry, aiming to promote the green job market in the City. During 2014 a course solar photovoltaic was held, with the aim of generating new green experts; opened to the community, its curricula included the sizing of the installation, security criteria, and basic knowledge of solar energy.

IMPLEMENTATION LEVER

Policy / Incentive / Program / Procurement

POTENTIAL CO-BENEFITS

LOW-CARBON ACTIONS CATALOGUE

Hamilton