Heritage Heights Community Energy Plan and Secondary Plan Energy Policy Guidance

City of Brampton

This report is the result of a collaboration between the following members of the consulting team under the leadership of Garforth International Canada Inc. and the review and contribution of the Project Working Team assigned to this project.

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1. Introduction

The Heritage Heights Community Energy Plan (CEP) was commissioned to identify a pathway to achieving a near net zero future for the Heritage Heights Community with much less reliance on fossil fuels for the heating and cooling of buildings and for transportation, and a greater focus on locally generated renewable energy.

Near net zero implies little or no energy is drawn from the electricity grid or from pipelines, and little or no greenhouse gas emissions are released.

Community energy planning considers all local energy flows that impact activities within a community, from supply through distribution to its end use by consumers. CEPs, developed under the leadership of municipal governments, are a standardized and structured approach to transformative urban emission reductions and enhanced energy system resilience in communities across Canada. However, their application at the secondary planning level is a relatively new practice.

In addition to identifying actions to reduce energy use, emissions and cost, community energy planning can help a community anticipate and prepare for changes in the energy marketplace outside their direct influence. A good example would be the rapid transition in the market from gasoline and diesel internal combustion vehicles to battery and plug-in hybrid electric vehicles.

The Heritage Heights CEP informs the Heritage Heights Secondary Plan and the development approvals process to deliver significant reductions in GHG emissions compared to a typical suburban community in Ontario. The development of the Heritage Heights community is the equivalent of building a medium-sized Canadian city, with between 100,000 and 200,000 residents expected when fully built out.[1] Building a climate-friendly community means Brampton has an opportunity to lead the transformation of city building in Ontario and Canada. The CEP project findings will also inform future planning studies within the City of Brampton.

This report consolidates and summarizes the Heritage Heights Community Energy Plan (CEP) process and related secondary planning policy guidance in support of near net zero development. This is the last in a series of reports:

- Report 1 – Background Review and Analysis
- Report 2 – Land Use and Energy Planning: Key Considerations for Policy Integration
- Report 3 – Built Form Base Case and Efficiency Case[2]
- Report 4 – Transportation Base Case and Efficiency Case
- Report 5 – CEP Recommendations and Policy Directions
- Report 6 – Regional Energy Planning Implications

While this report materially reflects the content found in earlier reports, given the iterative nature of the work, refinements have been made along the way, therefore this report should serve as the primary reference.

[1] Source: City of Brampton Planning & Development Committee Recommendation Report, June 5, 2020
[2] Reports 3 and 4 (as outlined in the City of Brampton's Request for Proposals) were consolidated into a single document.

2. Background

The Heritage Heights Community is in north-west Brampton, south of Mayfield Road, and east of Winston Churchill Boulevard. Consisting of approximately 623 hectares (1,540 acres), this area is the last remaining unplanned Greenfield Area in Brampton (Figure 1).

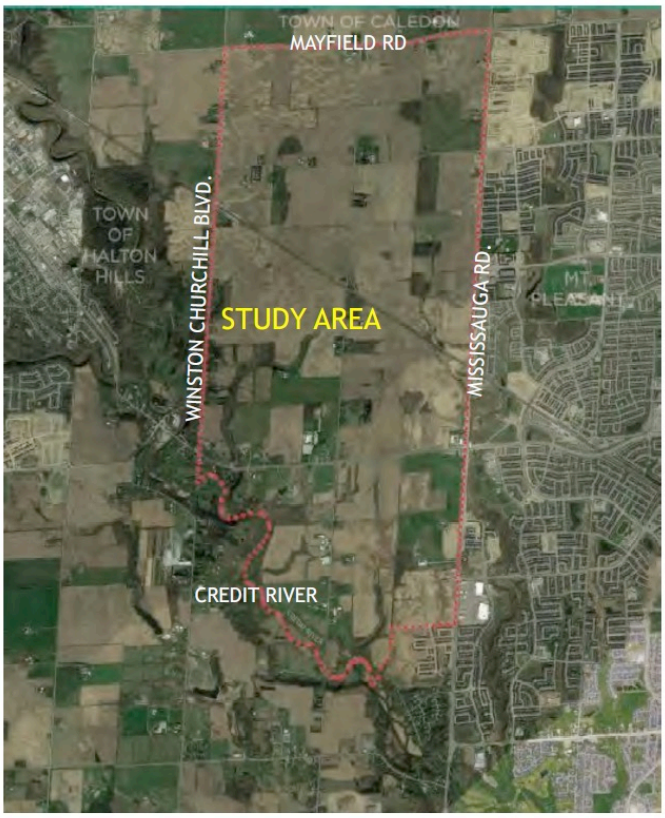

Figure 1: Heritage Heights Secondary Planning Area

The Heritage Heights Community was identified in the Brampton 2040 Vision as the proposed location for a new town centre – a complete, full-service, mixed-use community with diverse work and housing options and where neighbourhoods are designed to be walkable and cyclable and accessible by transit. It is also proposed by the municipality as a location for a third healthcare facility in Brampton.

In 2020, the City of Brampton approved a Conceptual Land Use Plan (CLUP) for the Heritage Heights Community as part of ongoing secondary planning for the area (see Section 4.1 for details). Approval of the CLUP included a recommendation to develop an integrated energy plan to ensure the Heritage Heights Community contributes to achieving the City's energy and emission goals outlined in the City of Brampton's Community Energy and Emissions Reduction Plan (CEERP) (September 2020). The CEERP identified the Heritage Heights Community as a near net zero community (see Appendix 2 – CEERP Direction. The Heritage Heights CEP has been developed to meet or exceed the 2041 objectives and targets of the seven CEERP Strategic Directions (Figure 2). The CEERP Strategic Directions reflect Brampton's urban and energy transitions, as well as the Brampton 2040 Vision. Consistent with the CEERP, the Heritage Heights CEP has been aligned with global best practice for new developments.

Figure 2: Brampton's Community Energy and Emissions Reduction Plan Strategic Directions.

The development of a Heritage Heights CEP provides an opportunity to consider several innovative approaches in community energy management, as well as the potential to showcase the Heritage Heights Community as an example of sustainable community planning and near net zero energy planning.

Land use planning *is* energy planning.[3] With the growth of centralized energy systems for electricity, natural gas and transportation fuels, urban centres have been planned with the assumption that energy is generated outside of the community. Municipal energy planning has ensured the municipal right of way accommodates linear energy distribution infrastructure. See Appendix 1 – Existing Energy Services for a description of existing energy services.

Emerging low-carbon technologies are now able to provide thermal and electrical power on a site-specific basis, district basis, or as part of a more expansive utility grid system. As a result, urban centres are becoming spaces for energy production not just energy consumption. This puts land use planning on the "front line" of the transition to net zero communities.

Municipal governments approve policies and by-laws that guide and regulate the growth and development of the community, most notably housing and transportation systems. As such, they have an important role in ensuring a policy framework is established that enables local stakeholders and product and service providers to succeed in the transitioning energy market.

3. Modelling an Alternative Energy Future for a New Community

This section describes the process undertaken to model an alternative energy future for Heritage Heights and summarizes the CEP findings.

3.1 Framing Goals

Framing Goals for 2051 were established by the CEP Project Working Team (PWT) at the outset of a community energy planning process to set appropriate benchmarks against which to evaluate the performance of the energy modelling (Table 1). For comparison, the 2041 CEERP Goals are summarized in Table 1. They were considered mandatory minimum requirements in setting the Framing Goals for the Heritage Heights CEP. The CEERP also included an emissions reduction goal for the City of Brampton of 80% below the 2016 Baseline by 2050 (i.e., 1.3 tonnes/capita).

Table 1: 2051 Heritage Heights CEP Framing Goals comparison with 2041 CEERP Goals.

Goal	2041 CEERP Goal	2051 Heritage Heights Framing Goal
Energy efficiency	50% below 2016 Baseline (75 GJ/capita)	>70% below 2016 Baseline (45 GJ/capita)
Emission reductions	50% below 2016 Baseline (2.8 tonnes/capita)	90% below 2016 Baseline (1.1 tonnes/capita)
Economic benefit	Retain > $28 billion energy costs	Prorated to reflect the efficiency & emissions goals

[3] Reference: https://questcanada.org/aire-protocol/land-use-planning/

3.2 Stakeholder Engagement

Engaging stakeholders in the development of a CEP helps to facilitate learning, manage expectations, attain buy-in, and establish enabling networks. These are widely recognized as essential factors in achieving broad, system-level goals. Stakeholder engagement connects economic, environmental, and technical energy issues to wider community debates and values; if these are ignored, or if communication breaks down during the process, even the most technically sound and economically rational plan may not be acknowledged or successfully implemented.

Stakeholder engagement also facilitates essential non-governmental action in energy performance change. Stakeholders are engaged for their input into what the municipality should do with respect to energy planning. They are also engaged to help develop and share a common CEP vision, and to jointly participate in the development and implementation of energy efficiencies and emissions reduction not only through this CEP process but over the long term as people live and work in Heritage Heights. These community solutions may not involve any direct government action, so they will need the buy-in of the public, stakeholders, and community leaders to act. The implementation of a CEP, regardless of scale, requires the involvement of many stakeholders.

Guided by an Engagement Plan, a wide variety of local stakeholders were actively involved in the development of Heritage Heights CEP. The methodology and engagement activities are described in Appendix 3 – Stakeholder Engagement.

3.3 Integration of Land Use Planning and Energy Modelling

The CEP is an energy model of the entire Heritage Heights Secondary Plan Area based on the land use plan for the community. The relationship between land use designations, residential versus non-residential uses, and planned building types had to be understood in developing the CEP. This section connects the dots between energy modelling and land use planning to establish a framework to support policy development for the Heritage Heights Secondary Plan. The proposed land use designations and general neighbourhood types were described in terms of their future energy requirements as input to the detailed technical model. To do this, assumptions were made about the building types generally planned for each neighbourhood and the transportation modes within and between neighbourhoods. For each building type, energy demand and energy supply data were input to the model. Potential energy services and technologies related to demand management and supply were considered (see *Section 3.4 Energy Measures*).

Energy-related decisions regarding scope, assumptions and methodology for the Heritage Heights CEP are summarized in Appendix 4 – CEP Scope, Base and Efficiency Case Simulation Assumptions and Methodology. Several guiding documents informed the development of the Heritage Heights CEP and policy recommendations (see Appendix 5 – Annotated Summary of Guiding Documents). Land use designations, building typologies, and transportation choices were based on the Conceptual Land Use Plan (CLUP) (July 2020) for the Secondary Plan Area (SPA). A summary of the CLUP is found in Appendix 6 – Heritage Heights Conceptual Land Use Plan (CLUP). Energy simulations were informed by density, built form, estimated population, and employment associated with the CLUP. This data was provided by the City of Brampton and is summarized in Appendix 7 – Planned 2051 Area, Growth and Employment.

For the purpose of the Heritage Heights CEP, the CLUP was divided into Spatial Planning Zones (SPZs) (Figure 3) that have each been assigned various land use area requirements (in hectares) by land use designation.[4] An overlay of SPZ boundaries and CLUP is provided in Figure 4, for reference.[5]

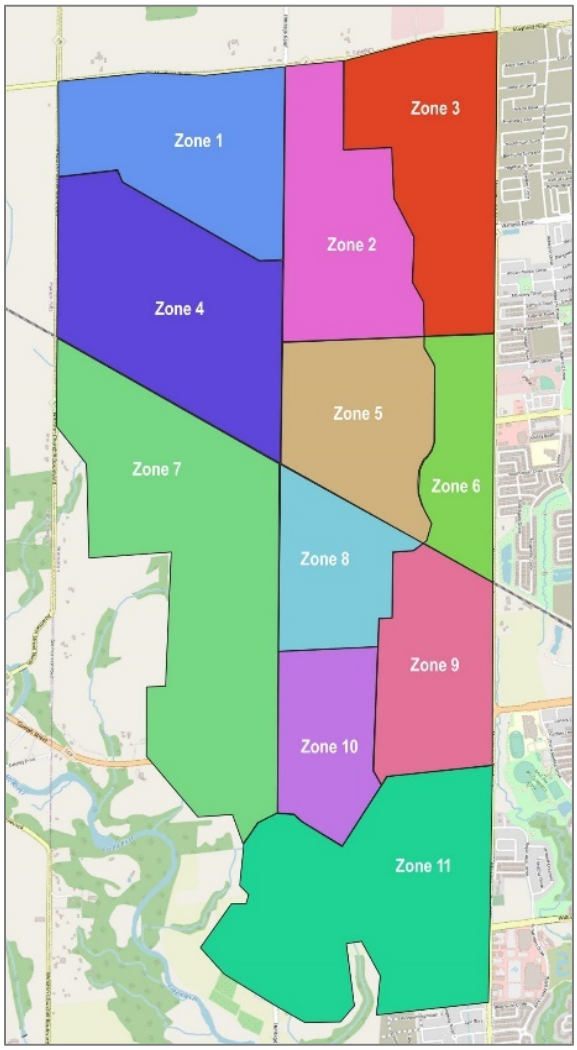

Figure 3: Heritage Heights Community

Figure 4: Overlay of Spatial Planning Zones (SPZs) and the Heritage Heights Conceptual Land Use Plan (CLUP)

[4] Note: Data provided by the City of Brampton.
[5] Note: For the purposes of the Heritage Heights CEP analysis, a Spatial Planning Zone is considered synonymous with an Energy Planning Zone or Sub-Energy Planning District. The appropriate terminology will be determined during the Official Plan update process.

The process to develop the Heritage Heights Secondary Plan continued concurrently with the development of this CEP, and it should be noted that several Character and Precinct areas now describe the SPA Secondary Planning Area? but do not affect the CEP modelling.

The Heritage Heights Secondary Plan will have to address development and infrastructure phasing to successfully achieve a near net zero community. The analytical energy model assumed all SPZs start development at the same time and evolve at the same rate towards the 2041 and 2051 estimates (including the building of schools). The model assumed development to begin immediately upon approval of the Secondary Plan. For the purposes of modelling for the CEP, phasing within each SPZ was not a consideration. The planned phasing of development will be an important consideration to integrate viable energy alternatives into neighbourhood development.

The Heritage Heights CLUP is based on key attributes including a vibrant town centre, main street/boulevard and compact mixed-use neighbourhoods designed with a focus on proximity of daily needs. The CLUP illustrates five Neighbourhood Typologies:

- Low-Density Area (LRA)
- Medium-Density Mixed Use (MDMU)
- High-Density Mixed Use (HDMU)
- Industrial Area (IND)
- Hospital Area (HOS)

A land needs assessment for the City of Brampton was undertaken through the Municipal Comprehensive Review process to allocate the 2051 forecast population and employment by area and land use designation. Based on this work, data was provided by the City of Brampton to the CEP PWT.

With the goal of creating a net-zero development, a forecast of future energy use was developed by assigning potential energy services and technologies to building archetypes within the planned Neighbourhood Typologies.

Thirteen (13) Building Archetypes were identified for the Heritage Heights Community and are summarized in Appendix 8 – Building Archetypes. Each Building Archetype included a floor area (m^2) estimate and 2051 energy use forecast based on the population and employment forecasts. Appendix 9 – Building Archetype Distribution provides a summary of the modelled distribution (% and m^2) of Building Archetypes by Neighbourhood Typology for the simulations and a summary of distribution (% and m^2) of Building Archetypes by Spatial Planning Zone.

The Building Archetypes were matched with each of the CLUP land use designations and major Neighbourhood Typologies. This approach served as the framework for integrating energy and climate policy with land use planning (see Appendix 10 – Integration Framework).

Some energy-related policy considerations are driven by the configuration and interrelationship between SPZs. For instance, the Town Centre and related “main street” Urban Boulevard, along with the planned GO Station and a Major Transit Station Area, will be accessed often by people throughout the new community. Schools are planned within each neighbourhood and a fire station is also identified. These considerations are summarized in Appendix 11 – Spatial Planning Zone (SPZ) Features.

3.4 Energy Measures

Several low carbon energy services and technologies were considered for inclusion in the Heritage Heights CEP. An analysis of the likely impact of these energy services and technologies on the Heritage Heights CEP is found in Appendix 12 – Evaluation of Low Carbon Energy Services and Technologies.[6]

The energy parameters considered in the development of the Heritage Heights CEP included:

- Energy End Use Efficiency – including efficient homes, buildings, and transportation.
- Energy Services – including energy services to homes and buildings, energy services to transportation, energy supply portfolio and efficient system management.
- Energy Services Infrastructure – including energy generation, distribution, and delivery services.

3.4.1 Building End Use Efficiency

Homes and building represented 44% of Brampton's source energy use in 2016 and 28% of GHG emissions. Reducing building energy demand through efficiency measures reduces energy-related emissions and costs and underwrites the business case for other CEP measures. Recommended building end use efficiency measures fell under the following four categories: efficient building construction, electricity generation at the building, thermal energy generation at the building, and efficient building management. See Appendix 13 – Energy Measures for a detailed description of these energy measures.

3.4.2 Transportation End Use Efficiency

Transportation represented 35% of Brampton's source energy use in 2016 and 59% of GHG emissions. Transportation end use efficiency measures fell under the following four categories: active transportation, mobility services, vehicle efficiency[7], and urban form[8]. See Appendix 13 – Energy Measures for a detailed description of these energy measures.

3.4.3 Energy Services

Energy services measures fall under the following four categories: energy services to homes and buildings, energy services to transportation, supply portfolio, and efficient energy supply management. See Appendix 13 – Energy Measures for a detailed description of these energy measures.

3.5 Base Case and Efficiency Case Results

To identify a pathway to a near net zero future for the Heritage Heights community, the Heritage Heights CEP simulated an integrated picture of all built form and transportation energy end uses and sources.

The first simulation showed the results (i.e., the expected energy use, emissions, and cost profile for the Heritage Heights Community in 2051) should no action be taken to address energy efficiency improvements, local energy production and distribution, and GHG emission reduction. This was called the Business-As-Usual (BAU) Scenario or **Base Case**.

[6] Note: Of the energy measures considered, the following were not included in the Heritage Heights CEP simulations: combined heat and power using fuel cells, combined heat and power using solid combustion and deep geothermal.
[7] Most vehicle efficiency measures are largely outside the control of the municipality. However, some assumptions were included in the Base Case and Efficiency Case simulations. They are presented in the Appendix for completeness and transparency.
[8] The City's vision for the Heritage Heights Community as a complete, full-service, mixed-use place – where neighbourhoods are designed to be walkable and cyclable and accessible by transit. Community design is recognized as an important energy measure.

The second simulation showed the results should certain actions (i.e., energy measures) be taken by the City of Brampton, development community, and utilities. This was called the **Efficiency Case**. Analytical simulations were designed to meet the Heritage Heights CEP Framing Goals (see Section 3.1).

Table 2 provides a comparison of the Base Case and Efficiency Case relative to the goals for the Heritage Heights Community. The Efficiency Case does achieve the goal for emissions (tonnes/capita) while falls short of achieving the goal for energy efficiency (GJ/capita).

Table 2: Comparative performance of the Base Case and Efficiency Case relative to the Heritage Heights CEP Goals

Performance	Base Case	Efficiency Case	Heritage Heights Goal
SPA[9] site energy (GJ)[10]	15.4M[11]	5.9M	Not applicable
SPA source energy (GJ)	22.2M	10.4M	Not applicable
SPA greenhouse gas emissions (metric tonnes)	691,000	137,000	Not applicable
Source energy efficiency (GJ/capita)	179	84	45
Greenhouse gas emissions per capita index (tonnes/capita)	5.6	1.1	1.1
2051 annual utility costs – lower range and carbon tax	$1,040M	$350M	Not applicable

3.6 Simulated 2051 Efficiency Case Outcomes

The Efficiency Case puts the Heritage Heights Community on a pathway to near net zero. Compared to the Base Case (BAU), the 2051 outcomes include:

- 62% reduction in site energy use.
- 53% reduction source energy use.
- 80% reduction in GHG emissions.
- 53% improvement in energy efficiency per capita.
- 80% improvement in GHG emissions per capita.
- 66% reduction in energy costs.

The Efficiency Case represents a significant change in the overall energy characteristics of the built-form and transportation called for in CLUP.

The energy characteristics for building design within the SPA include:

[9] SPA means Secondary Plan Area
[10] GJ means gigajoule
[11] M means million

- End use efficiency at least 25% to 30% above 2016 Ontario Building Code (OBC) for all homes and buildings.
- Solar photovoltaics (PV) integrated into all homes and buildings.
- Solar thermal integrated into all low-density residential homes and buildings.
- Air-based heat pumps with supplementary solar thermal and electric induction heating serve the heating, cooling and hot water needs of low-density residential areas (limited use of ground-effect heat pumps).
- District energy supplies most of the heating and cooling needs of medium- and high-density residential, industrial and hospital areas (limited electric air conditioning in medium- and high-density areas).
- LED lighting in all homes and buildings.
- Smart meters in all homes and buildings.

By 2051 the characteristics for transportation within the SPA include:

- 25% of modal mix is active transportation (walking and cycling).
- 20% of modal mix is Brampton Transit.
- 12% of modal mix is GO Train.
- 5% of modal mix scooters and motorcycles.
- Expanded pick-up/drop off areas for on demand transportation services.
- Average trip length reduced between 5 to 15% depending on mode.
- 80% electric light-duty vehicles.
- 35% electric heavy-duty vehicles.
- 100% electric buses and trains.

The 2051 outcomes for energy services within the SPA include:

- Grid electricity service to all homes and buildings offset by increased local electricity generation.
- Solar photovoltaics (PV) supply 12% of the Heritage Heights total electricity demand.
- Combined heat and power generation supplies 19% of the Heritage Heights total electricity demand by 2051.
- No retail natural gas service to low-density residential areas.
- Natural gas service limited to energy centres in medium- and high-density residential, industrial and hospital areas and some industries.
- District energy centres initially use natural gas, with a reduced GHG content supply portfolio instituted over time with specific GHG reduction targets and dates.
- 12% of district energy heating is sourced from waste heat recovery

- Solar thermal provides one-third of hot water demand in low-density residential areas.
- 18% of all source energy will be captured from the atmosphere or ground.
- Battery storage implemented across the SPA matching supply and demand and mitigating reliability issues.
- Thermal storage (heat and cold) located in medium- and high-density residential areas as part of the district energy system
- Integrated “Smart Energy Community” analysis and reporting ensures ongoing optimization of energy management

Figures 5 and 6 illustrate the energy flow (Sankey diagram) for the Heritage Heights Community for the Base Case (BAU) and Efficiency Case, respectively. Figure 5 describes the energy flow (i.e., expected energy use in the Heritage Heights Community in 2051) through the community should no action be taken to address energy efficiency improvements, local energy production and distribution, and Greenhouse Gas (GHG) emission reduction. Figure 6 describes the energy flow through the community should the Heritage Heights CEP recommendations be implemented. These diagrams visually illustrate both the overall reduction in total energy use and cost, and the lower percentage of unused energy in the Efficiency Case compared to the Base Case (BAU).

Two alternative energy transition pathways were also considered: 1) end-use efficiency measures only and 2) electric heat only. In both cases, these pathways underperformed compared to the Efficiency Case. See Appendix 14 – Alternate Pathways for additional narrative.

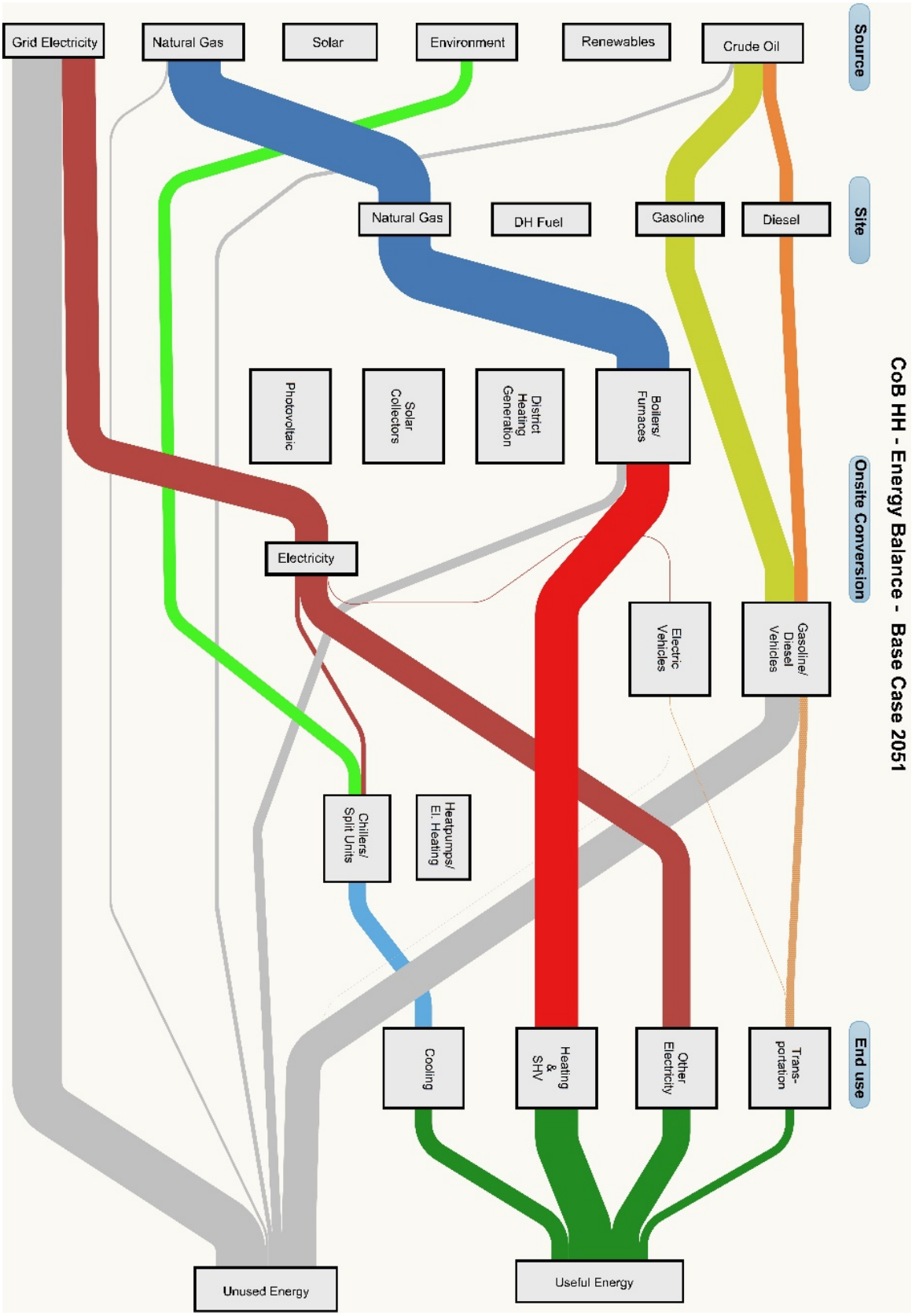

Figure 5: Base Case energy flow for the Heritage Heights Community

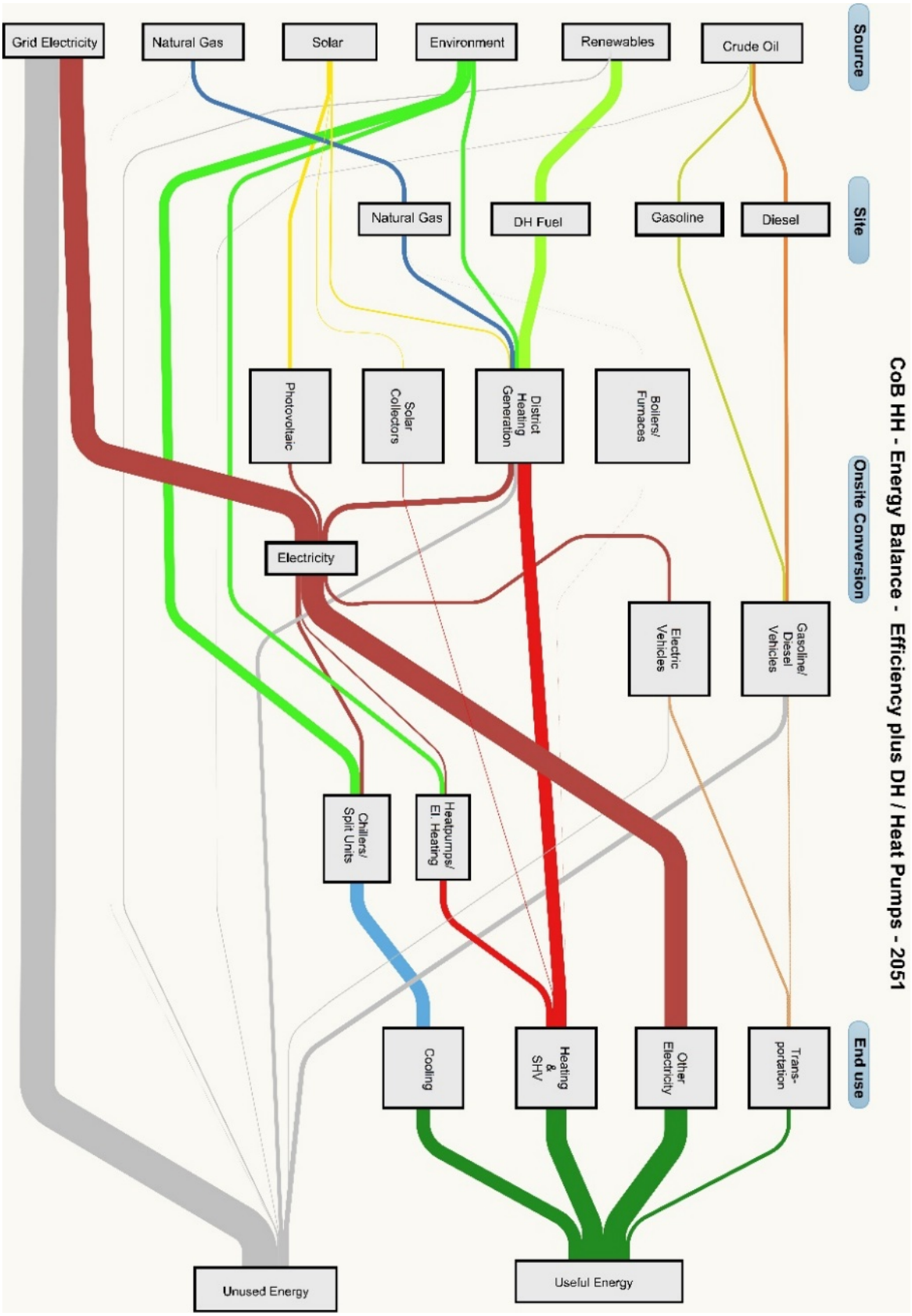

Figure 6: Efficiency Case energy flow for the Heritage Heights Community

3.9 Recommendations

Based on the results of the simulations, the Heritage Heights CEP provides nineteen (19) recommendations to achieve a near net zero community called for by the CEP Framing Goals. Appendix 12 – Energy Measures aligns each of the CEP energy measures included in the Efficiency Case simulation with these recommendations. Many of the recommendations to achieve the CEP objective and targets exceed the authority/jurisdiction/role of the municipality and, therefore, will require strong partnerships and buy-in from industry and stakeholders for success.

Implementation of the CEP energy measures to achieve these recommendations must start on day-one. There is neither sufficient time, nor available financial and other resources, in 30 years to accommodate a retrofit of the Heritage Heights Community and achieve the CEP goals to reduce energy use, GHG emissions, and costs while making a material contribution to achieving the CEERP goals.

Heritage Heights CEP Recommendations

Building End Use Efficiency

- Ensure above Ontario Building Code energy efficiency for all homes and buildings.
- Ensure building integrated solar photovoltaic for all homes and buildings.
- Ensure building integrated solar thermal for all homes and buildings located in low-density residential areas.
- Use air-based heat pumps with supplementary solar thermal and electric induction heating to serve the heating, cooling, and hot water needs of homes and buildings located in low-density residential areas.
- Use district heating and cooling to serve the heating, cooling and hot water needs of homes and building located in medium- and high-density mixed use, industry, and hospital areas.
- Install smart power, thermal and water meters.

Transportation End Use Efficiency

- Build pedestrian-friendly neighbourhoods and buildings.
- Build cycling-friendly neighbourhoods and buildings.
- Build transit-friendly neighbourhoods.
- Build on-demand-transportation-friendly neighbourhoods.
- Build motorcycle and scooter-friendly neighbourhoods and buildings.
- Build electric vehicle (EV)-friendly neighbourhoods and buildings.
- Build compact built form and mixed-use neighbourhoods to minimize average trip length.
- Promote inbound investment in local employment to develop complete communities and minimize average trip length.

Energy Services

- Increase local energy (thermal and electrical) generation and storage.
- Reduce (capture and use) waste heat.
- Limit natural gas service to neighbourhood energy centres and industry.
- Establish a thermal utility to provide municipal district energy (heating and cooling) services.
- Establish a smart energy network (power and thermal, built environment, and transportation).

4. Secondary Plan Policy Guidance

Heritage Heights is being planned and designed to be a near net zero community. The CEP recommendations will be implemented in large part through policies and processes set out in the Secondary Plan, which will inform the detailed planning, design, and development of the new community. The planning framework at the Secondary Plan level will provide guidance for subsequent stages of the planning process (e.g., Precinct Plan, Draft Plan of Subdivision, and Site Plan) so energy goals can be implemented. Table

3 identifies the opportunities to integrate CEP policies into regulated land use planning tools. Most, but not all, CEP principles fit with land use planning principles. Table 4 identifies complementary municipal planning tools not regulated by the *Planning Act* that can be used in conjunction with the aforementioned planning tools to achieve energy plans and objectives. Appendix 15 – Regulated Land Use Planning Tools and Appendix 16 – Other Municipal Tools and Instruments provide a description of these tools and instruments and detailed policy and process recommendations.

In analyzing the energy measures, consideration must also be given to who will be responsible for implementing energy policies. For example, through the planning and development approval process, the responsibilities for infrastructure construction and longer-term maintenance must be clear: what infrastructure will be the responsibility of the developer and what will be the responsibility of the City, private sector, or relevant utility. If an energy measure is deemed to be a developer responsibility, then the Secondary Plan has to identify what technical studies are required and when, for instance at the Precinct Plan (Block Plan), draft Plan of Subdivision, or Site Plan stages. The City's local service guidelines should also be updated to reflect infrastructure that is considered to be installed or paid for by the owner as a condition of approval under section 51 or 53 of the *Planning Act*. Master plans and/or other supporting studies must clearly indicate if it is the City's or the relevant utility's responsibility, and then also reflected in capital budgets with identified funding sources (e.g., energy service payments, private investment, community benefits or development charges, property taxes, grants, and others).

All expectations for the private sector, whether through CEP policy, guidance, or intention, are requirements for the public sector including, but not limited to, the Government of Canada, the Province of Ontario, Peel Region, and the City of Brampton.

Table 3: Heritage Heights planning and policy framework deploying regulated land use planning tools.

Regulated Land Use Planning Tools	**Heritage Heights Planning and Policy Framework**
Official Plan	• Develop general policies regarding energy and emissions based on the CEERP and the Heritage Heights CEP.
Secondary Plan	• Develop policies informed by the CEERP and CEP. • Identify potential locations for future energy infrastructure (e.g., district heating and cooling centres, and energy services distribution networks). • Set out development phasing and implementation measures, including all energy considerations for precinct plans and development review (e.g., responsibilities for and timing of energy services infrastructure).
Precinct Plan	• Include detailed community structure and infrastructure considerations. • Physical plan indicated for district heating and cooling centres and local energy distribution infrastructure • Infrastructure easements identified • Ensure policies complement adjacent land uses • Recognize the importance of natural heritage features that support carbon sequestration.

	• Include requirement for Integrated Energy Master Plans to implement the CEP.
Zoning By-law	• Include zoning regulations to achieve policy objectives of the Secondary Plan. • Include energy regulations by zone, especially related to height and setbacks of energy infrastructure (e.g., renewable energy technology, ground source geo-thermal systems, etc.). • Include direction for providing on-site renewables "as of right" while ensuring appropriate setbacks and mitigating potential land use conflicts.
Plan of Subdivision, Plan of Condominium and/or Site Plan	• Include CEP implementation objectives. • Include requirement of Energy Management Strategy
Development Design Guidelines (DDG)	• Increase guidance on sustainable building and neighbourhood design and materials, as well as location and scale of on-site renewable energy and district energy interconnections. • Include guidance on integrating low-carbon transportation outcomes into the built form.
Sustainability Metrics Program	• Incorporate CEP performance metrics into Sustainability Metrics.

Table 4: Heritage Heights planning and policy framework deploying other municipal tools and instruments.

Other Municipal Tools & Instruments	**Heritage Heights Planning and Policy Framework**
Transportation and Transit Master Plan	• Integrate CEP energy policy and targets
Active Transportation Master Plan	• Integrate CEP energy policy and targets
Parks & Recreation Master Plan/ PathWays Master Plan	• Consider designing parks that contribute to the quality of life and respond to emerging climate change issues • Consider inclusion of parks in local energy production, such as solar PV in parking areas, bio-waste, and geo-exchange.
Ontario Building Code	• All development in Ontario is required to meet the minimum building code requirements. Heritage Heights should anticipate future code probabilities. • The Federal government has committed to developing a model net-zero energy-ready building code by 2030. • Non-Canadian codes can inform / anticipate probable future Canadian Building Code evolution. • Municipal policy and guidelines can encourage the achievement of standards greater than the building code. However, these are difficult to monitor/enforce. Incentives through Community Improvement Plans (CIPs) can be explored to close the gap.

Integrated Energy Master Plan/Energy Strategy	• Require an energy strategy and energy modelling to be addressed through Precinct Plans or other development approvals, especially for SPZs where energy centres and DE network connections are required.
Financial Incentives	• Develop programs for new construction. • Provide information and support processes for incentive applications. • Include in Community Improvement Plans (CIPs).
Voluntary Standards and Ratings	• Encourage developments to meet industry performance standards and ratings.
Public Education and Community Consultation	• New governance approaches to support a fundamentally different planning and permitting approach to all aspects of the built environment.

The land use planning principles in Heritage Heights conform to the climate change policies set out in Provincial Policy Statement (2020) and Growth Plan for the Greater Golden Horseshoe (2020). The CLUP and Heritage Heights Secondary Plan have been designed to meet the overarching principles of compact urban form, complete communities, and mixed use, all intended to reduce travel distances between home, work, and everyday destinations, encourage efficient use of land and infrastructure, and reduce building energy and emissions.

It is critical to highlight where energy services take up space in the built environment and how this can be optimized to protect developable land. Space needs of energy services need to be addressed within proposed land use designations. The planning and installation of these energy services require policy direction in the Secondary Plan, design standards, and/or studies and plans drafted as part of the subsequent development approvals process. Many technologies are related to buildings and the building envelope which are mostly out of scope for planning policy[12].

The City of Brampton has Development Design Guidelines (DDGs), as well as the Sustainability Metrics Program to help guide and evaluate the sustainability performance of new development, including energy efficiency and management considerations for Precinct Plans, Plans of Subdivision, Site Plans and associated Zoning By-law Amendments. Energy policies generated through the Heritage Heights CEP will be supported by the DDGs and Sustainability Metrics Program. In addition, the Heritage Heights Urban Design Guidelines should also provide appropriate direction to achieve the goals of the CEP.

Applicants will have to submit reports/documentation demonstrating their conformity to the expected policy outcomes and provide a detailed submission to the City as part of their development application submission for it to qualify as a “complete” application.

4.1 Policy Guidance by Neighbourhood Typology

This section considers secondary policy guidance through the lens of neighbourhood type (Table 5). Only policies specific to the neighbourhood type are summarized in Table 5. Policies relevant to all neighbourhood types are found in subsequent tables (i.e., Table 6 and 7).

[12] Not all building envelope matters are outside the score of planning policy. Municipalities do have *some* authority over “exterior building design”, which is part of the building envelope (subclause 41(4)2(d) of the Planning Act)

Table 5: Policy guidance for the five major Heritage Heights Neighbourhood Typologies.

Neighbourhood Typology	Policy Direction
Low-density residential area (LRA)	• Builder/developers are expected to integrate high-efficiency air-based heat pumps with supplementary solar thermal and electric induction heating into all LRA homes and buildings. • Builder/developers are expected to integrate solar thermal into all LRA homes and buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include heat pumps, ensure the electrical infrastructure supports all-electric LRA homes and buildings and to explore and develop incentives for developers to include renewables. • No retail natural gas service.
Medium-density mixed-use residential area (MDMU)	• Builders/developers are expected to design MDMU buildings to be district-energy ready. • The City of Brampton's intends to explore options to immediately provide comprehensive district energy (heating and cooling) services. • Retail natural gas service limited to energy centres.
High-density mixed use residential area (HDMU)	• Same as MDMU.
Industrial area (IND)	• Same as MDMU and HDMU, with the exception of retail natural gas to some industries.
Hospital area (HOS)	• Same as MDMU and HDMU.

4.2 Policy Guidance by Land Use Plan Designation

This section considers policy guidance through the lens of land use plan designations (Table 6)

Table 6: Policy direction for land use plan designations at the spatial planning zone (SPZ) level.

Land Use Plan Designation	Policy Direction
Residential over Main Street Retail/Town Square (SPZ 5)	• Precinct Plans to require an Integrated Energy Master Plan for the entire centre that targets net zero GHG performance and flexible integration and operation with district energy system. • Location of a significant energy centre. • Individual buildings to require building energy modelling at draft Plan of Subdivision or Site Plan approval stage.
Hospital and Wellness District (SPZ 5)	• Secondary Plan-level policy to anticipate integration of hospital campus energy centre with community energy system beyond the site. • Hospital campus to require Integrated Energy Master Plan for net zero GHG performance and flexible integration and operation with district energy system.

	• Other buildings will require building energy modelling at draft Plan of Subdivision of Site Plan approval stage.
Urban Boulevard (SPZ 2, 5, 8, 10 and 11)	• Secondary Plan policies to prioritize transit and active transportation modes. • Secondary Plan policies co-locating energy infrastructure (power and thermal) within road right-of-way. • Use other tools to minimize GHG impact of high-volume through-traffic (e.g., High Occupancy Vehicle (HOV) / Low Emission Vehicles (LEV) dedicated lanes, Low Emissions Zone (LEZ) for Heavy Duty Vehicles (HDV) (or emissions penalties), Connected and Autonomous Vehicles (CAV)-ready design, transit prioritized, adaptive flow management).
Major Transit Station (SPZ 5)	• Require Site Plan Integrated Energy Master Plan for large inter-modal stations with net zero GHG performance and flexible integration and operation with district energy system. • Precinct Plan to maximize intermodal access and flexibility including bicycle parking services, electric vehicle (EV) charging and pedestrian-friendly design. • Consider co-location of neighbourhood energy centre.
Transit/GO Train Links (SPZ 2, 5 and 10)	• Required Integrated Energy Master Plan for stations with net zero GHG performance and flexible integration and operation with district energy system. • Policies to maximize intermodal access and flexibility including pedestrian access, light duty vehicle and bicycle parking services, and electric vehicle charging. • Potential location of energy centre.
Separated Bicycle Facility (SPZ 1, 2 and 3)	• Policies to maximize intermodal access. • Individual builders/developers are expected to design their buildings and developments to maximize cycle/e-cycle access, including linking to neighbourhood routes.
Elementary School (SPZ 1, 2, 4, 5, 7, 10 and 11)	• Precinct Plan to require an Integrated Energy Master Plan for net zero GHG performance and flexible integration and operation with district energy system when called for by neighbouring built form. • Draft Plan of Subdivision or Site Plan approval stage to include building energy modelling.
Secondary School (SPZ 1 and 7)	• Precinct Plan to require an Integrated Energy Master Plan for net zero GHG performance and flexible integration and operation with district energy system when called for by neighbouring built form. • Draft Plan of Subdivision or Site Plan approval stage to include building energy modelling.
Catholic Schools (SPZ 1 and 11)	• Precinct Plan to require to require an Integrated Energy Master Plan for net zero GHG performance and flexible integration and operation with district energy system when called for by neighbouring built form. • Draft Plan of Subdivision or Site Plan approval stage to include building energy modelling.

Fire Station (SPZ 5)	• Precinct Plan to require an Integrated Energy Master Plan for net zero GHG performance and flexible integration and operation with district energy system. • Draft Plan or Subdivision or Site Plan approval stage to include building energy modelling.
Recreation Centres (SPZ 4 and 11)	• Precinct Plan to require an Integrated Energy Master Plan for net zero GHG performance and flexible integration and operation with district energy system when called for by neighbouring built form. • Encourage co-location of shared energy resources with other public buildings, such as schools. • Draft Plan of Subdivision or Site Plan approval stage to include building energy modelling.
Natural Heritage (all but SPZ 1 and 6)	• Protected.
Parks (all SPZs)	• Potential for renewable energy. (i.e. solar PV on parking areas, bio-waste, geo-exchange)
Stormwater Management Ponds (all SPZs)	• Potential for renewable energy.
Regional Water Reservoir (SPZ 11)	• Potential for renewable energy. (i.e. thermal exchange, thermal storage)

4.3 Policy Guidance by Energy Measure

This section considers policy guidance through the lens of the energy measures included in the Heritage Heights CEP (Table 6). Note: this information is also included in Appendix 13 – Energy Measures which provides a detailed description of each energy measure.

Table 6: Policy directions for the energy measures included in the Heritage Heights CEP.

Energy Measure	Policy Direction
Building End Use Efficiency	
Efficiency Building Construction:	
Building envelope	• Developers/builders will rigorously comply with the Ontario Building Code, ideally supported by a voluntary Energy Performance Label. • Developers/builders are encouraged to anticipate expected 2030 Ontario Building Code increases in energy efficiency. • The City of Brampton's intention is to explore and develop incentives for developers/builders to further exceed code efficiencies starting in 2022.
Lights and appliances	• Developers/builders will rigorously comply with code, ideally supported by a voluntary Energy Performance Label. • Developers/builders are encouraged to only offer LED lighting and Energy Star most-efficient rated appliances. • The City of Brampton's intention is to explore and develop incentives for developers/builders to further exceed lighting and appliance efficiencies starting in 2022.

Heating and cooling	• Builder/developers are expected to design LRA buildings with air-based heat pumps with supplementary solar thermal and electric induction heating. • Builders/developers are expected to design MDMU and HDMU buildings to be district-energy ready. • The City of Brampton's intention is to explore options to immediately provide comprehensive district energy (heating and cooling) services.
Electricity Generation at Building:	
Solar photovoltaics	• Builder/developers are expected to integrate solar PV into all buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include renewables.
Thermal Energy Generation at Building:	
Solar thermal	• Builder/developers are expected to integrate solar thermal into all LRA homes and buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include renewables.
Air-based heat pumps	• Builder/developers are expected to integrate high-efficiency air-based heat pumps into all LRA homes and buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include heat pumps. • The City of Brampton's intention is to ensure the electrical infrastructure supports all-electric LRA homes and buildings.
Ground-effect heat pumps	• Builder/developers can include ground-effect geothermal exchange heating and cooling systems in all areas in specific circumstances. • See below for the spatial impact of potential grid connections.
Efficient Building Management:	
Smart meters	• Builder/developers are expected to design homes and buildings with management systems that facilitate metering and sub-metering of all major energy supply, conversion, and consumption systems. • The City of Brampton's intention is to provide design guidance for smart metering and sub-metering expectations for multiple property types.
	Transportation Energy Efficiency
Active Transportation:	
Walking	• Neighbourhoods to be walkable and accessible by active transportation. • Builders/developers are expected to design their buildings and developments to maximise pedestrian access including linking neighbourhood pedestrian trails.
Cycling	• Neighbourhoods to be cyclable/e-cyclable. • The City of Brampton's intention is to develop service agreements with on-demand cycle/e-cycle availability. • Builders/developers are expected to design their buildings and developments to maximize cycle/e-cycle access including linking to neighbourhood routes.
Mobility Services:	

Brampton Transit	• The City of Brampton's intention is to establish flexible and frequent transit availability and competitive service quality within and between neighbourhoods in the SPA and the rest of the City. • The City of Brampton's intention is to establish design guidelines that facilitate transit use and modal transfer. • Builders/developers are expected to design their buildings and developments to maximise convenient access to transit for residents and employees including reasonable bus access.
GO Transit	• The City of Brampton's intention is to develop specific neighbourhood design guidelines around the GO Train stations that maximize the convenient transfer between all modes of transportation. • Builders/developers are expected to design their buildings and developments to maximise convenient access to the GO Train for residents and employees.
On-demand transportation services	• The City of Brampton's intention is to develop neighbourhood design guidelines that facilitate the availability of on-demand vehicles and on-demand service providers. • Builders/developers are expected to design their buildings and developments to maximise convenient access for on-demand vehicles and on-demand service providers, including reasonable provisions for on-demand infrastructure.
Urban Form:	
Compact and complete community design	• The City of Brampton's intention is to develop neighbourhood design guidelines to create compact urban forms that reduce distances and travel times between daily personal and professional functions. • The City of Brampton's intention is to proactively develop economic development plans to attract local employment to the SPA. • Builders/developers are expected to design their buildings and developments to maximise mixed-use and minimise distances between different uses.
Vehicle Efficiency:	
Battery electric vehicles	• The City of Brampton's intention is to provide guidelines to maximize the availability of EV charging infrastructure in buildings, developments, and neighbourhoods. • Builders/developers are expected to provide EV charging infrastructure for occupants and visitors.
Gas, diesel, biodiesel, natural gas, plug-in hybrids	• None
Motorcycles and Scooters	• The City of Brampton's intention is to develop neighbourhood and road design guidelines that facilitate the safe and convenient use of motorcycles and scooters. • Builders/developers are expected to design their buildings and developments to be convenient for motorcycle and scooter users including dedicated parking infrastructure.
Energy Services	
Energy Services to Homes and Buildings:	

Grid electricity	• Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide services for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Microgrid electricity (new service)	• Alectra (the distribution company) in coordination with Hydro One (the transmission company), and IESO will provide interconnection, information, and other services to qualified users and operators for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Natural gas	• Enbridge will supply natural gas to district energy centres/some industry.
Thermal energy (new service)	• Builders/developers are expected to design MDMU and HDMU buildings to be district-energy ready. • It is the City of Brampton's intention to explore options to immediately provide comprehensive district energy (heating and cooling) services.
Energy Services to Transportation:	
Electricity	• The City of Brampton's intention is to provide guidelines to maximise the availability of EV charging infrastructure in buildings, developments, and neighbourhoods. • Builders/developers are expected to provide EV charging infrastructure for occupants and visitors. • Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide services for the restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power and electric transportation.
Gas, diesel, biodiesel, compressed natural gas, liquid natural gas	• None.
Supply Portfolio:	
Electricity	• Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide services for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Natural gas	Enbridge will supply natural gas to district energy centres and some industry. The GHG index of network supplied gas will reduce over time as biogas and green hydrogen are blended with natural gas.
Solar PV	• Builder/developers are expected to integrate solar PV and supporting battery storage into all buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include renewables. • Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide interconnection, information, and other services to qualified users and operators for the restructured SPA demand resulting from increased efficiency, building integrated solar PV, local CHP, and electric transportation.

Solar thermal	• Builder/developers are expected to integrate solar thermal into all LRA homes and buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include renewables.
Combined heat and power (engines)	• The City of Brampton's intention is to explore options to immediately provide comprehensive district heating and cooling services in Heritage Heights. • Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide interconnection, information, and other services to qualified users and operators for the restructured demand in Heritage Heights resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Waste heat	• None • These are operational decisions and negotiations between the thermal utility and the waste heat source
Environmental (air-based)	• Builder/developers are expected to integrate high-efficiency air-based heat pumps into all LRA homes and buildings. • The City of Brampton's intention is to explore and develop incentives for developers to include heat pumps. • The City of Brampton's intention is to ensure the electrical infrastructure supports all-electric LRA homes and buildings.
Environmental (ground-effect)	• Builder/developers may include ground-effect geothermal exchange heating and cooling systems in all areas. • The Thermal Utility may include ground-effect geothermal exchange heating and cooling arrays as a supply asset. • All Ground-effect geothermal exchange heating and cooling systems in medium and high-density areas will be capable of being integrated into the DE network.
Electricity storage (battery)	• The City of Brampton's intention is to create guidelines to include building integrated battery storage, including battery electric vehicle connectivity. • Builders/developers are expected to consider offer integrated battery storage and battery electric vehicle connectivity as a standard option. • Alectra and IESO will include highly distributed battery storage in their demand management planning for Heritage Heights.
Thermal storage (cistern)	• None – other than land use. • The size and timing of implementing thermal storage is an operational and commercial decision of the thermal utility. Typically, thermal storage would be integrated into a district energy centre or on a mutually agreed location on a customer site. Theoretically, this can include stormwater ponds and pools when combined with an appropriate conversion system.
Efficient Energy System Management:	
Smart energy network	• The City of Brampton's intention is to develop information and equipment guidelines to capture relevant transportation data.

	• The City of Brampton's intention is to develop "Smart Community" system architecture guidelines to enable qualified users to optimize their operations. • The City of Brampton's intention to develop an institutional structure to capture and report the energy performance of the Heritage Heights Community on a routine basis.

4.4 Policy Guidance for the Great Toronto Area West Transportation Corridor

Currently, the Greater Toronto Area (GTA) West Transportation Corridor proposal is for a 6-lane 400-series Highway.[13] As an alternative, the Heritage Heights Conceptual Land Use Plan (CLUP) incorporates an urban boulevard form (Grand Boulevard). The Heritage Heights Grand Boulevard follows the proposed route of the GTA West Transportation Corridor.

From a transportation standpoint, the Boulevard is configured to both serve reasonably high volumes of traffic passing through the Secondary Plan Area (SPA) whilst retaining convenient access for all modes of local traffic, including active transportation (walking and cycling) and transit (bus). This Boulevard is also configured to facilitate mode transfer. Multimodal access and transfer are key to the Heritage Heights CEP in terms of meeting the transportation GHG goals. Incidentally, the separated transportation lane structures, including heavy-duty vehicle (HDV) transit could make future low emission vehicle (LEV) constraints easier to implement.

From a built-form standpoint, the Boulevard anticipates mostly high-density mixed-use development on its immediate boundary. The through traffic lanes are separated from the built form with a mix of urban forestry, pedestrian and cycling routes, local traffic, parking, and transit. By facilitating attractive high-density residential and local employment, transportation energy and GHG impacts are reduced, along with the higher levels of built energy efficiency that comes with density.

The Heritage Heights CEP simulation assumed the transportation and built-form energy and GHG impacts based on the CLUP. The estimates included the assumption that any vehicles passing through Heritage Heights on the through lanes would be considered contributing to the SPA's carbon footprint.

For the purpose of the Heritage Heights CEP, the energy and GHG impact of the GTA West Corridor being a conventional 6-lane 400-series highway was not analytically simulated, since a new CLUP would have to be developed first. Obviously, the impacts on the possible built-form, and the limitations on multi-modal access and transfer, and average trip lengths, would substantially increase the overall energy use and greenhouse gas emissions.

[13] Note: Ontario's Ministry of Transportation (MTO) initiated the Environmental Study for the GTA West Transportation Corridor in January 2007. Stage 1 was completed in November 2012. Stage 2 was stopped in February 2018 but was subsequently resumed in June 2019. MTO released a revised Technically Preferred Route (TPR) in August 2020. The TPR does not reflect the City's request that the highway through Heritage Heights be converted to an urban boulevard. Study completion is expected by the end of 2022. The City of Brampton requested the Government of Canada conduct an Environmental Assessment of the proposed major transmission corridor. In May 2021, the Federal government designated the project and indicated that the federal concerns will need to be addressed either as part of the ongoing provincial project or through a federal environmental assessment study (if required). One of the City of Brampton's objectives is to minimize the amount of land required and provide recommendations for future design and inclusion into the right of way of the GTA West Transportation Corridor. The City of Brampton continues to advocate for an urban boulevard rather than a provincial highway as identified in the Heritage Heights Conceptual Land Use Plan.

4.4.1 Greater Toronto Area West Utility Corridor

In parallel, the Ministry of Energy and the Independent Electricity System Operator (IESO) are conducting a study to identify and protect a corridor of land for future electricity infrastructure in the Northwest Greater Toronto Area (GTA). The project's study area aligns with the Ministry of Transportation's (MTO) Focused Analysis Area. The expectation is that the transmission corridor would parallel the transportation corridor. The study will not recommend specific infrastructure investments. It seeks, rather, to keep a viable transmission infrastructure option open by ensuring land remains available in the future.

4.5 Policy Guidance for Non-energy-related Emission Mitigation Measures

Non-energy related emission mitigation includes but is not limited to carbon sequestration and other land use measures, increased anaerobic treatment of bio-waste, reduced fugitive emissions and reduced process emissions. Carbon sequestration measures can include urban forestry, urban farming, green roofs, naturalization, and natural heritage protection. A co-benefit of sequestration measures can be the ambient climatic effects that shade, solar energy reflection, and transpiration have on energy use.

Carbon sequestration was not quantified in the Heritage Heights CEP. Sequestration was deemed outside of the scope of the CEERP. Nonetheless, secondary planning policy can explicitly recognize the role in carbon sequestration performed by green infrastructure, including trees and the natural heritage system. Additionally, while hard to quantify on a case-by-case basis, the role of urban trees and forests in reducing building energy demand should also be explicitly recognized.

The Heritage Heights CEP is the energy layer necessary to shape land use planning and built form decisions, while achieving affordability, supply quality and net zero goals. By definition, the CEP will not make recommendations that conflict with any "green" land use designations including green infrastructure (e.g., community park space, natural heritage).

Within SPZs, detailed design should be considered not at the secondary planning level but at the precinct planning stage, predominantly driven by the relevant Neighborhood Typology. Secondary plan policies will lay the groundwork for design and development decisions with respect to potential conflicts between Heritage Heights CEP and other goals. For example, expanding the urban forest (1 million new trees throughout Brampton by 2040) is a city-wide green infrastructure target recognized in the CEERP. Maximizing the opportunity to plant trees within future Heritage Heights neighbourhoods requires forethought as street trees must be given space to flourish within street rights-of-way. Streets need to be designed to minimize conflicts between trees and other competing uses, especially utilities underground.

5. Implementation Governance

Implementing ambitious energy and emissions goals can be challenging. Energy and emissions planning requires substantial and thorough planning by the City of Brampton, the evolution of new energy service structures, developer/builder buy-in, and the willingness of future residents and businesses to live and operate within an innovative neighbourhood.

Governance systems and structures are well established to support the delivery of existing energy services: grid electricity, natural gas, and gasoline and diesel fuels. That is not the case for many of the new energy services recommended for the Heritage Heights Community.

The following observations are made with respect to enabling implementation.

5.1 Development Industry

Best practice would recommend early engagement of the development industry in the planning process to mitigate risks associated with the proposed energy and climate policy guidance for Heritage Heights development. While there are business opportunities for the development industry in the energy transition, it should not be underestimated the change required to business models, supply chains and skilled trades. A strong partnership between the development industry and the municipality to build a net-zero development would optimize the benefits while mitigating risks for all parties.

5.2 Development Approvals Process

The development of the Heritage Heights community is the equivalent of building a medium-sized Canadian city. Delivering significant reductions in GHG emissions compared to a typical suburban development in Ontario will call upon new expertise throughout the development approvals process. Establishment of an internal multi-disciplinary team when considering development applications in the Heritage Heights Community (and future near net-zero secondary planning areas) is strongly recommended. This would support the institutionalization of an efficient and effective "climate-friendly" approach to planning while mitigating risk for the development industry.

Currently, utilities are engaged towards the end of the development approvals process. This will need to change to support the deployment of new energy services. Inviting representatives from the utilities (e.g. Alectra (with Hydro One as appropriate) and Enbridge) and IESO, along with the new Thermal Utility, to participate in the multi-disciplinary approach to processing net-zero development applications will be advantageous.

5.3 Thermal Utility

The CEERP, approved by City Council in September 2020, supports the following recommendation:

> *Implement district energy in high growth districts with a mix low-carbon heating and cooling source that serves the majority of existing target property in high growth Energy Planning Districts with district energy…and….to further integrate District Energy services in appropriate locations within the City of Brampton*.

The CEERP calls for these heating and cooling services to be operated and delivered by an entity that acts as a thermal utility for the City.

The Heritage Heights CEP calls for the immediate establishment of a thermal utility to provide municipal district energy (heating and cooling) services. The thermal utility will serve all areas except those classified as low-density residential.

Based on the energy and emissions simulations developed for Heritage Heights, the thermal utility is expected to deliver 70% of the total thermal load of the Heritage Heights Community, with 80% less GHG emissions than the Business-as-Usual (BAU) picture. The technical approach is an immediate pathway for cost competitive and low-carbon service for Heritage Heights. It also creates a pathway to completely eliminate all GHG from heating and cooling homes and buildings.

The district energy recommendation does not stand on its own. Many of the other 18 CEP Recommendations require the heating and cooling services to deliver their full potential.

The recommendations for district energy as necessary to achieving the near-net-zero emissions goal of Heritage Heights, as called by CEERP, calls for the commitment to promptly move forward to create the thermal utility to serve Heritage Heights as a major step to serving the whole city.

When fully built-out in 2050, the thermal utility would be managing a 100-to-150-kilometre total network connecting thousands of consumers with a wide portfolio of thermal sources including geothermal, solar thermal, renewable electricity, biofuel, and waste heat recovery. The fully built-out system could call for investments up to as much as $350 million. The investments would be timed and located to match the rate of development of Heritage Heights over the 30 years of the CEP. At the community level, these investments are far from fully incremental, compared to business-as-usual. Through the entity investing in providing comprehensive heating and cooling services, there are reduced site-specific investments for the developers.

A coalition of expertise and resources will need to be convened to establish a thermal utility to answer several keys questions:

- Who will commit to provide these services and make this investment?
- Will they have the skills and capacity to strategically develop and operate a thermal utility to competitively and reliably serve the heating and cooling services called for in the Heritage Heights CEP?
- Will the Heritage Heights thermal utility be the basis to establish heating and cooling services elsewhere in Brampton as called for in the CEERP?

Expertise for the coalition would include:

- Expertise in designing, constructing, marketing and operating community-scale modern district energy services.
- Ability to scale local resources to build and operate the Thermal Utility.
- Committed long-term investment capacity.
- Commitment to support necessary public policies, guidelines and provide overall service quality governance.

The members of this coalition are likely to be drawn from some combination of existing thermal service providers, existing local utilities, local infrastructure companies, the municipality, and strategic investors.

To align the public services interest and the necessary policy, guidelines, and other enabling measures, it is key that the municipality be a member of the coalition from the start. The thermal utility could be structured as a Municipal Service Corporation, enshrined in the *Municipal Act*. This allows for municipalities to enter into strategic partnerships that serve the municipal interest. Despite common misconceptions, it is important to note that the municipality would not be obligated to make major equity or financing investments into developing the thermal utility. Investments can be made by third party partners that are enabled and structured through the Municipal Services Company vehicle. This flexibility ensures long-term service quality is in the public interest, while minimizing the risk to Brampton residents. However, as is the case with the existing electricity LDC, Alectra, it would be reasonable for the Corporation of the City of Brampton to have some reasonable level of ownership in the thermal utility to receive regular dividends as a result.

The City of Brampton may choose to make equity investments in a thermal utility or not. However, the strategic role of the municipality is critical to the success of the thermal utility. In the initial phase, the City of Brampton is central to establishing the long-term commitment of other coalition members. The ownership

structure and mix of investors in the thermal utility may change over time; the consistency of the role of the municipality cannot and must be enshrined in the formal governance. The elements of the municipal role are described below:

Policy and Planning

In the Heritage Heights Secondary Plan, it is anticipated that both regulated and unregulated policy tools will be utilized to drive relevant developments to integrate district energy services into their design and construction. This will create the thermal energy demand that is in the coalition's, and the future thermal utility's, primary interest. Translating Heritage Heights' thermal energy policies to other Secondary Plans and supported in an updated Official Plan will further establish the market demand for thermal services across Brampton, as called for in the CEERP.

Operations

Coordinating the installation of linear infrastructure is not something new to municipalities. These processes already exist with water, sewer, natural gas, electricity, and broadband providers. Similar coordination with the thermal utility will be needed to build the integrated distribution and service district energy networks.

Ensuring the Public Interest

The thermal utility will serve thousands of customers for decades. The City will have an ongoing governance role to ensure the quality of the services, their cost, and the other conditions under which they are delivered, are consistent with the public interest.

5.4 Implications for Alectra and Enbridge

The Heritage Heights CEP recommends several measures to increase the end-use efficiency of buildings and transportation and to increase the generation and distribution of energy (including electricity and thermal energy) within the boundary of the SPA. The sum of these measures will change the demand and supply profile for electricity and natural gas within the Heritage Heights Community (see Appendix 17 – Utility Implications). Appendix 17 considers the policy, technical, business development, and regulatory implications of the Heritage Heights CEP for Alectra and Enbridge.

5.4.1 Alectra

For a regulated electricity utility, Heritage Heights presents a rare large-scale opportunity in Ontario (or, in fact, North America) for an LDC (Local Distribution Company) to evaluate the changes in investment and operating practices that will be needed as community energy systems transition to a net-zero future.

Alectra is the electricity distribution entity and Hydro One is the transmission entity. As both Alectra Utilities and Hydro One are regulated by the Ontario Energy Board, their licenses to operate are separate and distinct. Currently, Alectra Utilities does not have authority over the transmission company's Connection Impact Assessment (CIA) when determining the viability of connecting local generation to the grid. Also, Alectra works with Hydro One to understand what capacity is available on transformer stations.

The CEP recommendations also present many new potential market opportunities for the deregulated branch of Alectra's operations, Alectra Energy Solutions. Alectra has a strategic objective to grow the enterprise. Again, Heritage Heights presents a scale opportunity to pilot new business possibilities, for potential wider deployment.

Possible business development areas have not been discussed in any depth during the Heritage Heights CEP engagement process. Clearly the implementation of large-scale electric heating in the low-density area, the implementation of district energy with multiple thermal sources in the other areas, the installation of large quantities of solar PV and solar thermal, and the electrification of transportation create multiple areas where new business models are likely to emerge.

5.4.2. Enbridge

Heritage Heights presents a rare opportunity for Enbridge to explore new business opportunities that will result from the transformation of community energy systems to a net zero future. District energy in some form will have a major role in decarbonizing heating, cooling and hot water services in hundreds of cities in Canada and the USA. The thermal utility called for in the CEP is an opportunity for Enbridge participation.

5.5 Smart Energy Region

Measuring, communicating, and optimizing the results of the Heritage Heights CEP over decades will require a holistic approach capturing and managing energy related data from all sectors. This will facilitate maximizing the interrelated benefits between projects and sectors. A "Smart Energy Region" will identify areas where the energy and climate performance are exceeding or falling short of tracking targets and allow for appropriate adjustment to be recommended. The Smart Energy Community architecture for Heritage Heights will be the template for the wider City of Brampton.

5.6 Regional Energy Planning (IESO)

Coordination between Brampton's municipal energy initiatives and Alectra Utilities/Hydro One is important. Additionally, any recommendations and targets for distributed energy resources will be coordinated with Alectra Utilities and Hydro One to ensure that distribution system planning can identify synergies or limitations associated with their connection.

The regional planning process relies on Local Distribution Companies (LDCs) to provide demand forecasts for their service territories.

Early in 2021, the IESO acknowledged that "growing interest in electricity choice and planning at the local level has put a spotlight on the role of community involvement in developing solutions" and noted the "value of an integrated approach to meeting local needs, and of considering the merits of DERs [Distributed Energy Resources] and energy efficiency as alternatives to traditional generation and transmission infrastructure".[14]

Heritage Heights provides an opportunity for the IESO and Province of Ontario to evaluate many aspects of the changes in investment and operating practices that will be needed as community energy systems transition to a net-zero future.

6. Conclusion

The Heritage Heights CEP has identified a pathway to achieving a near net zero future for the Heritage Heights Community with much less reliance on fossil fuels for the heating and cooling of buildings and for transportation, and a greater focus on locally generated renewable energy.

[14] Source: https://ieso.ca/en/Corporate-IESO/Media/Speeches-and-Presentations/2021-Priorities

The integration of the recommended CEP energy policies into the Heritage Heights Secondary Plan land use policies will deliver a unique, large-scale prototype and a national benchmark for advancing the relationship between energy planning and spatial planning.

Appendix 1 – Existing Energy System

The energy needs of Height Heights Community could be met by three existing centralized energy services for electricity, natural gas, and gasoline/diesel.

1. Electricity

In 2021, Ontario's installed capacity for electricity generation was 33% nuclear, 29% natural gas, 23% hydro, 12% wind, 1% solar, and less than 1% biofuel (Figure 4).[15]

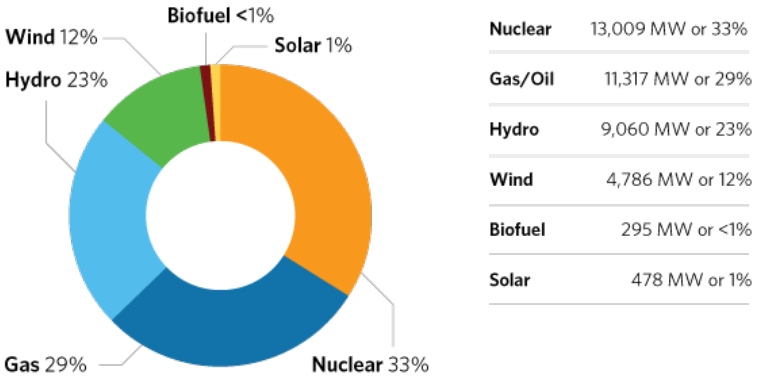

Figure 5: Ontario's 2021 current installed energy capacity by fuel type on Ontario's transmission system (IESO).

Up until the 1950s, Ontario's electricity system was almost 100 percent renewable hydroelectric power. The introduction of non-renewable primary energy sources (i.e., fossil fuel and nuclear) to meet the power demands of increasing population, industrialization and urbanization has had two consequences: 1) the creation of waste by-products (i.e., the release of carbon dioxide into the atmosphere from fossil fuel use and nuclear waste that must be managed for hundreds of thousands of years); and 2) increased system losses.

System losses include conversion losses that occur when energy is transformed from one form to another. For example, when natural gas is used to create electricity, more than 40% of the energy is lost as heat to the environment. In contrast, hydro-electric power is approximately 95% efficient. System losses also occur when energy is moved from location to another. For example, when electricity is conveyed from generating facilities to end-users over transmission lines energy is lost along the way as heat. These system losses reduce the efficiency of the system.

In 2014, Ontario completed the closure or conversion of all coal-fired power plants to natural gas delivering several environmental and health benefits, including the reduction of GHG emissions.[16] It also resulted in

[15] Source: IESO 2021 https://ieso.ca/en/Learn/Ontario-Supply-Mix/Ontario-Energy-Capacity
[16] Source: CAPE. (2017). "Ontario's Coal Plant Phase-out Produced Many Health and Environmental Benefits". CAPE. https://cape.ca/ontarios-coal-plant-phase-out-produced-many-health-and-environmental-benefits/

cleaner air. For example, in 2005, there were 53 smog days recorded in Toronto, but ten years later, in 2015 with comparable temperatures, there were none recorded.[17]

Alectra is the Local Distribution Company (LDC) with the franchise for distributing electricity from the provincial transmission grid (managed by Hydro One) to homes and businesses in Heritage Heights Community.[18]

Land use planning implications in Brampton include: 1) locating sub-stations and 2) accommodating linear infrastructure (underground conduit, poles, and wires) in the municipal right-of-way. A substation is a part of the electrical generation, transmission, and distribution system. Substations transform voltage from high to low for distribution to homes and businesses. The custody of electricity is transferred from Hydro One to Alectra at the sub-station.

As noted in Section 4.9, the Ministry of Energy, Northern Development and Mines and the Independent Electricity System Operator (IESO) are conducting a study to identify and protect a corridor of land for future electricity infrastructure in the Northwest Greater Toronto Area (GTA). The expectation is that the transmission corridor would run through the Heritage Heights Community.

2. Natural gas

Natural gas is a nonrenewable energy source which is used primarily for space heating, domestic water heating, and industrial steam and process heat, as well as electricity generation. Most of our natural gas comes from outside the province and has been delivered by interprovincial pipelines since 1958. Natural gas used for home heating and industrial processes is a major contributor to GHG emissions in the Greater Toronto Area (GTA). Enbridge is the LDC with the franchise for distributing natural gas to home and businesses in Brampton.[19]

Land use planning implications in Brampton include: 1) locating and sizing of gate stations and 2) accommodating linear infrastructure (pipelines) in the municipal right-of-way. Gate stations are defined as the pressure regulating stations where the custody of natural gas is transferred from transmission companies to Enbridge. Natural gas is measured, heated, pressure regulated, and odourized at the gate stations prior to entering distribution mains.

3. Gasoline and diesel

Gasoline and diesel are nonrenewable sources of energy that are primarily used as engine fuel for various types of transportation vehicles. They are mostly sourced from crude oil, almost all of which comes from outside Ontario and is imported from western Canada, the Atlantic offshore, and the United States. Gasoline and diesel use in cars and trucks is a significant contributor to GHG emissions in Brampton and the GTA. Gasoline and diesel fuels are transported to gas stations by tanker trucks. The land use planning implication for Brampton includes the compatible location of gas stations within the urban environment and future flexibility for repurposing.

[17] Source: CBC News. (June 8th, 2017). “Smog study shows 'significant decreases' in pollutants in Ontario”. CBC. Retrieved from: https://www.cbc.ca/news/canada/windsor/smog-study-shows-significant-decreases-in-pollutants-in-ontario-1.4151183

[18] Found at: https://alectrautilities.com/

[19] Found at: https://www.enbridge.com/

Appendix 2 – CEERP Direction

The City of Brampton's Community Energy and Emissions Reduction Plan (CEERP) established 39 Energy Planning Districts (EPDs) within Brampton. EPDs were aligned with the City's land use planning and growth plans for population and employment. The Heritage Heights Community was represented by EPDs 1, 15, 16 and a small part of 2.[20] The CEERP identified the development of the Heritage Heights Community as a near net-zero GHG emissions community to contribute towards achieving Brampton's energy and emissions goals (Figure 5).

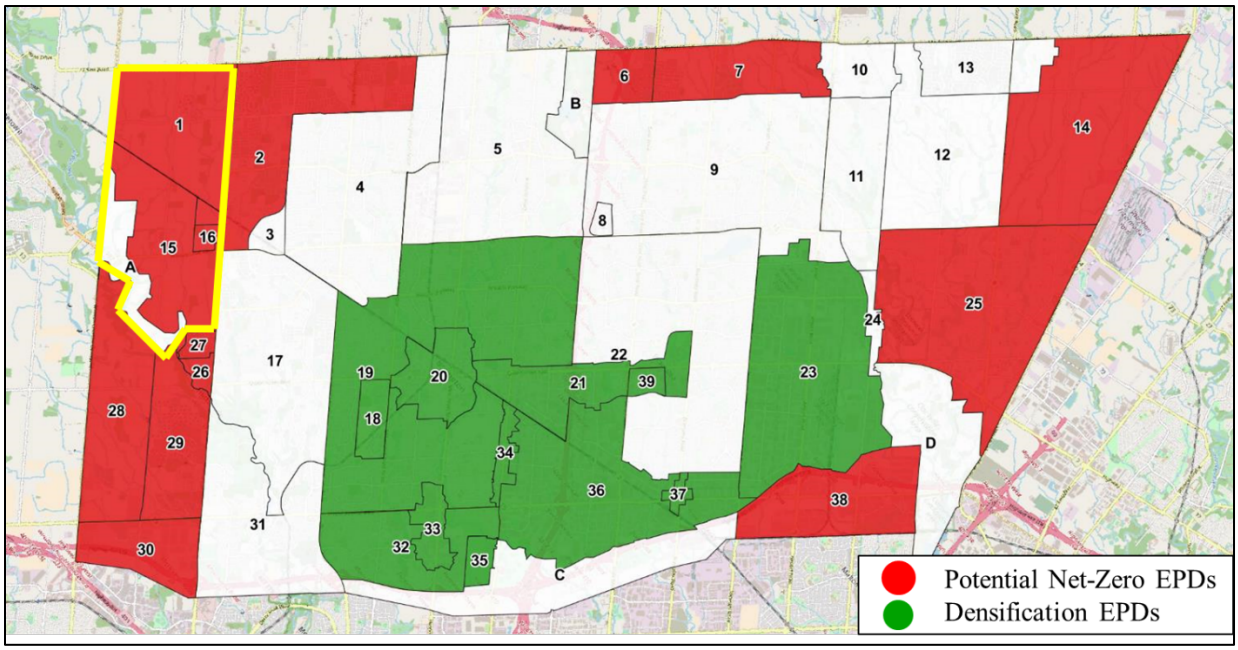

Figure 5: Energy Planning Districts (EPDs) identified in the Community Energy and Efficiency Reduction Plan (CEERP).

The CEERP identified preliminary technical specifications for near net zero developments (see insert below) which also informed the Heritage Heights CEP.

[20] The area identified as "A" in Figure 1 is natural heritage feature. Natural heritage lands are excluded from energy demand modelling.

CEERP Technical Specifications for Near Net Zero Developments

- New building construction measures would be above-code (i.e., near Passive House) with integrated solar photovoltaics (PV).
- Existing buildings would be retrofitted to increase energy performance and considered for thermal energy services.
- Most of the community's heating and cooling would be supplied by a shared district energy thermal infrastructure.
- District heating networks would be expected to operate at low-medium supply water temperatures (between 30°C and 95°C) typical of Generation 3, 4 or 5 district heat networks. Any exceptions to these parameters to be supported by analytical rationale. A thermal supply portfolio, including storage, would be developed.
- Neighbourhood design for transportation, including scale intermodal transfers, would clearly contribute to increased share of journeys by walking and cycling, reduced average journey lengths, and increased share of journeys by transit and ride-share.
- The use of low- or zero-emissions vehicles would be maximized (approaching 100%) requiring the provision comprehensive electric vehicle (EV) charging infrastructure.

Appendix 3 – Stakeholder Engagement

1. Methodology

The Engagement Plan for the Heritage Heights CEP was based on the International Association of Public Participation (IAP2) Spectrum of Public Engagement (Figure 1). The Heritage Heights CEP contributes to CEERP implementation through the provision of energy policy guidance to the Heritage Height's secondary planning process. So, consideration was given to moving further down the spectrum in designing engagement activities.

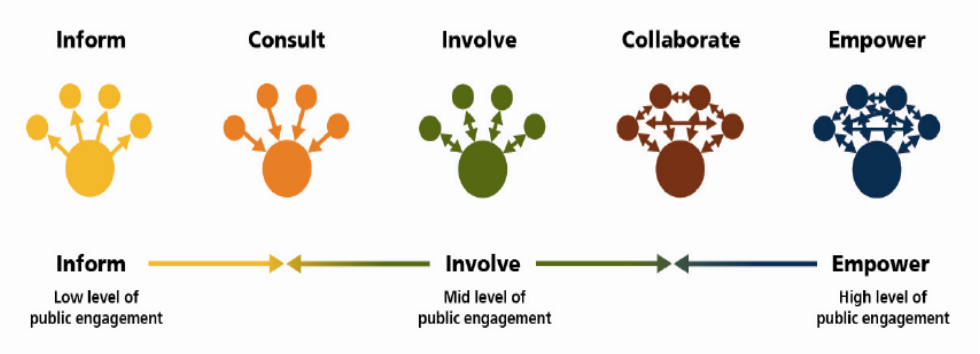

Figure 1: Spectrum of Public Engagement, International Association of Public Participation

The goal of the Engagement Plan was to engage a broad and appropriate cross-section of municipal and community stakeholders and the public in the process to develop the Heritage Heights CEP. The objectives of the Strategy were to:

- Earn community buy-in CEP, including Brampton Council
- Build knowledge and grow the capacity of municipal and community stakeholders to implement the CEP
- Motivate municipal and community stakeholders to act

The process was designed with the following principles:

- be data-informed and evidence-based
- engage an appropriate cross-section of the municipality and community
- respect stakeholders' time by employing process-appropriate engagement activities and stakeholder-appropriate engagement activities
- be accessible
- be flexible
- promote implementation
- measure outcomes and impact

2. Stakeholder Identification

Two primary categories of community stakeholders and the public were identified. **"Stakeholders"** are individuals or institutions within the community that have, or perceive they have, something to gain or lose from the implementation of the CEP. **"Capacity-holders"** are individuals or institutions within the community who possess strengths or resources that add value to both the development or implementation of the CEP and to their own activities.

Capacity holders were primarily engaged through a Project Working Team (PWT) along with the consulting team. The Project Working Team included municipal and utility representatives and the consulting team.

Stakeholders can be further defined by the level of their stake in a CEP:

- "Decision-makers and regulators" have the most direct authority over CEP strategies.
- "Transactors" have a direct stake in CEP strategies.
- "Active interests" are affected by CEP decisions and can influence wider community action.
- "Audiences" have a small stake but can channel CEP messages and drive community energy and climate culture.

The following key stakeholders were identified in consultation with the Project Working Team:

Decision-makers and regulators:

- Mayor and Council
- Senior administrative leadership
- Utilities (Alectra and Enbridge)
- Regional energy planners (IESO and Ministry of Energy and Northern Development and Mines)

Transactors

- Developers

Active Interests

- Centre for Community Energy Transformation (CCET) Task Force
- Brampton's Environment Advisory Committee.

3. Summary of Engagement Activities

The following table summarizes the engagements that took place over the course of the project. These engagements were conducted to mainly, but not exclusively, support the execution of Task 6 and the resulting *Report #6 – Regional Planning Implications*. As defined in the project's scope of work, the engagements were conducted to:

- Provide a common understanding of the future Regional Electricity Planning needs, objectives and impacts on Heritage Heights.

- Provide guidance on the impact of the energy density of the planned development and recommendations that reduce local energy density to help to slow demand growth in the identified pocket

- Inform the local distribution companies (Alectra and Enbridge) and the IESO to adjust demand forecasts for their service territories, weighing in renewable energy objectives of Heritage Heights.

Engagements were held in the form of online meetings and typically lasted one to two hours.[21]

[21] Note: At the time of writing this report, additional engagements were anticipated, but not yet confirmed with Brampton Environmental Advisory Committee and Enbridge (3rd engagement).

Date	Stakeholder(s)	Key Highlight(s)
07-21-21	Centre for Community Energy Transformation	Overview of Heritage Heights CEP process, framing goals and key principles
08-09-21	Project Senior Leadership Team	Review of Community Energy and Emissions Reduction Plan (CEERP) Heritage Heights CEP overview Preview of policy considerations
08-19-21	Developers Focus Group	Heritage Heights CEP- goals, principles, and key elements and preview of policy considerations
08-25-21	Alectra	Heritage Heights CEP Overview with a focus on projected electricity energy demand and distribution as result of implementing the Heritage Heights CEP and need to coordinate implementation with Hydro One
08-26-21	Independent Electricity System Operator (IESO) – Part 1	Focus on anticipated Distributed Energy Resources (DERs) – efficiency, local generation, and distribution – as it could affect regional electricity planning efforts by the IESO
09-08-21	Enbridge – Part 1	Heritage Heights CEP Overview with a focus on projected natural gas demand and distribution as result of implementing the Heritage Heights CEP
09-13-21	Ministry of Energy, Northern Development and Mines	Overview of Heritage Heights CEP process, framing goals and key principles Update from Ministry on the status of Ontario's Long Term Energy Plan
09-20-21	Enbridge – Part 2	Discussion RE: Enbridge's business development plans for alternative energy services
10-01-21	Independent Electricity System Operator (IESO) – Part 2	Update on IESO's progress on IESO's Regional Electricity Planning - Peel/Halton (GTA West) Region

Appendix 4 – CEP Scope, Assumptions and Methodology

1. CEP Scope

1.1 Geographic boundary

The geographic boundary for the Heritage Heights CEP was aligned with the Secondary Planning Area (SPA).

1.2 Planning Horizon

The planning horizon for the Heritage Heights CEP is 2051. The planning horizon for the CEERP was 2041 to align with Brampton's Official Plan and the Growth Plan for the Greater Golden Horseshoe. The Growth Plan was recently extended from 2041 to 2051. Brampton has updated their Official Plan to 2051. The Heritage Heights Secondary Plan area is to be planned to accommodate between 95,000–210,000 persons and 33,000–92,000 jobs by 2051, although full build out may extend past the 2051 planning horizon. 2050 is not only aligned with the general planning horizon for Heritage Heights but also represents the international target for achieving net zero emissions.

1.3 Energy End Users

Energy end users considered in the Heritage Heights CEP included all built forms within the SPA and transportation.

1.4 Emissions

From an emissions perspective, community energy planning places an emphasis on reducing energy related emissions. Energy related emissions arise from the heating and cooling of our homes and buildings, the powering of industries and the movement of people and goods. Community energy planning may also consider measures that address non-energy related sources of emissions, e.g., local opportunities for waste-to-energy or methane-to-energy.

The Heritage Heights CEP considered Scope 1 and Scope 2 emissions as defined:

- Scope 1 – All energy-related direct emissions from the activities occurring within the boundaries of the Heritage Heights Secondary Plan area, including fuel combustion on site and transportation
- Scope 2 – Indirect energy-related emissions from electricity purchased and used within the boundaries Heritage Heights Secondary Plan area

Scope 1 and 2 emissions represent approximately 70 to 75% of a community's emissions. See section 4.5 in the main report for a discussion of non-energy related emission mitigation.

2. CEP Assumptions

2.1 Introduction

The general approach taken by the Project Working Team in establishing the assumptions for the CEERP was to include only assumptions where the legislative trajectory was already established, or where technical and economic evidence was overwhelming. This mitigated the risk that the Base Case, in particular, did not reflect individual opinions of how Canada's energy and emissions future would evolve. It also ensures the CEERP recommendations are credible and achievable. Adopting this approach means that any future enabling legislation, policies and technologies will only serve to accelerate the implementation of the

Heritage Heights CEP. The assumptions established for the CEERP served as the default for the Heritage Heights CEP and were updated as required to reflect any material changes to legislation, policies, and technologies. All recommendations are to be consistent with the CEERP.

2.2 Baseline

The simulations established the Baseline year for the Heritage Heights CEP as 2022. As an unplanned Greenfield Area, energy use, emissions, and costs in 2022 were set at zero.

2.3 Development Rate

The simulations assume development in the Heritage Heights Secondary Plan Area (SPA) started in 2023 in all SPZs and Neighbourhood Typologies.[22] All SPZs and Neighbourhood Typologies achieved 3% of their 2051 population and employment in the first year of development. Population and employment then grew linearly to the CLUP estimates for 2041, and similarly from 2041 to the CLUP 2051 estimates. New residential and non-residential buildings are added at a rate consistent with population and employment growth.

2.4 Energy Emissions

2.4.1 Provincial Electricity Grid

The simulations assume Ontario will maintain a very low carbon generating mix for the entire CEP period.[23] The GHG indexes (in tonnes of CO_{2e} per MWh_{el}[24]) used in the simulation will follow the current average and marginal assumptions published by The Atmospheric Fund (TAF) to 2036.[25] In subsequent years they are assumed to follow the trajectory of the prior 5 years average. These indexes will be applied to the CEP as follows:

- Use the most current TAF data for average and marginal indexes
- Use average indexes for all Base Case electricity
- Use average indexes for all Efficiency Case electricity end-use (except for heat pumps)
- Use marginal indexes for electricity used in heat pumps
- Use marginal indexes for electricity used for EVs
- Use marginal indexes as reduction in grid demand due to in-boundary electricity generation

2.4.2 Provincial Natural Gas Network

The simulations assume that Enbridge's decarbonization strategy will reduce the GHG index (in tonnes of CO_{2e} per MWh_{th}[26]) of their network through the addition of biogas and green hydrogen by at least 1% per year for the CEP period.[27] These gas indices were applied for both the Base Case and the Efficiency Case.

2.5 Energy Services

2.5.1 Electricity

For the Base Case simulation, electricity continues to be supplied by sources outside the management of the City of Brampton and distributed to homes and buildings by Alectra. For the Efficiency Case simulation, grid electricity is supplemented by local power generation from photovoltaics (PV) and combined heat and power (CHP).

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[22] The Heritage Heights Secondary Plan will have to address development and infrastructure phasing.
[23] To best of the information available The Atmospheric Fund (TAF) estimates and reasonable extrapolation, this does include the use of natural gas for peaking. It does not include the GHG impact of strategic replacement of nuclear or hydro power.
[24] MWhel means megawatt hours of electricity
[25] Source: https://taf.ca/wp-content/uploads/2019/06/A-Clearer-View-on-Ontarios-Emissions-June-2019.pdf
[26] MWh_{th} means megawatt hours of thermal energy.
[27] Sources: https://www.enbridgegas.com/sustainability/renewable-hydrogen and https://www.enbridgegas.com/sustainability/renewable-natural-gas

2.5.2 Natural Gas

For the Base Case simulation, natural gas continues to be supplied by sources outside the management of the City of Brampton and distributed to homes and buildings by Enbridge. The role of natural gas, as a fossil fuel, for the Efficiency Case is assumed to be a transition fuel only. The use of coal has peaked and is declining globally. In North America, it is declining rapidly. In Ontario, it has been largely eliminated from the energy supply mix. In contrast, natural gas, is growing dramatically in all regions, largely driven by increasing use as a convenient, cheap, and somewhat lower carbon fuel for generating electricity. In Ontario it is used for marginal (peaking) power generation, providing space heating and hot water for home and buildings, and for a range of industrial purposes. The current price of natural gas in Canada is one of the lowest in the world. However, price will effectively increase in the CEP plan period as the impact of the carbon tax grows.

A primary challenge of the Heritage Heights CEP is to establish a technical, institutional, and policy framework that creates a credible pathway to decarbonizing the heating and hot water needs of the Secondary Plan Area (SPA) by 2051. Given the Secondary Plan Area is a greenfield, this means there must be immediate changes from current normal practice at the start of build-out. If the Heritage Heights Secondary Plan is to deliver on the 1.1 metric tonnes CO_2/capita target by 2051, the CEP must minimize the use of natural gas for home and building hot water and heating. The following simulation assumptions have been made for the Efficiency Case:

- No natural gas is available for low-density residential, with heating and hot water supplied by electricity and solar thermal.
- No natural gas is available for medium and high-density homes and buildings, which will receive heating and hot water services from the district energy utility, partly generated using natural gas
- No natural gas is available for light industrial customers who will receive process heating, space heating and hot water services from the district energy utility. There may be exceptions if the industry's process requires the chemistry of natural gas.
- Natural gas will serve the district energy centres to efficiently create heat and some local electricity.
- From 2023, the natural gas used by the district energy utility has a progressively lower carbon index as Enbridge adds biogas and hydrogen to their network.
- Starting in 2032 the heating supply mix to district energy will include lower carbon sources (waste recovery, ground, and air heat pumps, solar thermal, biofuels etc.) with the mix managed by the district energy utility based on availability, cost, and emissions impacts.

2.5.3 Thermal

The Efficiency Case simulation assumes the provision of a new energy service to the Heritage Heights Community – thermal energy – to support the decarbonization of heating and hot water needs of the Secondary Plan Area (SPA) by 2051. It is assumed that a district energy company will supply heating and cooling services, as is common in many cities around the world and more locally, in Markham. The district energy company is assumed to operate both ground source geothermal supply assets on a particular site, the wider district energy system, and neighbourhood energy centres.

Modern district energy is an internationally recognized pathway to decarbonize urban heating and cooling.[28]

District energy systems supply thermal energy (heating and/or cooling) to multiple buildings from a central plant or from several interconnected but distributed plants. Thermal energy is conveyed with water through a closed network of pre-insulated pipes to meet end users' need for cooling, heating, and domestic hot water. Historically, steam networks have been used and are still used in some older systems. A district

[28] http://www.districtenergyinitiative.org/

energy system is comprised of three sub-systems, which include the collection and/or generation of thermal energy, the distribution of that thermal energy from the plant(s) to end-users, and the transfer of the thermal energy to the energy consumer.

Combined heat and power (CHP) systems produce electricity and thermal energy from a single fuel source (e.g., natural gas, biogas). When electricity is generated in large scale regional gas-fired power plants, as much as 60% of the energy value is lost (mostly as heat at the point of generation and the remainder during transmission). This systemic inefficiency can be addressed by generating electricity within the community and capturing the heat for use in a district energy system.

Modern district systems (Figure 1) facilitate creating a flexible portfolio of many kinds of low carbon heat sources. These include large solar-thermal arrays, biofuel boilers and combined heat and power, sewage waste heat recovery from multiple sources, geothermal arrays, and even boilers using renewable electricity.

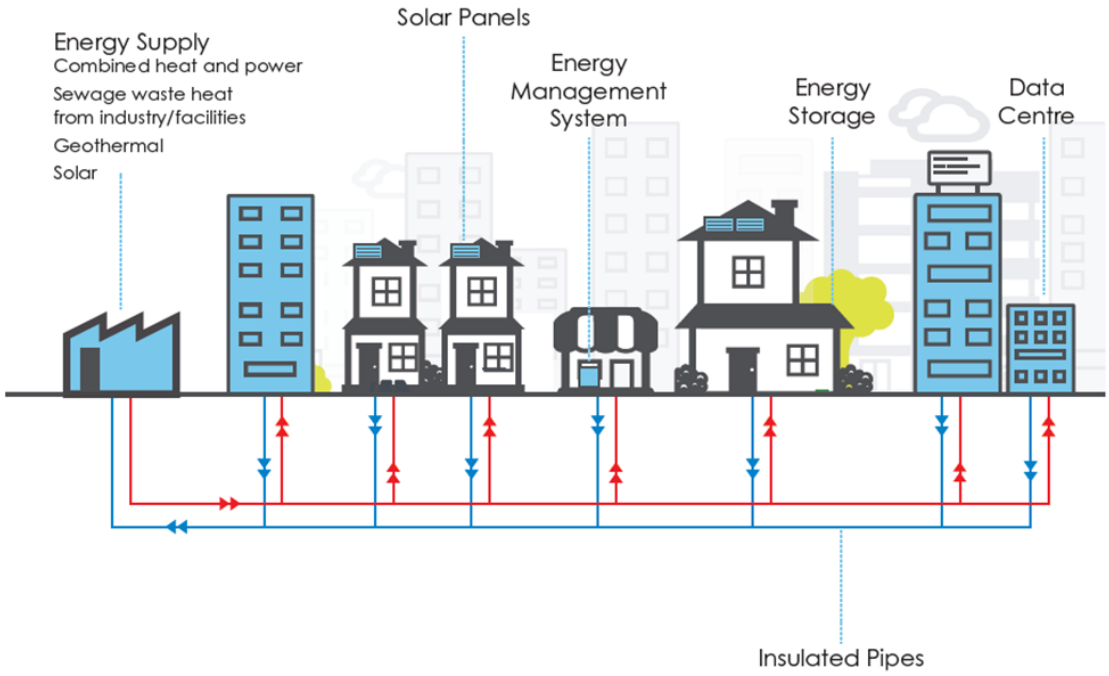

Figure 1: Modern district energy system

2.6 Energy Pricing

Lower and higher price outlooks are used to estimate risk and opportunity. Lower range aligned with Independent System Electricity Operator's (IESO's) Ontario 2017 Long Term Energy Plan and discussions with Alectra and Enbridge Gas (Figure 2). The higher range was based on utility risk planning estimates wherever possible and with discussions with Alectra and Enbridge Gas.

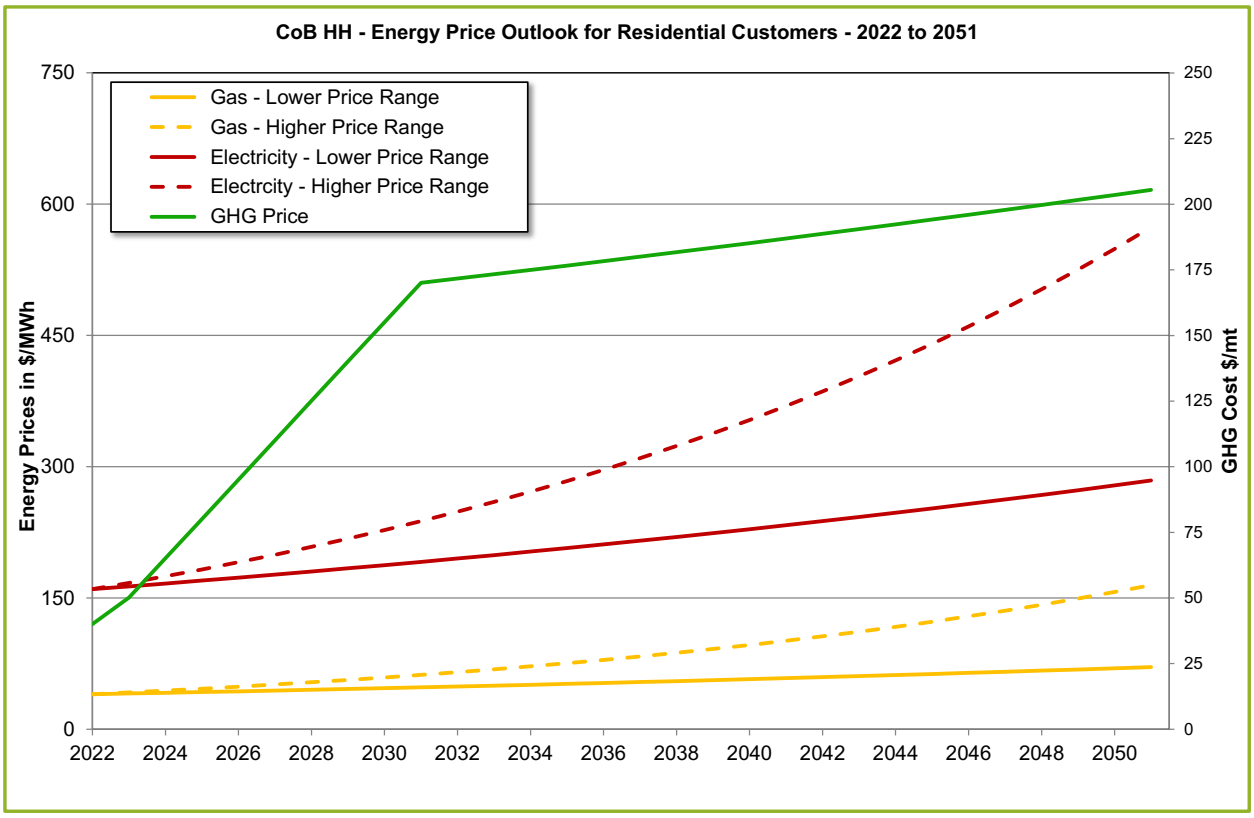

Figure 2: Energy price outlook for residential customers from 2022 to 2051.

2.7 Carbon Pricing

With passage of the Greenhouse Gas Pollution Pricing Act (GGPPA) in 2018, implemented in 2019, and upheld by the Supreme Court in 2020, there is now a confirmed carbon pricing outlook for Canada. Provinces have the flexibility to create their own carbon pricing solution if their approach minimally meets Federal standards in terms of both carbon pricing and revenue redistribution principles.

With the current political outlook in Ontario, the CEP will assume the Federal backstop will apply. Ontario will, by default, collect a carbon-tax based on the December 2020 Federal announcement summarized as: *"For the 2020 compliance year, the carbon tax is set at $30 per tonne of CO2-equivalent. The carbon tax is currently scheduled to increase by $10 annually until it hits $50 per tonne in 2023. The recent announcement, if implemented into law, will increase the carbon tax by $15 per tonne per year starting in 2023 until the tax hits $170 per tonne in 2030."*

The following profile of carbon pricing will be used for the energy cost simulation assuming the cost applies from the January of the relevant year.

- 2023 – $50 / tonne CO_{2e}
- 2024 to 2030 – increase by $15 / tonne CO2e annually to $155 / tonne CO_{2e}
- 2031 – $170 / tonne CO_{2e}
- 2032 to 2051 – linear increase of 1% per year to $202 / tonne CO_{2e}

The levels for 2023 to 2031 are based on the GHGPPA with the conservative assumption that the $170 level is effective from January 2031. The 2031 level is almost the same as the current (2021) Swedish Carbon Tax of SEK 1,190.[29,30]

The levels from 2032 are a recommended extrapolation from the consulting team based on the assumption that Canada will align long-term policy with patterns expected in Scandinavia in part to maintain revenues as GHG emissions reduce.

This replaces the more conservative CEERP higher and lower carbon pricing outlook with a single outlook based on the revised Federal Policy. This assumption will be used for all energy related GHG emissions both the Base Case and the Efficiency Case.

2.8 Built Form Assumptions

A primary challenge of the Heritage Heights CEP is to establish a technical, institutional, and policy framework that creates a credible pathway to decarbonizing the heating and hot water needs of the Secondary Plan Area (SPA) by 2051. Given the Secondary Plan Area is a greenfield, this means there must be immediate changes from current normal practice at the start of build-out. Specifically, to deliver on the 1.1 metric tonnes CO2/capita target by 2051, the CEP must minimize the use of natural gas for home and building hot water and heating. The challenge of decarbonizing heating, cooling, and hot water services is a global challenge, and the simulation draws experiences in other heating-oriented regions including Germany and Scandinavia. Efficient building design and construction is a major factor.

In the simulation Base Case, the efficiency of each residential and non-residential Building Archetype is assumed to be 100% compliant with the current iteration (2016 and current amendments) of the Ontario Building Code (OBC). In the real world, full OBC compliance from an energy performance perspective is not always the case, so this assumption represents an improvement over current market actual practice.

Ontario will probably enact at least two Ontario Building Code (OBC) updates between 2023 and 2051 likely resulting in near-Passivhaus[31] levels of end-use energy efficiency by 2051, a level approximately 50% more efficient than current code.

In the simulation Efficiency Case, starting in 2023, all residential and non-residential archetypes have efficiency measures applied that yield an average 25% overall energy efficiency improvement above current Code. No further efficiency gains for residential buildings are assumed in the remaining CEP period, making this a conservative assumption in the later years. Non-residential buildings are assumed to be actively managed and as a result will have a 0.5% per year average efficiency gain.

2.8.1 Low Density Residential Area

Table 2 describes the simulation assumption for three energy parameters for Low-Density Areas: efficiency, public utilities, and on-site supply. The Team's archetypes model specific energy efficiency measures to give realistic balance between energy end-uses and required utility services.

[29] https://www.government.se/government-policy/taxes-and-tariffs/swedens-carbon-tax/
[30] https://taxfoundation.org/sweden-carbon-tax-revenue-greenhouse-gas-emissions/
[31] https://passiv.de/en/index.html

Table 2: Simulation assumptions for Low-Density Mixed-Use Areas in the Heritage Heights Community.

ENERGY PARAMETER	BASE CASE	HERITAGE HEIGHTS CEP MINIMUM
Efficiency	• 2016 OBC	• End-use 25% above 2016 OBC
Public utility	• Grid electricity • Network natural gas • Main water/sewer • Smart meters (natural gas & electricity) • Dumb meter (water)	• Grid electricity • Main water/sewer • Smart meters (electricity & water)
On-site supply & conversion	• Natural gas water heater • Natural gas furnace • Electric air conditioner • LED Lighting	• Building integrated solar thermal • Building integrated solar PV • Air-heat pump (heating & cooling) • Supplemental electric heating • On-demand solar hot water electric boiler • Class 2 electric vehicle charger[32] • Battery storage • LED lighting • Smart metering (8 parameter)[33]

The Efficiency Case simulation assumes the following:

- all construction will be at least an average of 25% more efficient than the current OBC from 2023[34]
- all homes and buildings will use air-based heat pumps with supplementary solar thermal, electric induction heating to serve their heating, cooling, and hot water needs
- no retail natural gas will be available[35]
- all homes and buildings will include solar thermal[36] and solar PV for their own use

While the default for all low-density development will be simulated based on air heat pumps and on-site renewables, the CEP, and the permitting process could include a development using ground-effect geothermal (geothermal) exchange combined with water-based heat pumps. This would obviously require a geological assessment. In the simulation these situations are assumed to be statistically irrelevant in the low-density areas.

2.8.2 Medium and High Density – Mixed Use Areas

Table 3 describes the simulation assumptions for four energy parameters for Medium- and High-Density Mixed-Use Areas: efficiency, public utilities, on-site supply and conversion and utility energy centres.

[32] Note: The CEERP assumed 32% of LDVs are battery electric vehicles or plug-in hybrid vehicles. CEP increases that to 80% given most manufacturers plan to phase out gas/diesel models by about 2035.
[33] Note: The 8 parameters include: grid power, water, solar PV, solar thermal, heat pump demand, supplemental heating, hot water, and vehicle charge/discharge.
[34] Note: CEERP assumed a 10% increase in OBC energy performance in 2022, 2032 and 2042.
[35] Note: CEERP assumed retail natural gas was still available.
[36] Note: CEERP assumed at least 10% of heating/service hot water from solar-thermal in homes not district heating connected. CEP kept the same assumption.

Table 3: Simulation assumptions for Medium- and High-density Mixed-Use Areas in the Heritage Heights Community.

ENERGY PARAMETER	BASE CASE	HERITAGE HEIGHTS CEP MINIMUM
Efficiency	• 2016 OBC	• End-use 25% above 2016 OBC
Public utilities	• Grid electricity • Network natural gas • Main water/sewer • Smart meters (natural gas & electricity) • Dumb meter (water)	• Grid electricity • Main water & sewer • District heating – medium temperature • Cooling • Smart meters (electricity, water & heat)
On-site supply & conversion	• Natural gas water heater • Natural gas furnace • Electric air conditioning • LED lighting	• Building integrated solar PV • District heating energy transfer station (heating & service hot water (SHW) • Electric air conditioning or ground-level district cooling energy transfer stations • Class 2 electric vehicle charger[37] • Battery storage • LED lighting • Smart metering (7 parameter)[38]
Utility energy centres	• None	• Combined heat & power – natural gal • Heat only boilers – natural gas • Air conditioning – electric • Thermal storage – heat and cold • Building integrated solar PV • Class 2 electric vehicle chargers • Smart metering (11 parameter)[39]

The Efficiency Case simulation assumed the following:

- all construction will be at least an average of 25% more efficient than the current OBC[40]
- all heat will be supplied by a district energy company whether via a district energy network or geothermal/heat pump combination[41]
- at least three-quarters of cooling will be supplied by a district energy company via either district cooling local networks or a geothermal/heat pump combination[42]

[37] Note: The CEERP assumed 32% of LDVs are battery electric vehicles or plug-in hybrid vehicles. CEP increases that to 80% given most manufacturers plan to phase out gas/diesel models by about 2035.
[38] Note: The 7 parameters include: grid power, water, solar PV, district energy heat total, hot water, district energy cooling (or electric cooling) and vehicle charge/discharge.
[39] Note: The 11 parameters include: grid power, network gas, solar PV, gas (combined heat and power), gas (boilers), electricity (air conditioning), district heat to network, district energy cooling to network, vehicle charge/discharge, waste heat recovery and alternative fuel heat.
[40] Note: CEERP assumed a 10% increase in OBC energy performance in 2022, 2032 and 2042.
[41] Note: CEERP designates the Heritage Heights Community as a district heating priority area
[42] Note: Cooling recommended to be combined with heating as a public service – technical implementation will vary by site/building configuration.

- other cooling on an optional basis for developments served via district energy[43]
- all developments will include solar PV for their own use
- no retail natural gas will be available
- district energy centres will initially use natural gas fuel high-efficiency combined heat and power and heat-only boilers in a 70/30 heat-demand ratio[44]
- all developments should be able to operate at adequate heating comfort and hot water service levels based on a 70 degree C supply either from:
    - low-temperature district energy system connected to the building via an energy transfer station owned and operated by a district energy company
    - combination of on-site geothermal array (if sufficient land available) and heat-pump providing both heating and cooling thermal supply owned and operated by a district energy company
    - development-oriented geothermal heat pumps supply structures could be integrated into the wider district energy system, in effect becoming network assets rather than dedicated to a single development
- the carbon-content of the heat supply services will be reduced over time through the development of a low-carbon supply portfolio including the addition of network-based heat pumps (geothermal and air based), waste heat recovery, bio-fueled heat sources, optimization between DH network and site-specific geothermal assets, electric heat only boilers etc.
- the implementation this decarbonization portfolio development will be simulated as follows:
    - 2023 to 2032 – assume 100% natural gas for district energy system
    - 2023 to 2051 – increase site-specific geothermal heat pump rate by 5% every five years
    - 2033 to 2051 – assume 5% reduction of fuel GHG index of district energy generation every five years, reflecting a mix of low carbon fuels and waste heat recovery

2.8.3 Industrial and Hospital Area

Table 4 describes the simulation assumptions for four energy parameters for Industrial and Hospital Areas: efficiency, public utilities, on-site supply and conversion and utility energy centres.

Table 4: Simulation assumptions for Industrial and Hospital Areas in the Heritage Heights Community.

ENERGY PARAMETER	BASE CASE	HERITAGE HEIGHTS CEP MINIMUM
Efficiency	• 2016 OBC	• End-use 25% to 30% above 2016 OBC
Public utilities	• Grid electricity • Network natural gas • Main water/sewer • Smart meters (natural gas & electricity) • Dumb meter (water)	• Grid electricity • Network natural gas • Main water & sewer • District heating – medium temperature • Cooling • Smart meters (electricity, water, heat, and gas)
On-site supply & conversion	• Natural gas water heater • Natural gas furnace	• Building integrated solar PV

[43] Note: Cooling from air-sourced heat pumps as occasional exceptions.
[44] Note: Initially the 70% of the total heat demand will be supplied from appropriately sized CHP engines, with the remaining 30% supplied from high-efficiency heat only boilers. This combination ensures the highest efficiency in the use of gas to generate district heat and associated electricity. In later years, the heat mix is supplemented with lower carbon sources.

	• Electric air conditioning • LED lighting	• District heating energy transfer station (heating & service hot water) • Electric air conditioning or ground-level district cooling energy transfer station • Class 2 electric vehicle chargers[45] • Battery storage • LED lighting • Multiple natural gas and electric processes • Smart metering
Utility Energy Centres	• None	• Combined heat & power – natural gas • Heat only boilers – natural gas • Electric – air conditioning • Thermal storage (heat and cold) • Building integrated solar PV • Class 2 electric vehicle chargers • Smart metering (9 parameter)[46]

The Efficiency Case simulation assumes the following:

- all construction will be at least an average of 25% to 30% more efficient than the current OBC47
- all heat will be supplied by a district energy company whether via a district energy network or geothermal/heat pump combination[48]
- on-site natural gas for process needs only; no retail natural gas will be available
- Industrial Park will offer customized utility services (e.g., process steam, compressed air, heat recovery, process cooling)[49]
- all developments will include solar PV for their own use
- most cooling will be supplied by a district energy company via either district cooling local networks or a geothermal/heat pump combination [50]
- other cooling on an optional basis for developments served via district energy[51]
- district energy centres will initially use natural gas fuel high-efficiency combined heat and power and heat-only boilers in a 70/30 heat-demand ratio
- all developments should be able to operate at adequate heating comfort and hot water service levels based on a 70 degree C supply either from:
    - low-temperature district energy system connected to the building via an energy transfer station owned and operated by a district energy company
    - combination of on-site geothermal array (if sufficient land available) and heat-pump providing both heating and cooling thermal supply owned and operated by a district energy company

[45] Note: CEERP assumed 32% of LDVs are battery electric vehicles or plug-in hybrid vehicles. CEP increases that to 80% given most manufacturers plan to phase out gas/diesel models by about 2035.
[46] The 9 parameters include: grid power, network gas, water, solar PV, combined heat and power (gas), hot water, district energy cooling (or electric cooling), waste heat recovery and vehicle charge/discharge.
[47] Note: CEERP assumed a 10% increase in OBC energy performance in 2022, 2032 and 2042. The CEERP also called for a best practice sharing networks to achieve 1% year on year efficiency gains.
[48] Note: CEERP designates the Heritage Heights Community as a district heating priority area.
[49] Note: Tailored services will call for added plant – steam boilers, compressors, advanced heat recovery, industrial chillers *etc*. Plant may be centralized or distributed and could be physically on end-user site.
50 Cooling recommended to be combined with heating as a public service – technical implementation will vary by site/building configuration.
[51] Note: Cooling with air-sourced heat pumps as occasional exceptions.

    - development-oriented geothermal heat pumps supply structures could be integrated into the wider district energy system, in effect becoming network assets rather than dedicated to a single development
- the carbon-content of the heat supply services will be reduced over time through the development of a low-carbon supply portfolio including the addition of network-based heat pumps (geothermal and air based), waste heat recovery, bio-fueled heat sources, optimization between DH network and site-specific geothermal assets, electric heat only boilers etc.
- the implementation this decarbonization portfolio development will be simulated as follows:
    - 2023 to 2032 – assume 100% natural gas for district energy system
    - 2023 to 2051 – increase site-specific geothermal heat pump rate by 5% every five years
    - 2033 to 2051 – assume 5% reduction of fuel GHG index of district energy generation every five years, reflecting a mix of low carbon fuels and waste heat recovery

2.9 Transportation Assumptions

In Brampton, the CEERP identified that the transportation sector accounts for 35% of the energy use, 59% of energy costs, and 59% of energy-related emissions. The Heritage Heights Secondary Plan and the associated transportation, transit, and active transportation plans, presents the City of Brampton with an opportunity to address energy and climate impacts from the start.

CEERP transportation assumptions are the starting point for the simulations.[52] Other than the modest annual efficiency gain, the transportation Base Case is based on the Heritage Heights Community being developed in such a way that it represents the historical city average in terms of local employment and built form. It also assumes transportation needs, vehicle choices, and travel habits of the residents will be pretty much the same as today.

The interactions with the changes in land use planning in the CLUP and the impact on transportation energy must be very clearly communicated – they are tightly interrelated and cannot be separated.

Employment/population ratio impacts modal choice. The CLUP calls for above average employment to population ratio reducing average trip length. Density and mixed-use affects modal choice. The CLUP calls for the inclusion of comprehensive active and transit friendly measures including neighbourhood and route design to promote multi-modal trips.

Table 5 describes the simulation assumptions for three energy parameters for transportation: efficiency, trip length reduction and modality mix.

Table 5: Simulation assumptions for the Transportation Sector in the Heritage Heights Community.

TRANSPORTATION PARAMETER	BASE CASE	HERITAGE HEIGHTS CEP MINIMUM
Efficiency	• Fleet average 0.2% per year gain	• Electric vehicle-friendly neighbourhood and building design • 2051 Outlook • 80% electric light duty vehicles[53]

[52] The CEERP included assumption for: fleet mix, fleet efficiency, modal mix, commercial vehicle kilometres travelled (VKT) per job, passenger kilometres travelled (PKT) per population, light duty vehicle (LDV) PKT/VKT, fuel GHG emission indexes (validated against current published indexes), electricity index (aligned with CEP marginal).

[53] CEERP calls for 30% electric light duty vehicles.

		• 35% electric heavy-duty vehicles[54] • 100% electric vehicles for Brampton Transit and GO Train • 1% annual efficiency gain for electric vehicles. • 2% annual efficiency gain for diesel & gas vehicles
Trip length reduction	• No change in passenger kilometres travelled	• Compact mixed-use design[55] • Proactive local employment planning 2051 Outlook • 12% increase in Brampton transit passenger kilometres travelled • 5% increase in GO Train passenger kilometres travelled •
TRANSPORTATION PARAMETER	**BASE CASE**	**HERITAGE HEIGHTS CEP MINIMUM**
Modality mix[56]	• No change in passenger kilometres travelled for each mode	• Active-friendly route design • Transit-friendly routes & schedules • Modal transfer neighbourhood design • 2051 Outlook • 25% of modal mix active (walking and cycling) • 5% of modal mix motorcycles and scooters • 12% of modal mix GO Train • 20% of modal mix Brampton Transit

3. CEP Methodology

To estimate the year-on-year energy end-use needs of the built-environment, a RET Screen[57] model of each of the Building Archetypes was created for both the Base-Case (Business-as-Usual) and Efficiency Case conditions, these models were allocated on a year-by-year basis to the relevant SPZ and Neighbourhood Typology. Residential archetypes were allocated based on population and household size. Schools were allocated by population, and non-residential by employment.

The energy supply for the built environment was assigned to each archetype, In the Base Case, this followed current practice through the plan period. In the Efficient Case, the assumptions included the use of district energy, local renewable supplies and, of course, electricity and natural gas. For district energy, the primary sources for heating shifted to a lower carbon mix over time.

To estimate the secondary planning area's demand for transportation, a model of kilometres travelled by people and goods was developed using a mix of Ontario and Greater Toronto Area averages. This was

[54] CEERP calls for 10% electric heavy-duty vehicles.
[55] CEERP call for compact mixed use neighbourhood design.
[56] CEERP calls for a modal mix of 20% active transportation, 15% GO Train and 10% Brampton Transit.
[57] See https://www.nrcan.gc.ca/maps-tools-and-publications/tools/modelling-tools/retscreen/7465

assigned to the Secondary Planning Area on an annual basis using population indicators for passenger kilometers and using employment for goods kilometres. In the Base Case, the modal mix between active, transit, and individual vehicles was assumed to remain the same as the current level. In the Efficiency Case, the modal mix changed to a greater share of active and transit, and the average trip lengths reduced.

The energy supply for transportation was assigned to each vehicle type. In the Base Case, this consisted entirely of gasoline and diesel. In the Efficiency Case, the energy supply mix included the growing use of electricity as the overall fleet of individual vehicles, busses, trains, and commercial vehicles, following trends driven by both the global transportation industry and the design of the Heritage Heights neighbourhoods.

The prices for each of gasoline, diesel, electricity, and natural gas were estimated for each major sector on a year-by-year basis over the plan period. Recognizing the many uncertainties, each price outlook has a lower and upper estimate associated with it. The carbon tax outlook was based on the recent Federal policy announcements.

All of these elements were combined into a single Integrated Workbook58 that allows the simulation of the energy cost, use and emissions impact of the entire development by both sector and geography on year-by-year basis to 2051. This integrated approach also facilitates the testing of alternative combinations of measures and assumptions to assess the overall impact on the Secondary Planning Area energy and climate performance.

[58] The IW is a tool used during the development of the CEP. This tool is not a Project Deliverable.

Appendix 5 – Annotated Summary of Guiding Documents

Key background documents that have informed the development of the Heritage Heights CEP and secondary planning guidance are summarized in this appendix.

1. Provincial Land Use Legislation and Plans

The Province of Ontario, through legislation, land use policies and plans, provides direction to the Region of Peel and its local municipalities in preparing their own policies and plans to guide development and change. Regional and local municipalities are required to address energy and emissions-related policy objectives identified by the Province of Ontario. In the land use planning process, policies must be consistent with the requirements of the Planning Act, Provincial Policy Statement (PPS), and other Provincial land use plans, including the Growth Plan and the Greenbelt Plan.

Municipalities develop official plan policies and secondary plans that are consistent with provincial plans and policies. Official plans are informed by various master plans (e.g., infrastructure, green space and natural heritage, climate change, energy) and area-specific secondary plans, and these may inform design guidelines for building and community design. Official plan policies inform detailed and site-specific land use regulation through municipal zoning by-laws. They also inform implementation through the development application and review process though plans of subdivision and site plan approvals.

The following land use planning actions are within the purview of municipalities in accordance with current planning legislative and policy requirements.[59]

- Integrate GHG emissions reduction targets and supportive policies and actions across official plans (including secondary plans), and zoning by-laws. Such policies can be supported by climate change master plans, energy management plans, and GHG inventories, etc.
- Implementation of these policies and actions require appropriate studies to be submitted in support of block plans and other forms of development applications and approvals.
- Create policies that enable the development of district energy systems and creation of local energy supply (e.g., developing district energy design guidelines, supporting partnerships with local electricity distributors and developers).
- Ensure municipal council support throughout all stages of the process (e.g., policy development, strategic investments, direction for neighbourhood design).
- Engage with stakeholders (e.g., area municipalities, energy distributors and operations, private developers etc.) when developing policies and ensure “marketability” of the net zero communities for prospective buyers.

2. The Living Mosaic: Brampton 2040 Vision

The Living Mosaic: Brampton 2040 Vision[60] is a strategic plan to take the City of Brampton to 2040 that sets out seven target visions, including population growth and an expanded green network and transit system. While the development and implementation of the CEP will enable the implementation of all seven target visions, the strongest connections can be made with the following vision targets:

[59] Reference: https://www.peelregion.ca/officialplan/review/pdf/draft-climate-change-laura-taylor-designs.pdf
[60] Found at: https://www.brampton.ca/EN/City-Hall/Documents/Brampton2040Vision/brampton2040Vision.pdf

Vision 1: Sustainability and the Environment – In 2040, Brampton will be a mosaic of sustainable urban places, sitting within an interconnected green park network, with its people as environmental stewards – targeting 'one-planet' living.

Vision 2: Jobs and Living Centres – In 2040, Brampton will be a mosaic of vibrant centres with quality jobs, a rich range of activities, and integrated living.

Vision 4: Transportation and Connectivity – In 2040, Brampton will be a mosaic of safe, integrated transportation choices and new modes, contributing to civic sustainability, and emphasizing walking, cycling, and transit.

Vision 6: Health – In 2040, Brampton will be a mosaic of healthy citizens enjoying physical and mental wellness, fitness, and sports.

3. Official Plan

The *Official Plan 2006 (2020 Office Consolidation)*[61] speaks to the importance of finding sustainable alternatives to conserve energy and reduce GHG emissions, including in its corporate operations. It provides support for sustainable development practices such as mixed-use, compact, and transit-oriented development and specifically supports the use of renewable and district energy systems in the city. The Official Plan is currently in the process of being updated and is expected to take on a climate change lens.

4. Heritage Heights Secondary Planning Process

A secondary planning process is underway for the Heritage Heights Community. Heritage Heights Secondary Plan makes up 1/16 of Brampton's total area. A Conceptual Land Use Plan for Heritage Heights was endorsed by City Council in August 2020, which reflects best practices in creating a community where future residents and employers will enjoy a healthy lifestyle and a high quality of life. Approval included a recommendation to develop an integrated energy plan to ensure the Heritage Heights Community contributes to achieving the City's energy and emission goals as outlined in the City of Brampton's Community Energy and Emissions Reduction Plan (CEERP).

The following Guiding Principles were created that will provide a foundation for policies, design, and growth in Heritage Heights:

1. Create walkable communities for people to gather, recreate, work, and live.
2. Development should be compact and diverse to achieve walkable and affordable active neighbourhoods.
3. Implement sustainable and resilient plans, technologies, and design approaches.
4. Include arts and cultural uses that will leverage Brampton's diversity and attract investment.
5. Conserve the natural and cultural heritage of the area, creating a destination for local and regional visitors.
6. Foster a competitive environment for employment and economic development.

[61] Found at: https://www.brampton.ca/EN/City-Hall/Official-Plan/Documents/Sept2020_Consolidated_OP_2006.pdf

7. Plan for wellbeing - physical, mental, social - through the design of people-centric spaces that are safe and age-friendly.

8. Integrate and connect green and open spaces into the design of neighbourhoods while being sensitive to existing ecological systems.

Information from several Secondary Plan component studies will be considered in the development of the Heritage Heights CEP and include:

Community Visioning

- Visioning Report (complete)
- Conceptual Land Use Plan (complete)

Community Design and Development

- Community Design Guidelines
- Master Open Space and Recreation Plan
- Growth Management Staging and Sequencing Strategy

Economic Impacts

- Economic Impact Analysis Study (in progress)
- Employment Implementation Study (in progress, subject to peer review)
- Commercial & Institutional Land Study (in progress, subject to peer review)

Environment & Sustainability

- Sub-Watershed Study and Landscape Scale Analysis Update (in progress)
- Shale Resource Study[62] (complete)

Transportation

- Heritage Heights Transportation Master Plan (in progress)
- GO Station Feasibility Study (in progress)
- GTA West Corridor[63]

Infrastructure

- Servicing and Infrastructure (in progress)

Cultural Heritage

- Cultural Heritage Study (in progress)

Health

- Healthy Development Framework Study (in progress)

Hospital

- The City is seeking expedited Provincial action to fund a third health care facility in Brampton, to meet the current and growing needs of the community and support new approaches to health care service delivery.

[62] Found at: https://www.brampton.ca/EN/City-Hall/meetings-agendas/PDD%20Committee%202010/20191118pdc_Agenda.pdf

[63] Found at: https://www.gta-west.com/

5. Grow Green Environmental Master Plan

The Grow Green Environmental Master Plan (EMP)[64] aims to conserve, enhance, and balance the City's natural and built environments to create a healthier, resilient, and environmentally sustainable city. The EMP establishes environmentally sustainable directions, including a series of actions and performance targets that will serve to improve Brampton's environmental performance. The Plan structure includes six core components of People, Air, Water, Land, Energy and Waste. Conserving energy and greenhouse gas emissions are embedded throughout the Brampton Grow Green EMP, primarily captured under the core components of Air and Energy.

6. Sustainable Communities Program: New Development

The City of Brampton, along with the Cities of Vaughan and Richmond Hill, produced a set of Sustainability Metrics to evaluate and score the environmental sustainability performance of new Block Plans, Plans of Subdivision, and Site Plans.[65] The program encourages energy conservation and clean energy production in a variety of ways, including but not limited to guidelines and metrics related to energy conservation, renewable energy production, district energy, electric vehicle charging infrastructure, green/white roofs, embodied energy, active transportation infrastructure, as well as complete and compact communities.

7. Complete Streets Guidelines

The City of Brampton is currently developing Complete Streets Guidelines. Travel choices can have a significant impact on GHG emissions and energy consumption within a community. The safety, ease, and convenience of transportation modes greatly influence people's choice of transportation. Therefore, proper planning and design of our transportation networks are critical in creating viable, low emission alternatives of travel for residents such as transit, cycling, and walking. The Complete Streets Guidelines will address the safety, comfort, and accessibility of all users of streets and roads, not just the car and supports the CEP.

8. Community Energy and Emissions Reduction Plan (CEERP)

The City of Brampton, in partnership with Sheridan College, developed a Community Energy and Emissions Reduction Plan (CEERP).[66] This Plan integrates efforts of the municipality, local utilities, and community stakeholders to create a roadmap that will improve energy efficiency, reduce greenhouse gas emissions, ensure energy security, create economic advantage, and increase resilience to climate change. The CEERP is Brampton's first climate mitigation strategy and provides a plan to achieve a clean, sustainable, and resilient energy future in Brampton by focusing on global best practices in building energy efficiency, sustainable transportation, and sustainable energy supply and distribution.

On September 30, 2020, Brampton Council approved the CEERP, which includes the following energy and emission goals:

- Reduce community-wide energy use by 50% from 2016 levels by 2041.
- Reduce community wide GHG emissions by 50% from 2016 levels by 2041.
- Reduce community wide GHG emissions by 30% from 2016 levels by 2030.

[64] Found at: https://www.brampton.ca/EN/residents/GrowGreen/Documents/EMP/Brampton_Grow_Green_EMP_2020_Final.pdf
[65] Found at: https://www.brampton.ca/EN/Business/planning-development/guidelines-manuals/Pages/Measuring-the-Sustainability-Performance-of-New-Development.aspx
[66] Found at: https://www.brampton.ca/EN/residents/GrowGreen/Documents/CEERP/CEERP_Combined_20200921.pdf

- Establish a pathway to reduce emissions by at least 80% by 2050 to meet or exceed federal and provincial targets.

To achieve these goals, the CEERP recommends, under the Strategic Direction of "Green Communities", that all new development in Town Centres and Major Urban Growth Areas must strive to "achieve near net-zero GHG emissions". In addition, 80% of new development within growth areas should utilize district energy. Other energy related targets include:

- Achieve a 35% residential efficiency gain from 2016 levels by retrofitting 80% of existing homes.
- Achieve a 22% commercial and institutional efficiency gain from 2016 levels by retrofitting 60% of existing buildings.
- Serve 10% of hot water and heating needs in homes not served by district energy with solar hot water.
- Increase solar energy production by 8%.
- Plant 1 million trees by 2040.

The CEERP also identifies a series of 2041 transportation targets to be achieved on a citywide basis including:

- Reduce trip lengths by 3.75%.
- Increase Active Transportation to 7% passage kilometres travelled (PKT).
- Increase trips using Brampton Transit to 9% PKT.
- Increase trips using GO transit to 8.5% PKT.
- Increase efficiency of gasoline/diesel vehicles by 36%.
- Increase Electric Vehicle adoption by 20%.

The Heritage Heights CEP will ensure that the development of the last remaining unplanned Greenfield Area in Brampton makes an important contribution to achieving the CEERP goals and targets.

9. Transportation Master Plan

The *Transportation Master Plan*[67] (2015) is the City's blueprint for strategic transportation planning and direction for the future. The Plan addresses existing challenges and makes recommendations to provide sustainable transportation solutions to manage the transportation impacts and address travel demand associated with future growth. The Transportation Master Plan sets a target of having 50% of trips made during peak periods using a sustainable mode of transportation. The achievement of this target would contribute significantly to the realization of the transportation-related targets in the CEERP and Heritage Heights CEP. An update of the Transportation Master Plan starts in 2021. As the Plan is updated, it will further explore the role transportation can play in achieving energy and emission targets.

10. Active Transportation Master Plan

In 2019, Council endorsed the *Active Transportation Master Plan*[68] that includes goals and objectives for creating a pedestrian and cycling-friendly city. It aims to improve the safety of walking and cycling; provide options to all residents, including enhancing the accessibility of the transportation network; improve access to transit; and provide active transportation options for the first/last mile. By providing residents with more viable non-emitting transportation options, the Active Transportation Master Plan will support and assist in meeting the CEP's energy and GHG emission reduction targets.

[67] Found at: https://www.brampton.ca/en/business/planning-development/transportation/Pages/TMP-2014.aspx
[68] Found at: https://www.brampton.ca/EN/Business/planning-development/projects-studies/atmp/Pages/Welcome.aspx

11. One Million Trees

The *One Million Trees Program*[69] was developed to respond to the Brampton 2040 Vision's call for the planting of one million trees by 2040 to grow the urban forest, mitigate and adapt to climate change, and foster the delivery of ecosystem services.

In addition to the above reports, several regional planning documents included policies that support the development and implementation of the CEP.

12. Peel Official Plan

The *Region of Peel's Official Plan (December 2018 Office Consolidation)*[70] includes objectives to address energy and climate through land use planning, low carbon energy systems, and energy conservation. The Official Plan encourage area municipalities to incorporate policies on energy efficiency, district energy, renewable energy, low carbon vehicles, and building retrofits into their own Official Plans.

13. Peel Climate Change Strategy

The Peel Climate Change Strategy (2011) resulted from a partnership between the Region of Peel, City of Brampton, City of Mississauga, Town of Caledon, Credit Valley Conservation, and Toronto and Region Conservation Authority. The Strategy sets a long-term GHG reduction target of 80% below 1990 levels by 2050 and includes an action to "prepare a joint feasibility study to determine how to optimize the use of alternative energy sources through community energy planning and through pilots of district energy systems in Peel".[71]

14. Peel Climate Change Master Plan

The Region's *Climate Change Master Plan: 2020-2030*[72] (CCMP) sets forth directions for how the Region as a corporation will lead by example through the management of its assets, infrastructure, and services in a changing climate over the next decade. The Region will substantiate the influence necessary to support the community as it transforms in response to climate change. In doing so, the CCMP will complement and support the efforts of partners in the broader community. The Master Plan also establishes a corporate GHG emissions reduction target of 45% below 2010 levels by 2030. Action 8 of the Region's CCMP aims to "enable alignment of Regional actions with the transition toward diversified and decentralized energy systems.

[69] Found at: https://www.brampton.ca/en/residents/trees/pages/One-Million-Trees.aspx
[70] Found at: https://www.peelregion.ca/officialplan/
[71] Found at: https://cvc.ca/wp-content/uploads/2019/09/1rpt_PeelClimateChangeStrategy_2011.pdf
[72] Found at: https://www.peelregion.ca/climate-energy/

Appendix 6– Heritage Heights Conceptual Land Use Plan (CLUP)

The Heritage Heights CEP has been based on the Conceptual Land Use Plan (CLUP). In June 2020, a Conceptual Land Use Plan was approved for the Heritage Heights Community.[73]

The CLUP was designed to facilitate a walkable, compact, and mixed-use community that would allow for sustainable technologies to be implemented and once fully built, would accommodate roughly 95,000-210,000 persons and 33,000-92,000 jobs.

The CLUP is characterized by a mix of residential uses at varying densities and a mix of employment types. The natural heritage system and parks are found throughout the Secondary Plan area, as well as key transportation and goods movement corridors.

Table 3 provides the draft land use categories identified in the Conceptual Land Use Plan that informed the Heritage Heights CEP.

Through the secondary planning process, the planned concept will continue to be refined. The CEP is sufficiently flexible to respond to these refinements.

The City's vision for the Heritage Heights Secondary Plan area is of a new town centre—a complete, full-service, mixed-use place—where neighbourhoods are designed to be walkable and cyclable and accessible by transit. The successful implementation of the CEP is based on this vision, as compact, mixed-use built form supports district energy and building efficiency goals. The integration of energy and land use planning has already begun.

Successful urban energy planning is only possible if energy considerations are integrated in the entire urban planning process. But in many countries, including Canada, consideration of energy issues is missing in land use planning processes.

A natural connection should exist between urban development and energy development. However, a legacy of siloed urban land use and energy systems planning is a barrier to a more coordinated transition to low carbon and climate resilient communities. This barrier also exists among related professions including building professionals, engineers, finance professionals, and others.

Table 3: Draft land use categories identified in the Heritage Heights Conceptual Land Use Plan.

Category	Use	Character
Commercial Mixed-Use/High Density Residential	125-250 dwelling units per hectare, office, commercial, retail, restaurant, institutional	Multi-family attached housing such as medium-rise and high-rise apartment buildings

[73] Found at: https://www.brampton.ca/EN/City-Hall/meetings-agendas/PDD%20Committee%202010/20200727pdc_AGENDA.pdf

Medium Density Residential	50-100 dwelling units per hectare	Multi-family attached housing such as townhomes, rowhomes, walk ups, low-rise and medium-rise apartment buildings
Low Density Residential	20-50 dwelling units per hectare	Single or multi-family detached or attached housing
Wellness District	Hospital, medical office, hospice, assisted living, other health care-related uses	High, medium, and low-rise buildings, structured parking
Main Street	Retail, restaurant, service commercial, residential	Large single or double story buildings with surface parking
Light Industrial	Light manufacturing, research, technology and other	Single building divided with outparcels and surface parking
Convenience Commercial	Daily needs commercial such as grocery store, pharmacy, fast-casual restaurant	

Appendix 7 – Planned 2051 Area, Population, and Employment

This appendix provides descriptions of the planned 2051 area, population, and employment for the Heritage Heights Community with informed the development of the Heritage Heights CEP.

Table 1 summarizes the planned 2051 area, population, and employment for the Heritage Heights Community provided by the City of Brampton.

Table 1: Area, population, and employment in the Heritage Heights Community.

Total area (ha)	935.34
Total population in 2051	123,725
Total low-density area (LDA) (ha)	560.89
Total low-density area population in 2051	56,670
Total medium-density mixed-use area (MDMU) (ha)	194.77
Total medium-density mixed-use area population in 2051	39,510
Total high-density mixed-use area (HDMU) (ha)	102.84
Total high-density mixed use area population in 2051	27,545
Total hospital area (ha)	13.49
Total industrial area (ha)	83.35
Total employment in 2051	42,885

Table 2 provides population, area, and employment data for the Heritage Heights Community by Spatial Planning Zone.

Table 2: population, area, and employment data for the Heritage Heights Community by Spatial Planning Zone.

2051 Forecast	SPZ1	SPZ2	SPZ3	SPZ4	SPZ5	SPZ6	SPZ7	SPZ8	SPZ9	SPZ10	SPZ11	Total
Total 2051 population	6,766	11,303	9,903	13,479	7,731	8,184	20,037	7,434	7,770	8,530	22,589	123,725
Total low-density area (LRA) (ha)	60.2	1.38	51.66	111.52	7.3	10.57	188.53	0	37.92	0	91.19	560.69
Total 2051 low-density area population	6,127	139	5,221	11,272	738	1,068	19,055	0	3,833	0	9,217	37,615
Total medium-density mixed-use area (MDMU) (ha)	3.15	26.71	6.52	10.88	13.73	25.53	4.84	19.89	13.51	24.99	45.02	194.77
Total 2051 medium-density mixed-use area population	639	5,418	1,323	2,207	2,785	5,179	982	4,035	2,741	5,069	9,133	39,511
Total high-density mixed-use area (HDMU) (ha)	0	21.45	12.54	0	15.71	7.23	0	12.69	4.47	12.92	15.83	102.84
Total 2051 high-density mixed use area population	0	5,745	3,359	0	4,208	1,937	0	3,399	1,197	3,461	4,240	27,546
Total hospital area (ha)	0	0	0	0	13.49	0	0	0	0	0	0	13.49
Total industrial area ha)	32.59	5.34	25.42	0	0	0	0	0	0	0	00	63.35
Total 2051 employment	2,006	1,1049	2,865	0	9,930	1,300	0	4,620	600	9,145	1,370	42,885
Employment to Population Ratio	.3	1.0	.3	0	1.3	.15	0	1.2	.1	1.1	.1	.4

Table 3 provides a qualitative assessment of the projected employment to population ratios by Spatial Planning Zone.[74]

- SPZs 2, 5, 8 and 10 have high employment to population ratios, meaning a relatively higher concentration of jobs.
- SPZs 1 and 3 have moderate ratios.
- Ratios are low in SPZ 6, 9, and 11 as they are predominantly residential.
- Little to no employment is expected in SPZ 4 and 7 as these are almost exclusively residential.

[74] Note: Employment data does not include the teaching and administrative staff in the 12 planned schools. This will be added based on population development in the analytical assumptions.

As a general guideline, the Heritage Heights CEP established energy policy by Neighbourhood Typology, including transit hub and active transportation network considerations. Table 3 also identifies the Neighbourhood Typologies found in each SPZ. Most SPZs are a mix of least two of the major Neighbourhood Typologies.

Table 3: Employment to Population Ratios and Neighbourhood Typologies for each Spatial Planning Zone (SPZ) in the Heritage Heights Community.

Spatial Planning Zone	Employment to Population Ratio[75]	Neighbourhood Typologies
1		Primarily Low-Density Area with some Medium-Density Mixed Use and Employment (Industrial Area)
2		Primarily High-Density and Medium-Density Mixed Use and Employment (Industrial Area)
3		Primarily Low-Density Area with some Medium- and High-Density Mixed Use and Employment (Industrial Area)
4		Predominately Low-Density Area
5		Primarily High- and Medium-Density Mixed Use and a Hospital Area (Wellness District)
6		Primarily Medium-Density Mixed Use
7		Predominantly Low-Density Area
8		High- and Medium-Density Mixed-Use
9		Primarily Low-Density Area with some Medium- and High-Density Mixed Use
10		High- and Medium-Density Mixed-Use
11		Mixture of Low-Density Area and High- and Medium-Density Mixed Use.

[75] Intensity of colour indicates a higher employment to population ratio.

Appendix 8 – Building Archetypes

The following table lists the building archetypes that were identified for Heritage Heights energy modelling.

Full-Name	Short Form	Description
Single Detached - Residential	SD	• One or two storey houses with four external vertical walls
Single Semi-detached - Residential	SSD	• One or two storey houses with three external vertical walls and one shared wall
Single Townhouse - Residential	ST	• Two or three storey houses with two external vertical walls and two shared walls • End-units with three external vertical walls and one shared wall
Multi-unit residential – Low rise	MLR	• Apartment building with 1 storey
Multi-unit residential – Mid-rise	MMR	• Apartment building with 4 storeys
Multi-unit residential – High Rise	MHR	• Apartment building with 18 storeys
Light Industrial	IND	• Building housing industrial processes that do create unusual noise, emissions, or other safety hazards
Office	OFF	• Space used for typical office functions including clerical, information technology, managerial and meeting spaces
Retail	RET	• Space used for the display and sale of goods and services to walk-in customers
Food service	FS	• Space used for the preparation and consumption of prepared food
Elementary School	ES	• One or two storey school building for Grades K to 8
Secondary School	SS	• One or two storey school building for Grades 9 to 12
Hospital	HOS	• Full service acute care hospital including a full range of out-patient services, along with emergency, surgical, intensive care, and other in-patient services.

Appendix 9 – Building Archetype Distribution

Table 1 provides a summary of the distribution (% and m^2) of Building Archetypes by Neighbourhood Typology for the simulations.[76]

Table 1: Assumed distribution (% and m^2) of Building Archetypes by Neighbourhood Typology based on the Heritage Heights Conceptual Land Use Plan

Building Archetype[1]	Low-Density Area		Medium-Density Mixed Use		High-Density Mixed Use		Industrial Area		Hospital Area	
	%	m^2	%	m^2	%	m^2	%	m^2	%	m^2
SD	54%	1,983,450	0%	0	0%	0	0%	0	0%	0
SSD	19%	680,040	0%	0	0%	0	0%	0	0%	0
ST	19%	680,040	12%	237,066	0%	0	0%	0	0%	0
MLR	8%	283,350	10%	197,555	0%	0	0%	0	0%	0
MMR	0%	0	41%	790,220	32%	413,190	0%	0	0%	0
MHR	0%	0	37%	711,198	68%	867,699	0%	0	0%	0
IND	0%	0	0%	0	0%	0	34%	106,080	13%	326,944
OFF	0%	0	0%	0	0%	0	6%	17,160	11%	283,965
RET	0%	0	0%	0	0%	0	60%	187,200	19%	480,800
FS	0%	0	0%	0	0%	0	0%	0	31%	787,763
ES	0%	0	0%	0	0%	0	0%	0	1%	19,200
HS	0%	0	0%	0	0%	0	0%	0	1%	24,000
HOS	0%	0	0%	0	0%	0	0%	0	24%	595,800

Table Note 1: Single Detached Residential (SD); Single Semi-detached- Residential (SSD); Single Townhouse – Residential (ST); Multi-unit residential – Low rise (MLR); Multi-unit residential – Mid-rise (MMR); Multi-unit residential – High Rise (MHR); Light Industrial (IND); Office (OFF); Retail (RET); Food service (FS); Elementary School (ES); High School (HS); Hospital (HOS)

Building Archetypes have been identified for each of the five major Neighbourhood Typology (i.e., Low Residential Area, Medium-Density Mixed Use, High-Density Mixed Use, Industrial Area, and Hospital Area). Building Archetype assumptions for each Heritage Heights Spatial Planning Zone are found in Tables 1 and 2.

Table Legend:

General

- Spatial Planning Zone (SPZ)
- Square metre (m^2)

Building Archetype

- Single Detached (SD)
- Single Semi-detached (SSD)
- Single Townhouse (ST)

76 In the draft CLUP, Brampton currently designates MDMU and HDMU Neighbourhood Typologies, as 100% residential. The non-residential portion will be estimated in subsequent revisions of Secondary Plan. The energy modelling can be updated accordingly.

- Multi-unit residential – Low rise (MLR)
- Multi-unit residential – Mid-rise (MMR)
- Multi-unit residential – High Rise (MHR)
- Light Industrial (IND)
- Office (OFF)
- Retail (RET)
- Food Service (FS)
- Elementary School (ES)
- High School (HS)
- Hospital (HOS)

Neighbourhood Typology

- Low Residential Area (LRA)
- Medium-Density Mixed-Use Area (MDMU)
- High-Density Mixed-Use Area (HDMU)
- Industrial Area (IND)
- Hospital Area (HOS)

Table 1: Building Archetype distribution (m^2) by Heritage Heights Spatial Planning Zone

m²	SD	SSD	ST	MLR	MMR	MHR	IND	OFF	RET	FS	ES	HS	HOS
SPZ1	214,445	73,524	77,358	33,830	12,780	11,502	54,563	8,826	96,288	0	2,400	6,000	0
SPZ2	4,865	1,668	34,176	27,785	194,535	278,492	300,533	48,616	444,592	0	4,800	6,000	0
SPZ3	182,735	62,652	70,590	32,720	76,845	129,623	77,928	12,606	127,120	0	0	0	0
SPZ4	394,520	135,264	148,506	67,395	44,140	39,726	0	0	0	0	2,400	0	0
SPZ5	25,830	8,856	25,566	17,615	118,820	182,682	0	43,692	0	148,950	0	0	595,800
SPZ6	37,380	12,816	43,890	31,235	132,635	154,238	0	14,300	0	48,750	0	0	0
SPZ7	666,925	228,660	234,552	100,185	19,640	17,676	0	0	0	0	2,400	6,000	0
SPZ8	0	0	24,210	20,175	131,685	179,699	0	50,820	0	173,250	2,400	0	0
SPZ9	134,155	45,996	62,442	32,870	72,775	87,044	0	6,600	0	22,500	2,400	0	0
SPZ10	0	0	30,414	25,345	153,295	200,264	0	100,595	0	342,938	0	0	0
SPZ11	322,595	110,604	165,402	91,750	246,260	297,954	0	15,070	0	51,375	2,400	6,000	0
Total	1,983,450	680,040	917,106	480,905	1,203,410	1,578,897	433,024	301,125	668,000	787,763	19,200	24,000	595,800

Table 2: Building Archetype distribution (%) by Heritage Heights Spatial Planning Zone

%	SD	SSD	ST	MLR	MMR	MHR	IND	OFF	RET	FS	ES	HS	HOS
SPZ1	11%	11%	8%	7%	1%	1%	13%	3%	14%	0%	13%	25%	0%
SPZ2	0%	0%	4%	6%	16%	18%	69%	16%	67%	0%	25%	25%	0%
SPZ3	9%	9%	8%	7%	6%	8%	18%	4%	19%	0%	0%	0%	0%
SPZ4	20%	20%	16%	14%	4%	3%	0%	0%	0%	0%	13%	0%	0%
SPZ5	1%	1%	3%	4%	10%	12%	0%	15%	0%	19%	0%	0%	100%
SPZ6	2%	2%	5%	6%	11%	10%	0%	5%	0%	6%	0%	0%	0%
SPZ7	34%	34%	26%	21%	2%	1%	0%	0%	0%	0%	13%	25%	0%
SPZ8	0%	0%	3%	4%	11%	11%	0%	17%	0%	22%	13%	0%	0%
SPZ9	7%	7%	7%	7%	6%	6%	0%	2%	0%	3%	13%	0%	0%
SPZ10	0%	0%	3%	5%	13%	13%	0%	33%	0%	44%	0%	0%	0%
SPZ11	16%	16%	18%	19%	20%	19%	0%	5%	0%	7%	13%	25%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Appendix 10 – Integration Framework

Table 1 aligns the Built-Form Land Use categories (the world of land use planners) with Building Archetypes (the world of energy planners) with Neighbourhood Typologies (the bridge between the two worlds).

Table 1: Alignment of Built Form Land Use Categories and Building Archetypes with Neighbourhood Typologies.

Built Form Land Use Category[77]	**Neighbourhood Typology**	**Building Archetypes**
Low Density Residential Elementary School Secondary School Convenience Commercial	**Low-Density Area**	Single Detached (SD) Single Semi-detached (SSD) Single Townhouse (ST) Multi-unit residential – Low rise (MLR) Elementary & Secondary School Retail Food Service
Medium Density Residential Elementary School Secondary School Convenience Commercial	**Medium-Density Mixed Use**	Single Townhouse (ST) Multi-unit residential – Low rise (MLR) Multi-unit residential – Mid-rise (MMR) Multi-unit residential – High Rise (MHR) Elementary & Secondary School Retail Food Service
Commercial Mixed Use/ High Density Residential Main Street Convenience Commercial	**High-Density Mixed Use**	Multi-unit residential – Mid-rise (MMR) Multi-unit residential – High Rise (MHR) Retail Office Food Service
Light Industrial	**Industrial Area**	Light Industrial
Wellness District	**Hospital Area**	Hospital Retail Office Food Service

[77] Based on the Heritage Heights Conceptual Land Use Plan.

Appendix 11 – Spatial Planning Zone (SPZ) Features

There are some energy-related policy considerations that were driven by the configuration and interrelationship between SPZs. The following observations can be made from the Council endorsed Conceptual Land Use Plan (CLUP) and were considered in the development of the Heritage Heights CEP.

Built Form

- Low Density Residential is found in all SPZs except SPZ 8 and 10.
- Medium Density Residential is found in all SPZs.
- High Density Residential is not found SPZs 1, 4 and 7.
- Light Industrial is found SPZ 1, 2 and 3.
- Convenience commercial is found in all SPZs.
- A Wellness (Hospital) District is found in SPZ 5.
- A Fire Station is found in SPZ 5.
- Elementary Schools are found in all SPZs except 3, 6 and 8.
- Secondary Schools are found in SPZ 1 and 7.
- Catholic Schools are found in SPZs 1 and 11.[78]

Note: The City proposes to build a Community/Recreation Centres in each of SPZ 4 and 11. While these facilities will not be specifically included in the energy modelling, energy-related and other policy recommendations will be provided. These facilities are probable locations for energy centres.

Transportation

- A Separated Bicycle Facility is identified in the CLUP along the boundary of the industrial land uses in SPZ 1, 2 and 3.
- An Urban Boulevard[79] runs through SPZs 2, 5, 8, 10, and 11 replacing the Provincially proposed 400 Series Highway.
- A future Brampton Transit Facility is found in SPZ 5.
- Major Transit Station Areas (MTSAs) are found in SPZs 2, boundary of 5 and 8 and 10.
- Transit/GO Train Links are found along the boundary of SPZ 5 and 8.

Green Space/Natural Heritage

- A Regional Water Reservoir is only found in SPZ 11. Future Storm Water Management Facilities are likely to be found in all SPZs.
- All but SPZ 1 and 6 contain the Natural Heritage System.
- All SPZs accommodate parks.

Table 1 provides a description of each Spatial Planning Zone (SPZ) based on the CLUP.

Table 1: Description of Spatial Planning Zones (SPZs) in the Heritage Heights Community based on the Conceptual Land Use Plan.

Conceptual Land Use Plan	SPZ1	SPZ2	SPZ3	SPZ4	SPZ5	SPZ6	SPZ7	SPZ8	SPZ9	SPZ10	SPZ11

[78] Assumed 100% Secondary School for the purposes of energy modelling.
[79] The Urban Boulevard will support a robust connected street network, multiple routing options, multi-modal transportation options, maximizes short trip making and provide a framework for a complete community.

Commercial Mixed-Use/High Density Residential		É	É		É	É		É	É	É	É
Medium Density Residential	É	É	É	É	É	É	É	É	É	É	É
Low Density Residential	É	É	É	É	É	É	É		É		É
Wellness District					É						
Main Street					É						
Light Industrial	É		É								
Convenience Commercial	É	É	É	É	É	É	É	É	É	É	É
Elementary School	É	É		É	É		É			É	É
Secondary School	É						É				
Catholic School	É										É
Urban boulevard		É			É			É		É	É
Major Transit Station		É			É			É		É	
Transit/GO Train links		É			É			É		É	
Separated bicycle facility	É	É	É								
Park	É	É	É	É	É	É	É	É	É	É	É
Open space connection		É	É	É	É		É	É	É	É	É
Environmentally sensitive		É	É	É	É		É	É	É	É	É
Water Reservoir											É
Fire Station					É						

Appendix 12 – Evaluation of Low Carbon Energy Services and Technologies

Existing and emerging low carbon energy services and technologies were evaluated for their impact on the Heritage Heights CEP (Table 1) based on the following criteria:

- High - Technology in its current or likely form and at its current or likely cost must be deployed to meet the Heritage Heights CEP efficiency, emissions, and economic goals.
- Medium - Technology in its current or likely form and at its current or likely cost will be supportive of the Heritage Heights CEP efficiency, emissions and economic goals and should be encouraged.
- Low - Technology in its current or likely form and at its current or likely cost will need to evolve to be supportive of the Heritage Heights CEP efficiency, emissions, and economic goals.
- None - Technology cannot be applied or is irrelevant to the Heritage Heights CEP.

This evaluation informed the selection of energy measures for the Efficiency Case.

Table 1: Summary of the impact of emerging low carbon energy services and technologies on the Heritage Heights CEP.

Energy Technology	High	Medium	Low	None
High-efficiency envelopes	●			
Efficient lighting & appliances		●		
Efficient heating & cooling	●			
Smart building & neighbourhood optimization		●		
Solar photovoltaic	●			
Solar thermal		●		
Combined Heat & Power – engines	●			
Combined Heat & Power – fuel cells			●	
Combined Heat & Power – solid combustion		●		
Heat pumps – air source	●			
Heat pumps – ground source		●		
Deep geothermal (direct use)				●
Absorption chillers		●		
Waste heat recovery	●			
Heat and cold storage cisterns	●			
Electricity storage - batteries		●		
District heating & cooling	●			
Electrical microgrids	●			
Battery electric vehicles (BEV)	●			
Hydrogen fuel cell vehicles (FCV)		●		
Biodiesel vehicle			●	
Natural gas vehicle			●	
Plug-in hybrid elective vehicle (PHEV)	●			
Autonomous vehicle operation	●			
On-demand transportation services	●			

A summary of the impact of these emerging low carbon energy services and technologies on the Heritage Heights Secondary Plan are summarized in Table 2 using the following criteria:

- Immediate - The first iteration of the Heritage Heights Secondary Plan must include policies and guidelines to facilitate the immediate deployment of the technology.
- Future - The first iteration of the Heritage Heights Secondary Plan should include indicative policies and guidelines to support the effective deployment of the technology within the first decade.
- Never - The current iteration of Heritage Heights Secondary Plan will specify all technologies that have no current or future role in the meeting the energy and climate goals. This list many change over time.

Table 2: Summary of the impact of emerging low carbon energy services and technologies on the Heritage Heights Secondary Plan.

Energy Technology	Immediate	Future	Never
High-efficiency envelopes	●		
Efficient lighting & appliances	●		
Efficient heating & cooling	●		
Smart building & neighbourhood optimization	●		
Solar photovoltaic	●		
Solar thermal	●		
Combined Heat & Power – engines	●		
Combined Heat & Power – fuel cells		●	
Combined Heat & Power – solid combustion	●		
Heat pumps – air source	●		
Heat pumps – ground source	●		
Deep geothermal (direct use)			●
Absorption chillers		●	
Waste heat recovery	●		
Thermal storage - cisterns	●		
Electric storage - batteries	●		
District heating & cooling	●		
Electrical microgrids	●		
Battery electric vehicle	●		
Hydrogen fuel cell vehicle		●	
Biodiesel vehicle	●		
Natural gas vehicle	●		
Plug-in hybrid electric vehicle	●		
Autonomous vehicle operation	●		
On-demand transportation services	●		

Appendix 13 – Energy Measures

This appendix provides details on each energy measures included in the Heritage Heights CEP. A description of the details provided is found in Table 1.

Table 1: Description of information provided for each energy measure included in the Heritage Heights CEP

Category	**Description**
Description	Provides a description of the energy measure
Recommendation(s)	Identifies the CEP recommendation aligned with the energy measure
2051 Outcome	Describes the outcome in 2051 for the energy measure
Policy Direction	Describes the policy direction required to implement the energy measure
Policy Message	Describes the key rationale for the energy measure
Technical Functionality	Describes the technical features of the energy measure
Benefits and Challenges	Lists the benefits and challenges associated with the energy measure
CEERP Interpretation	Provides the direction found in the CEERP for the energy measure
CEP Relevance	Describes how important the energy measure is to the CEP
Spatial Impact	Provides the spatial impact of the energy measure if any
Regulatory Land Use Planning Tools	Lists the regulatory land use planning tools that can support implementation of the energy measure
Other Municipal Tools & Instruments	Lists other municipal tools and instruments that can support implementation of the energy measure

Energy measures were considered for **Building End Use Efficiency** (efficient building construction, electricity generation at the building, thermal energy generation at the building, efficient building management), **Transportation End Use Efficiency** (active transportation, mobility services, urban form, vehicle efficiency) and **Energy Services** (energy services to homes and buildings, energy services to transportation, supply portfolio, efficient energy system management).

The following serves as a hyperlinked table of contents for the Heritage Heights CEP energy measures.

1. Building End Use Efficiency

- Efficient Building Construction
  - Building envelope
  - Light and appliances
  - Heating and cooling
- Electricity Generation at the Building
  - Solar PV
- Thermal Generation at Building
  - Solar thermal
  - Air-based heat pumps
  - Ground-effect heat pumps
- Efficient Building Management
  - Smart meters

2. Transportation End Use Efficiency

- Active Transportation
  - Walking
  - Cycling
- Mobility Services
  - Brampton Transit
  - GO Train
  - On demand transportation services
- Urban Form
  - Compact and complete community design
- Vehicle Efficiency
  - Battery electric vehicles
  - Gas and diesel, biodiesel, natural gas, and plug-in hybrids
  - Motorcycles and scooters

3. Energy Services

- Energy Services to Homes and Buildings
  - Grid electricity
  - Microgrid electricity (new service)
  - Natural gas
  - Thermal energy (new service)
- Energy Services to Transportation
  - Electricity
  - Gas, diesel, biodiesel, compressed natural gas, liquid natural gas
- Supply Portfolio
  - Electricity
  - Natural gas
  - Solar PV
  - Solar thermal
  - Combined heat and power (engines)
  - Waste heat
  - Environmental (air-based)
  - Environmental (ground-effect)
  - Electricity storage (battery)
  - Thermal storage (cistern)

Efficient Energy System Management

Smart energy network

1. Building envelope

Energy Parameter	• **Building End Use Efficiency – Efficient Building Construction**
Description	• Includes roofs, walls, foundations, and windows.
CEP Recommendation	• Ensure above code efficiency for all homes and buildings.
2051 Outcome	• End use efficiency at least 25% above 2016 OBC for Low-Density Residential (LRA), Medium-Density Mixed-Use (MDMU) and High-Density Mixed-Use (HDMU) areas • End use efficiency at least 25-30% above 2016 OBC for Industrial (IND) and Hospital (HOS) areas
Spatial Impact	• Not applicable
Policy Directions	• Developers/builders will rigorously comply with the Ontario Building Code, ideally supported by a voluntary Energy Performance Label. • Developers/builders are encouraged to anticipate expected 2030 Ontario Building Code increases in energy efficiency. • It is the City of Brampton's intention to explore and develop incentives for developers/builders to further exceed code efficiencies starting in 2022.
Policy Message	• Building efficiency cannot be assessed in isolation from district energy and building integrated renewables. • Universal district energy services to the MDMU and HDMU areas by the new thermal utility significantly reduce the "vertical cost" for the developer, making it much more reasonable for the City of Brampton to insist on above code efficiency. • If buildings only meet current Code, a significant increase will be required in the cost of providing district energy services, as well as increasing the demand for waste heat and biofuels, even with a possible combination including all recommended supply-side transformations (e.g., district energy and building integrated renewables).
Technical Functionality	• Highly insulated roofs (R-60), walls (R-30), foundations (R-20), and triple-paned windows (U-0.25). • Airtight against infiltration (1.2 ACH50). • Optimized window-to-wall ratio. • Optimized window orientation. • Optimized exterior shading. • Optimized window coatings.
Benefits/Challenges	• Reduced Heating, Ventilation and Air Conditioning (HVAC) energy use due to limited wintertime heat loss and minimized solar heat gain unwanted in the summertime and wanted in the summertime. • Reduced HVAC capacity requirements. • Improved thermal comfort. • Improved resiliency against power loss. • Maximized natural lighting with minimized glare. • Increased space requirements. • Increased first costs.
CEERP Interpretation	• Achieve 17% Ontario Building Code (OBC) efficiency gain over 2016 levels. • Achieve a 34% water efficiency gain from 2016 levels.

	• Narrative suggests above-code efficiency in “green neighbourhoods”.
CEP Relevance	• Multiple approaches to achieve high-performance envelopes.
Regulatory land use planning tools	• Zoning by-law • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Ontario Building Code • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

2. Lighting and appliances

Energy Parameter	• **Building End Use Efficiency – Efficient Building Construction**
Definition	• Includes all lighting, fixtures, appliances within homes and buildings.
CEP Recommendation	• Ensure above code efficiency for all homes and buildings.
2051 Strategic Outcome	• LED lighting in all homes and buildings • Electric air conditioning in some MDMU and HDMU
Policy Directions	• Developers/builders will rigorously comply with code, ideally supported by a voluntary Energy Performance Label. • Developers/builders are encouraged to only offer LED lighting and Energy Star most-efficient rated appliances. • It is the City of Brampton's intention to explore and develop incentives for developers/builders to further exceed lighting and appliance efficiencies starting in 2022.
Policy Message	• Lighting and appliance efficiency cannot be assessed in isolation from both the efficiency of the building envelope and district energy and building integrated renewable. • Inefficient lighting and appliances in efficient envelopes increase the summer cooling demand.
Technical Functionality	• High-efficiency LED lighting with dimming controls. • Occupancy and vacancy sensors control lighting where feasible. • Daylight harvesting lighting controls in naturally lit areas. • Energy Star certified appliances, electronics, and water heaters. • Smart strips to control phantom load. • Low-flow sink, shower, and other flow fixtures.80
Benefits/Challenges	• Reduce lighting electricity demand controlled directly by occupants. • Reduce plug load electricity demand controlled directly by occupants. • Reduce domestic hot water use and heating energy.
CEERP Interpretation	• Achieve 17% OBC efficiency gain over 2016 levels. • Narrative suggests above-code efficiency in "green neighbourhoods".
CEP Relevance	• Incorporate into building permitting guidelines.
Spatial Impact	• Not applicable
Regulatory land use planning tools	• Not applicable
Other municipal tools & instruments	• Ontario Building Code • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

[80] Water-efficient appliances are included for their contribution to reducing energy associated with hot water use.

3. Heating and cooling

Energy Parameter	•	**Building End Use Efficiency – Efficient Building Construction**
Definition	•	Includes space heating and cooling of homes and buildings and hot water.
CEP Recommendations	•	Use air-based heat pumps with supplementary solar thermal, and electric induction heating to serve the heating, cooling, and hot water needs of low-density residential areas.
	•	Use district heating and cooling[81] to serve the heating, cooling and hot water needs of homes and buildings located in medium- and high-density mixed-use, industry and hospital areas.
2051 Outcome	•	No retail natural gas service provided to LRA
	•	District energy (heating and cooling) services provided to MDMU, HDMU, IND and HOS areas
Policy Direction	•	Builder/developers are expected to design LRA buildings with air-based heat pumps with supplementary solar thermal and electric induction heating.
	•	Builders/developers are expected to design MDMU and HDMU buildings to be district-energy ready.
	•	It is the City of Brampton's intention to explore options to immediately provide comprehensive district energy (heating and cooling) services.
Policy Message	•	Energy supply and distribution within the building cannot be assessed in isolation from building efficiency, district energy and building integrated renewables.
	•	Universal district energy services to MDMU and HDMU buildings by the new thermal utility significantly reduce the "vertical cost" for the developer, making it much more reasonable for the City of Brampton to insist on district energy ready design.
	•	A building with efficient envelope, lighting, and appliances, will require minimal design changes to be district energy ready.
Technical Functionality	•	HVAC systems selected via load calculation without oversizing.
	•	Hydronic radiant systems in large buildings with on-site hot and chilled water generation or in buildings of any size connected to district heating/cooling systems.
	•	All-electric high-efficiency variable refrigerant flow (VRF) and mini-split heat-pump systems in smaller buildings where district heating/cooling is unavailable.
	•	Fresh air for indoor air quality provided by energy recovery ventilation systems in all buildings.
Benefits/Challenges	•	Reduced unit cycling for reduced operations and maintenance costs and longer lifespan.
	•	Improved thermal comfort.
	•	Reduced HVAC energy consumption.
	•	Decreasing installed cost.
	•	Utility incentives available for some technologies.

[81] Note: For larger developments this could include possible use of development-specific ground-source heating and cooling pumped systems that are compatible with integration into the municipal district heating and cooling service structure.

CEERP Interpretation	• Serve 80% of new high-growth areas with district energy. • Achieve 17% OBC efficiency gain over 2016 levels.
CEP Relevance	• Multiple approaches to reduce heating and cooling energy homes and buildings. • Buildings connectable to district energy outfitted with hydronic radiant systems. • Buildings not connectable to district energy outfitted with VRF and mini-split heat pumps.
Spatial Impact	• Not applicable (see 2.3.1 Energy Services to Homes and Buildings - Thermal for a description of the spatial impact of district energy services)
Regulatory land use planning tools	• Zoning by-law • Development Design Guidelines • Sustainability Metrics Program • Site Plan Control
Other municipal tools & instruments	• Ontario Building Code • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

4. Solar PV

Energy Parameter Definition	• **Building End Use Efficiency – Electricity Generation at Building** • Includes technologies converting light into electricity (e.g., roof-top panels)
CEP Recommendation	• Ensure building integrated solar PV for all homes and buildings.
2051 Outcome	• Solar PV[82] will supply 12% of the Heritage Heights total electricity demand in 2051.
Policy Direction	• Builder/developers are expected to integrate solar PV into all buildings. • It is the City of Brampton's intention to explore and develop incentives for developers to include renewables.
Policy Message	• Building integration of solar PV at time of construction is more cost-effective. • District energy ready design frees up rooftop space for solar PV, green roofs, and recreational use.
Technical Functionality	• Converts solar radiation to power. • Building or floor mounting possible. • Power usage in buildings. • Power feed-in into distribution grids.
Benefits/Challenges	• Easy to integrate in roofs of new buildings. • Decreasing installation cost. • Battery storage possible to align generation and usage. • Combination with E-vehicle charging and heat pumps to maximize decentralized usage. • Feature for optimized microgrids. • Carbon free power generation.
CEERP Interpretation	• Supply 8% of Brampton's electricity with locally generated solar power.
CEP Relevance	• Multiple immediate measures to maximize solar PV integrated into all new developments.
Spatial Impact	• Physical form on the building (see 2.3.3.2 Supply Portfolio – Solar PV for the spatial impact of grid connections)
Regulatory land use planning tools	• Zoning By-law • Development Design Guidelines • Sustainability Metrics Program • Site Plan Control
Other municipal tools & instruments	• Ontario Building Code • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

[82] This is in boundary PV and separate from any PV generation operated by the provincial grid.

5. Solar thermal

Energy Parameter	• **Building End Use Efficiency – Thermal Generation at Building**
Definition	• Form of energy and a technology for harnessing solar energy to generate thermal energy (heat).
CEP Recommendations	• Ensure building integrated solar thermal for all homes and buildings located in low-density residential areas. • Increase local energy (thermal and electrical) generation and storage.
2051 Outcome	• Solar thermal will supply one-third of the Heritage Heights service hot water demand in LRA areas throughout the plan period • On-demand solar hot water electric boiler in all LRA homes and buildings
Policy Directions	• Builder/developers are expected to integrate solar thermal into all LRA homes and buildings. • It is the City of Brampton's intention to explore and develop incentives for developers to include renewables.
Policy Message	• Solar thermal service hot water for LRA homes and buildings cannot be viewed in isolation from the multiple measures included in the CEP to substantially reduce the GHG emissions from the use of natural gas for service hot water and heating and cooling homes and buildings. • In the business-as-usual case, the use of natural gas is the second largest source of GHG emissions in 2051 at 264kt (38% of total), falling to 22kt (17% of total) in the Efficiency Case.
Technical Functionality	• Converts solar radiation to heat. • Installation mainly on building roofs. • Usage for service hot water and heating system support. • Possible asset for generation 4 and 5 district heating systems.
Benefits/Challenges	• Easy to integrate in roofs of new buildings. • Decreasing installation cost. • Can be the only heating source in summer months. • Carbon free heat generation.
CEERP Interpretation	• Serve 10% of hot water and heating needs in homes not served by district heating with solar hot water.
CEP Relevance	• Multiple immediate measures to maximize solar thermal integrated into residential developments in non-DE areas.
Spatial Impact	• Physical form on the building
Regulatory land use planning tools	• Zoning By-law • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Ontario Building Code • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

6. Air-based heat pumps

Energy Parameter	•	**Building End Use Efficiency – Thermal Generation at Building**
Definition	•	An air-based heat pump is a reversible heat pump which uses the outside air as a heat source when in heating mode, or as a heat sink when in cooling mode using the same vapor-compression refrigeration process and same external heat exchanger with a fan as used by air conditioners.
CEP Recommendations	•	Use air-based heat pumps with supplementary solar thermal and electric induction heating to serve the heating, cooling, and hot water needs of low-density residential areas.
	•	Increase local energy (thermal and electrical) generation and storage.
2051 Outcome	•	No retail natural gas in low-density residential areas
Policy Directions	•	Builder/developers are expected to integrate high-efficiency air-based heat pumps into all LRA homes and buildings.
	•	It is the City of Brampton's intention to explore and develop incentives for developers to include heat pumps.
	•	It is the City of Brampton's intention to ensure the electrical infrastructure supports all-electric LRA homes and buildings.
Policy Message	•	The CEP assumes that LRA homes and buildings will be all-electric.
	•	Heat pumps in LRA homes and building cannot be viewed in isolation from the multiple measures included in the CEP to substantially reduce the GHG emissions from the use of natural gas for service hot water and heating and cooling homes and buildings.
	•	In the business-as-usual case, the use of natural gas is the second largest source of GHG emissions in 2051 at 264kt (38% of total), falling to 22kt (17% of total) in the Efficiency Case.
Technical Functionality	•	Heat pumps (HP) transfer outside air to a usable temperature level for heating and service hot water.
	•	Principle is the reverse refrigerator.
	•	HP can also be used for cooling.
	•	Generally driven by electricity (natural gas HPs are available).
Benefits/Challenges	•	High efficiency (1 kWh electricity generates up to 3.5 kWh heat).
	•	At lower outside temperatures (<-2°C) additional heating is required (boiler or direct electric heating).
	•	Combination with solar thermal collector and solar photovoltaics (PV) are recommended.
	•	Combination with high-efficiency envelope and hydronic heating and cooling distribution in buildings maximizes overall efficiency.
	•	Emissions dependent on sources of electricity from the grid and local renewables.
CEERP Interpretation	•	Not analytically included.
CEP Relevance	•	High-probability heating and cooling source for most buildings not served by district energy.
	•	Potential future part of energy supply portfolio facilitated by district energy and smart energy network.
Spatial Impact	•	Physical form on the building
Regulatory land use planning tools	•	Zoning By-law
	•	Development Design Guidelines

	• Sustainability Metrics Program
Other municipal tools & instruments	• Ontario Building Code • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

7. Ground-effect heat pumps

Energy Parameter	• **Building End Use Efficiency – Thermal Generation at Building**
Definition	• A ground source heat pump is a heating/cooling system for buildings that uses a type of heat pump to transfer heat to or from the ground, taking advantage of the relative constancy of temperatures of the earth through the seasons.
CEP Recommendation	• Increase local energy (thermal and electrical) generation and storage.
2051 Outcome	• Not applicable
Policy Direction	• Builder/developers may include ground-effect geothermal exchange heating and cooling systems in all areas in specific circumstances. • See Supply Portfolio for the spatial impact of potential grid connections.
Policy Message	• Most buildings in the low-density residential areas will use air-based heat pumps and on-site renewables. The permitting process will allow a development using ground-effect geothermal (geothermal) exchange combined with water-based thermal-exchange pumps. This would require a geological assessment. • The default for all medium- and high-density development will be district heating and cooling supplied by a portfolio of thermal sources managed by the utility. The permitting process will allow a development using geothermal exchange if the technical design allows for future integration into the wider district energy system. • The thermal utility could include centrally managed geothermal exchange arrays as part of the overall thermal supply portfolio.
Technical Functionality	• Heat pumps (HP) are transferring energy from water to a usable temperature level for heating and service hot water. • The principle is the reverse refrigerator. • HP can also be used for cooling. • Driven by electricity (natural gas HPs are available). • Sources with typical temperature of about 10 to 20°C include: 1) water cycled through ground array, 2) ground water / sewage water and 3) cold district energy systems.
Benefits/Challenges	• High efficiency (1 kWh electricity generates up to 5 kWh heat). • Combinations with solar thermal collector and solar PV are possible. • Combination with high-efficiency envelope and hydronic heating and cooling distribution in buildings maximizes overall efficiency. • Carbon emissions are dependent on the GHG index of the grid. • Ground effect geology and configuration is critical in higher density areas since neighboring systems can have negative interference. • Open space is needed. • Drillings may require geologic assessments and specific permissions.
CEERP Interpretation	• Not analytically included.
CEP Relevance	• Low-probability heating & cooling source for a few buildings not served by district energy. • Potential future part of energy supply portfolio facilitated by district energy and smart energy network.
Spatial Impact	• Physical form on the building
Regulatory land use	• Community Block Plan

planning tools	• Zoning by-law • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Integrated Energy Master Plan

8. Smart meters

Energy Parameter	•	**Building End Use Efficiency – Efficient Building Management**
Definition	•	A smart meter is an electronic device that records information such as consumption of electric energy, voltage levels, current, and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behavior, and electricity suppliers for system monitoring and customer billing.
CEP Recommendation		Install smart power, thermal and water meters.
2051 Outcome	•	Public utility smart meters installed for electricity and water in all low-density residential areas
	•	Public utility smart meters installed for electricity, water, and heat in all MDMU and HDMU areas
	•	Public utility smart meters installed for electricity, water, heat and gas in all IND and HOS areas
	•	On-site supply and conversion smart meters installed for several possible parameters[83] in MDMU, HDMU, IND and HOS areas
Policy Direction	•	Builder/developers are expected to design homes and buildings with management systems that facilitate metering and sub-metering of all major energy supply, conversion, and consumption systems.
	•	It is the City of Brampton's intention to provide design guidance for smart metering and sub-metering expectations for multiple property types.
Policy Message	•	The CEP assumes that the energy performance of all non-residential property and some aspects of vehicle use will be continually optimized through the availability and management of comprehensive energy supply and usage data. This is assumed to be a year-on-year continuous improvement in efficiency of about 0.5% per year.
Technical Functionality	•	Building Automation Systems (BMS) in medium and large-scale commercial and institutional properties.
	•	Smart Thermostats in small-scale commercial and residential properties.
	•	Intelligent controls optimized for building operation (e.g., unoccupied setback, HVAC capacity reset based on outdoor air temperature or load, economizer controls).
Benefits/Challenges	•	Reduced reliance on human intervention for energy efficient operation.
	•	Increased adaptability to environmental conditions.
	•	Decreasing installed cost.
	•	Utility incentives available.
CEERP Interpretation	•	Not analytically included.
CEP Relevance	•	Availability of selected in-building data and smart energy network control access.
Spatial Impact	•	Not applicable
Regulatory land use planning tools	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools &	•	Ontario Building Code

[83] Note: Parameters can include grid electricity (air conditioning), network gas (combined heat and power and boilers), solar PV, solar thermal, heat pump demand, supplemental heating, hot water, and vehicle charge/discharge, district heat to network, district energy cooling to network, waste heat recovery and/or alternative fuel heat.

instruments	• Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

9. Walking

Energy Parameter	•	**Transportation End Use Efficiency - Active Transportation**
Definition	•	Pedestrian mode of transportation
CEP Recommendation	•	Build pedestrian-friendly neighbourhoods and buildings.
2051 Outcome	•	25% of modal mix active (walking and cycling) (325 million PKT[84])
Policy Direction	•	Neighbourhoods to be walkable and accessible by active transportation.
	•	Builders/developers are expected to design their buildings and developments to maximise pedestrian access including linking neighbourhood pedestrian trails.
Policy Message	•	The impact of encouraging a greater share of walking cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels.
	•	In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Not applicable
CEERP Interpretation	•	Included
CEP Relevance	•	High
Spatial Impact	•	Accommodation of pedestrians and pedestrian infrastructure
	•	Active transportation to transit hubs in low-density residential areas
	•	Connection to local employment and transit hubs with focus on active options in MDMU and HDMU areas
	•	Connection to transit hubs and arterial streets in IND area
	•	Location of intermodal facilities
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning by-law
	•	Draft Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Transportation Master Plan (including demand management)
	•	Active Transportation Master Plan
	•	Parks and Recreation Master Plan (including PathWays Master Plan)

[84] Passenger Kilometres Travelled (PKT)

10. Cycling

Energy Parameter	• **Transportation End Use Efficiency - Active Transportation**
Definition	• Mode of transportation using a bicycle.
CEP Recommendation	• Build cycling-friendly neighbourhoods and buildings.
2051 Outcome	• 25% of modal mix active (walking and cycling) (325 million PKT)
Policy Guidance	• Neighbourhoods to be cyclable/e-cyclable. • The City of Brampton's intention is to develop service agreements with on-demand cycle/e-cycle availability. • Builders/developers are expected to design their buildings and developments to maximize cycle/e-cycle access including linking to neighbourhood routes.
Policy Message	• The impact of encouraging a greater share of cycling cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels. • In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	• Not applicable
Benefits/Challenges	• Not applicable
CEERP Interpretation	• Included
CEP Relevance	• High
Spatial Impact	• Accommodation of cyclists and cycling infrastructure • Active transportation to transit hubs • Accommodation of separated bicycle facility in SPZs 1, 2 and 3 as per CLUP (see Section 3 for specific policy direction related to this facility) • Location of intermodal facilities
Regulatory land use planning tools	• Community Block Plan • Zoning by-law • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Transportation Master Plan (including demand management) • Active Transportation Master Plan • Parks and Recreation Master Plan (including PathWays Master Plan)

11. Brampton Transit

Energy Parameter	•	**Transportation End Use Efficiency – Mobility Services**
Definition	•	Municipal bus transit service
CEP Recommendation	•	Build transit-friendly neighbourhoods.
2051 Outcome	•	20% of modal mix Brampton Transit (260 million PKT)
Policy Guidance	•	The City of Brampton's intention is to establish flexible and frequent transit availability and competitive service quality within and between neighbourhoods in the SPA and the rest of the City.
	•	The City of Brampton's intention is to establish design guidelines that facilitate transit use and modal transfer.
	•	Builders/developers are expected to design their buildings and developments to maximise convenient access to transit for residents and employees including reasonable bus access.
Policy Message	•	Transit-friendly guidelines and plans will include compact mixed-use neighbourhood design, proactive local employment planning, transit-friendly routing, and scheduling.
	•	Neighborhood design will facilitate convenient modal transfer between all transportation forms including parking, on-demand and charging infrastructure.
	•	The impact of encouraging a greater share of transit cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels.
	•	In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Not applicable
CEERP Interpretation	•	Included
CEP Relevance	•	High
Spatial Impact	•	Accommodation of transit-related infrastructure
	•	Location of intermodal facilities and transfer stations
	•	Location of a Brampton Transit Facility in SPZ 5 as per CLUP (see Section 3 for specific policy direction related to this facility)
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning by-law
	•	Draft Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Transportation Master Plan (including demand management)
	•	Transit Master Plan

12. GO Train

Energy Parameter	•	**Transportation End Use Efficiency – Mobility Services**
Definition	•	Regional rail transit service
CEP Recommendation	•	Build transit-friendly neighbourhoods.
2051 Outcome	•	12% of modal mix GO Train (156 million PKT)
Policy Direction	•	It is the City of Brampton's intention to develop specific neighbourhood design guidelines around the GO Train stations that maximize the convenient transfer between all modes of transportation.
	•	Builders/developers are expected to design their buildings and developments to maximise convenient access to the GO Train for residents and employees.
Policy Message	•	Transit-friendly guidelines and plans will include compact-mixed use neighbourhood design, proactive local employment planning, transit-friendly routing, and scheduling.
	•	Neighborhood design will facilitate convenient modal transfer between all transportation forms including parking, on-demand and charging infrastructure.
	•	The impact of encouraging a greater share of transit cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels.
	•	In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Not applicable
CEERP Interpretation	•	Included
CEP Relevance	•	High
Spatial Impact	•	Accommodation of transit users
	•	Accommodation of transit-related infrastructure
	•	Location of intermodal facilities and transfer stations
	•	Location of Major Transit Areas in SPZ 2 and boundary of SPZ 5 and 8 and 10 as per CLUP (see Section 3 for specific policy direction related to these facilities)
	•	Location of Transit/GO Train links at boundary of SPZ 5 and 8 as per CLUP (see Section 3 for specific policy direction related to this facility)
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning By-law
	•	Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Transportation Master Plan (including demand management)
	•	Transit Master Plan

13. On-demand transportation services

Energy Parameter	•	**Transportation End Use Efficiency – Mobility Services**
Definition	•	On-demand transport is the transport of passengers for hire or reward where the passenger or hirer determines the locations for the beginning and end of the journey, as well as the time of travel.
CEP Recommendation	•	Build on-demand-transportation-friendly neighbourhoods.
2051 Outcome	•	N/A
Policy Direction	•	The City of Brampton's intention is to develop neighbourhood design guidelines that facilitate the availability of on-demand vehicles and on-demand service providers.
	•	Builders/developers are expected to design their buildings and developments to maximise convenient access for on-demand vehicles and on-demand service providers, including reasonable provisions for on-demand infrastructure.
Policy Message	•	Neighborhood design will include access, information systems and physical infrastructure to facilitate convenient and competitive availability of a range of on-demand vehicles including cycles, e-cycles, cargo cycles, single-use vehicles along with on-demand transportation services such as Uber, paratransit, courier, and delivery services, etc.
	•	The impact of encouraging on-demand vehicles and services cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels.
	•	In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	•	Includes driverless and driver-assist vehicle operation.
Benefits/Challenges	•	Technology already at advanced development stage.
	•	Allows for higher route loadings through optimization.
	•	Improves efficiency through optimization.
CEERP Interpretation	•	At least 22% of all LDVs & transit, and 7% of HDVs will be BEV.
	•	At least 7% of all PKT will be Active including e-bikes.
	•	All liquid fueled vehicles increase efficiency by 30%.
	•	Reduce average trip length for Light-Duty Vehicles (LDV) by 3.75%.
CEP Relevance	•	Trip tracking / vehicle-type data acquisition.
	•	Transportation user interaction networks using interoperable data frameworks.
Spatial Impact	•	Accommodation of expanded pick-up/drop-off areas
Regulatory planning tools	•	Community Block Plan
	•	Zoning By-law
Other municipal tools & instruments	•	Transportation Master Plan

14. Compact and complete community design

Energy Parameter	• **Transportation End Use Efficiency – Urban Form**
Definition	• The compact city or city of short distances is an urban planning and urban design concept, which promotes relatively high residential density with mixed land uses. • Complete communities is an urban and rural planning concept that aims to meet the basic needs of all residents in a community, regardless of income, culture, or political ideologies through integrated land use planning, transportation planning, and community design.
CEP Recommendation	• Build compact built form and mixed-use neighbourhoods to minimize trip length. • Promote inbound investment in local employment to support complete community development to minimize trip length.
2051 Outcome	• Average trip lengths reduced between 5% and 15% depending on mode
Policy Guidance	• The City of Brampton's intention is to develop neighbourhood design guidelines to create compact urban forms that reduce distances and travel times between daily personal and professional functions. • The City of Brampton's intention is to proactively develop economic development plans to attract local employment to the SPA. • Builders/developers are expected to design their buildings and developments to maximise mixed-use and minimise distances between different uses.
Policy Message	• Compact neighbourhoods not only reduce transportation energy needs by reducing average trip lengths, but also facilitate greater use of active, on-demand and transit modes. • The impact of encouraging compact mixed-use neighbourhoods cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels. • In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	• Not applicable
Benefits/Challenges	• Not applicable
CEERP Interpretation	• Not analytically included
CEP Relevance	• High
Spatial Impact	• As per CLUP
Regulatory land use planning tools	• All
Other municipal tools & instruments	• Not applicable

15. Battery electric vehicles

Energy Parameter	• **Transportation End Use Efficiency – Vehicle Efficiency**
Definition	• A battery electric vehicle (BEV), pure electric vehicle, only electric vehicle or all-electric vehicle is a type of electric vehicle (EV) that exclusively uses chemical energy stored in rechargeable battery packs, with no secondary source of propulsion (e.g. hydrogen fuel cell, internal combustion engine, etc.).
CEP Recommendation	• Build EV-friendly neighbourhoods and buildings.
2051 Outcome	• 1% annual efficiency gain for each electric vehicle assumed • 80% electric light duty vehicles • 35% electric heavy-duty vehicles • 100% electric vehicles for Brampton Transit and GO Train
Policy Direction	• The City of Brampton's intention is to provide guidelines to maximize the availability of EV charging infrastructure in buildings, developments, and neighbourhoods. • Builders/developers are expected to provide EV charging infrastructure for occupants and visitors. • See Energy Services for Transportation for additional policy direction.
Policy Message	• Rapid update of battery electric vehicles assumed in the overall fleet. • On June 29, 2021, Canada's federal government announced a mandatory target to achieve 100% zero-emission for light duty vehicles by 2035. The shift in policy from a voluntary 2040 target was informed by a recent International Energy Association report that says that all light duty vehicles sales globally must be electric to achieve net zero emissions by 2050.[85] • Electric vehicles are more efficient than internal combustion vehicles in addition to contributing fewer or no emissions depending on the carbon intensity of the electricity supply. • See Energy Services for Transportation for other policy direction.
Technical Functionality	• Powered by on-board batteries charged from grid. • Wheels driven by electric motors. • Braking energy is recaptured to charge battery. • Chargers with different charging rates – fastest < 1hour. • Near constant torque at all speeds with rapid acceleration. • Zero on-board GHG emissions. • Battery to wheel efficiencies of ~ 80%.
Benefits/Challenges	• Comprehensive growing vehicle range available except long-haul trucks. • Ranges suitable for vast majority of trips. • Real GHG emissions depends on power source. • Quiet operation.
CEERP Interpretation	• At least 32% of all light duty vehicles & transit, and 7% of high duty vehicles will be battery elective vehicles. • At least 7% of all passenger vehicles travelled (PKT) will be active including e-bikes.
CEP Relevance	Multiple approaches to accelerate BEV use.

[85] Report found at: https://www.iea.org/reports/net-zero-by-2050

	•	Neighbourhood transit 100% EV. • Multi-modal e-mobility neighbourhood design. • Trip tracking / vehicle type data acquisition.
Spatial Impact	•	See Energy Services for Transportation
Regulatory land use planning tools	•	See Energy Services for Transportation
Other municipal tools & instruments	•	See Energy Services for Transportation

16. Gas and diesel, biodiesel, and natural gas vehicles

Energy Parameter	•	**Transportation End Use Efficiency – Vehicle Efficiency**
Definition	•	A type of vehicle that uses fossil fuels.
CEP Recommendation	•	None
2051 Outcome	•	2% annual efficiency gain for remaining diesel and gasoline vehicles assumed • Rapid decline in share of overall fleet assumed
Spatial Impact	•	Not applicable
Policy Direction	•	None
Policy Message	•	None
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Not applicable
CEERP Interpretation	•	None
CEP Relevance	•	None
Regulatory planning tools	•	Not applicable
Other municipal tools & instruments	•	Not applicable
Policy Guidance	•	None
Policy Message	•	None

17. Motorcycles and scooters

Energy Parameter	• **Transportation End Use Efficiency – Vehicle Efficiency**
Definition	• Generally, a two-wheeled vehicle that is powered by a motor and has no pedals.
CEP Recommendation	• Build motorcycle- and scooter-friendly neighbourhoods and buildings.
2051 Outcome	• 5% of modal mix motorcycles and scooters (65 million PKT)
Policy Direction	• The City of Brampton's intention is to develop neighbourhood and road design guidelines that facilitate the safe and convenient use of motorcycles and scooters. • Builders/developers are expected to design their buildings and developments to be convenient for motorcycle and scooter users including dedicated parking infrastructure.
Policy Messages	• Through the plan period a large percentage of the motorcycles and scooters will be electric. • The impact of encouraging the use of motorized two-wheelers (or three- or four-wheeler accessibility scooters) cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels. • In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions is from heavy vehicles on the Urban Boulevard.
Technical Functionality	• Not applicable
Benefits/Challenges	• Not applicable
CEERP Interpretation	• Not analytically included
CEP Relevance	• Low
Spatial Impact	• Accommodation of parking
Regulatory land use planning tools	• Not applicable
Other municipal tools & instruments	• Not applicable

18. Grid electricity service

Energy Parameter	•	**Energy Services – Energy Services to Homes and Buildings**
Definition	•	An electrical grid is an interconnected network for electricity delivery from producers to consumers.
CEP Recommendation	•	Not applicable
2051 Outcome	•	All homes and buildings in the Secondary Planning Area receive electricity service
Policy Direction	•	Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide services for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Policy Messages	•	Ontario's long-term commitment to remain one of the world's lowest-carbon electricity provider is a key assumption in the CEP.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Low emissions
CEERP Interpretation	•	Included
CEP Relevance	•	Yes
Spatial Impact	•	Accommodation of linear infrastructure in municipal right of way
	•	Location of transfer station
	•	Grid connections to building
Regulatory land use planning tools	•	Not applicable
Other municipal tools & instruments	•	Not applicable

19. Microgrid electricity service (*new)*

Energy Parameter	• **Energy Services – Energy Services to Homes and Buildings**
Definition	• A small network of electricity users with a local source of supply that is usually attached to a centralized national grid but can function independently.
CEP Recommendation	• Increase local energy (thermal and electrical) generation and storage.
2051 Outcome	• Solar PV will supply 12% of the Heritage Heights total electricity demand. • Combined heat and power will supply 19% of the Heritage Heights total electricity demand.
Policy Direction	• Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide interconnection, information, and other services to qualified users and operators for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Policy Message	• Ontario's long-term policy commitment to support the rapidly growing portion of locally sourced power and efficiency is a key assumption of the CEP.
Technical Functionality	• Not applicable.
Benefits/Challenges	• Low emissions.
CEERP Interpretation	• Not analytically included but part of narrative.
CEP Relevance	• Yes
Spatial Impact	• Location of energy centres. • Microgrid connection to buildings and electricity grid.
Regulatory land use planning tools	• Community Block Plan • Zoning By-law • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Integrated Energy Master Plan

20. Natural gas service

Energy Parameter	•	**Energy Services – Energy Services to Homes and Buildings**
Definition	•	Natural gas runs from the main into a home or business in what's called a service line.
CEP Recommendation	•	Limit natural gas to neighbourhood energy centres and industry.
2051 Outcome	•	No retail natural gas available in LRAs
	•	Natural gas service to energy centres only in MDHU and HDHU areas
	•	Natural gas limited to energy centres and industry only in IND areas
Policy Direction	•	See Building End Use Efficiency with respect to Efficient Heating and Cooling.
Policy Message	•	By limiting distribution to energy centres for district energy and some industry, the GHG emissions from the Heritage Heights Community's use of natural gas drops from 2051 Base Case total of 264kt to an Efficiency Case total of 22kt.
Technical Functionality	•	Not applicable.
Benefits/Challenges	•	High emissions
CEERP Interpretation	•	Included
CEP Relevance	•	Limited
Spatial Impact	•	Accommodation of linear infrastructure in municipal right of way
	•	System connection to buildings
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning By-law
	•	Draft Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Integrated Energy Master Plan

21. Thermal energy service (*new)*

Energy Parameter	• **Energy Services – Energy Services to Homes and Buildings**
Energy Parameter	• Energy service to homes and buildings
Definition	• The provision of thermal energy (heating and cooling) via infrastructure to homes and buildings.
CEP Recommendation	• Establish a thermal utility to provide district heating and cooling services.
2051 Outcome	<u>Low density residential areas</u> • No district energy services <u>All other areas</u> • All heating and service hot water will be supplied by a district energy company whether via a district energy network or geothermal/heat pump combination • Most cooling will be supplied by a district energy company via district cooling local networks or a geothermal/heat pump combination • Other cooling on an optional basis for developments served via district energy • District energy centres will initially use natural gas. The carbon-content will be reduced over time through the development of a low-carbon supply portfolio [86]
Policy Direction	• Builders/developers are expected to design MDMU and HDMU buildings to be district-energy ready. • It is the City of Brampton's intention to explore options to immediately provide comprehensive district energy (heating and cooling) services.
Policy Message	• Modern district energy is a globally recognized approach to decarbonizing heating, cooling, and hot water services. • Universal district energy services to MDMU and HDMU buildings by the new thermal utility significantly reduces the "vertical cost" for the developer, making it much more reasonable for the City of Brampton to insist on district energy ready design. • A building with efficient envelope, lighting, and appliances will require minimal design changes to be district energy ready. • Energy supply and distribution within the building cannot be assessed in isolation from building efficiency, district energy and building integrated renewables.
Technical Functionality	• Interconnects thermal sources with multiple end users • Wide range of temperatures are possible including medium and high-pressure steam for processes, hot water for heating and service hot water, chilled water for cooling processes, and warm water as source for heat pumps at end user. • Globally recognized standards for networks and building connections.
Benefits/Challenges	• Supports efficient generation in bigger units.

[86] Starting in 2032 the heating supply mix to district energy will include lower carbon sources (waste recovery, ground, and air heat pumps, solar thermal, biofuels etc.) with the mix managed by the district energy utility based on availability, cost, and emissions impacts. The implementation of this decarbonization portfolio development was simulated as follows: 2023 to 2032 – assume 100% natural gas for district energy system; 2023 to 2051 – increase site-specific geothermal heat pump rate by 5% every five years; and 2033 to 2051 – assume 5% reduction of fuel GHG index of district energy generation every five years, reflecting a mix of low carbon fuels and waste heat recovery.

	• Enables transport of waste energy. • Supports low carbon and carbon free thermal energy sources. • Facilitates migration to low-carbon thermal supply portfolio.
CEERP Interpretation	• Serve 70% of existing high-growth areas & 80% new high-growth areas with district energy. • Create new District Energy Company (DECO) serving as municipal thermal utility. • CEERP analysis based on natural gas with migration to low carbon in narrative.
CEP Relevance	• Multiple approaches to ensure district energy services are both available and connected in a timely manner.
Spatial Impact	<u>MDHU, HDMU, IND and HOS areas</u> • Accommodation of linear infrastructure in municipal right of way • Location of district energy centres (if not in building)87 • System connections to buildings and energy centres including easements to municipal right-of-way
Regulatory land use planning tools	• Community Block Plan • Zoning By-law (if in building) • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Integrated Energy Master Plan

[87] Energy centres include combined heat & power (natural gas), heat only boilers (natural gas), air conditioning (electric), thermal storage (heat and cold), building integrated solar PV, Class 2 electric vehicle chargers, and smart metering.

22. Transportation electricity service (*new)*

Energy Parameter	•	**Energy Services - Energy Services to Transportation**
Definition	•	Electrification of transportation.
CEP Recommendation	•	Build electric vehicle-friendly neighbourhoods and buildings.
2051 Outcome	•	80% electric light duty vehicles • 35% electric heavy-duty vehicles • 100% electric vehicles for Brampton Transit and GO Train
Policy Direction	•	The City of Brampton's intention is to provide guidelines to maximise the availability of EV charging infrastructure in buildings, developments, and neighbourhoods. • Builders/developers are expected to provide EV charging infrastructure for occupants and visitors. • Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide services for the restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power and electric transportation.
Policy Message	•	Rapid uptake of battery electric vehicles assumed in the overall fleet. • On June 29, 2021, Canada's federal government announced a mandatory target to achieve 100% zero-emission for light duty vehicles by 2035. The shift in policy from a voluntary 2040 target was informed by a recent International Energy Association report that says that all light duty vehicles sales globally must be electric to achieve net zero emissions by 2050.88 • Electric vehicles are more efficient than internal combustion vehicles in addition to contributing fewer or no emissions depending on the carbon intensity of the electricity supply. • While a major contributor, the impact of encouraging the use of BEVs cannot be viewed in isolation from other measures to reduce the GHG impact of transportation fuels. • In the business-as-usual case, the transportation is the largest source of GHG emissions in 2051 at 319kt (46% of total), falling to 88kt (65% of total) in the Efficiency Case. The bulk of the remaining GHG emissions are from gasoline and diesel fueled heavy vehicles on the Urban Boulevard.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Low emissions and higher efficiency
CEERP Interpretation	•	Included
CEP Relevance	•	Yes
Spatial Impact	•	Accommodation of EV charging infrastructure (Class 2 electric vehicle chargers for all homes and buildings) • Accommodation of EV parking
Regulatory land use planning tools	•	Community Block Plan • Zoning By-law • Draft Plan of Subdivision/Condominium • Site Plan Control

[88] Report found at: https://www.iea.org/reports/net-zero-by-2050

	• Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Transportation Master Plan • Building Code • Integrated Energy Master Plan • Financial Incentives • Voluntary Standards and Ratings • Public Education and Community Consultation

23. Gas, diesel, biodiesel, compressed natural gas, liquid natural gas transportation fuel service

Energy Parameter	• **Energy Services - Energy Services to Transportation**
Definition	• Includes vehicles using fossil fuel-based transportation fuels
CEP Recommendation	• Not applicable
2051 Outcome	• Not applicable
Policy Guidance	• None
Policy Message	• Rapid update of battery electric vehicles assumed in the overall fleet.
Technical Functionality	Biodiesel vehicle • Conventional compression-ignition diesel engine with minor modifications. • Biodiesel refined from energy crops including corn, palm, canola & soy. • Fuel can also be refined from waste cooking oil / fat. • Wheels driven by conventional IC engine and transmission. • Refueled from bio-diesel pump and stored in on-board tank. • On-board GHG emissions ~ 80% than conventional diesel. • Tank to wheel efficiencies of ~ 25%. Plug-in hybrid electric vehicle (PHEV) • Wheels driven by electric motors with power from on-board battery. • When driving battery is charged by on-board IC gasoline engine. • Braking energy is recaptured to charge battery. • Refueled from gasoline pump and stored in on-board tank. • Battery can be charged from EV charger when vehicle stationary. • On-board GHG emissions at least 50% less than gasoline. • Battery / tank to wheel efficiencies of ~ 30% in full hybrid operation.
Benefits/Challenges	Biodiesel vehicle • All current diesel vehicles could use biodiesel. • Real GHG impact includes energy used to farm, refine, and transport fuel. • Unresolved discussion as to overall environmental impacts. Plug-in hybrid electric vehicle (PHEV) • Wide selection of cars, SUVs, light trucks & delivery vans. • Real GHG impact includes plug-in power source and driving pattern. • Longer range than equivalent EV on single fill/charge. • EV only mode facilitates compliance in designated Low Emissions Zones.
CEERP Interpretation	Biodiesel vehicle • Not analytically included. • All liquid fueled vehicles increase efficiency by 30%. Plug-in hybrid electric vehicle (PHEV) • Share of HEV PKT drops from 1.2% to 0.5% by 2050. • Assumed to be overtaken by BEVs.
CEP Relevance	Biodiesel vehicle • Trip tracking / vehicle type data acquisition. Plug-in hybrid electric vehicle (PHEV) • Same measures to encourage BEV use apply.

		Trip tracking / vehicle type data acquisition
Spatial Impact	•	Transitional accommodation for fueling infrastructure
Regulatory land use planning tools	•	Zoning By-law
Other municipal tools & instruments	•	Not applicable

24. Grid electricity

Energy Parameter	•	**Energy Services – Supply Portfolio**
Definition	•	Includes electricity distributed from the provincial grid.
CEP Recommendation	•	Not applicable
2051 Outcome	•	All-electric energy services (heating, cooling, lighting, other, transportation) to low-density residential areas • All electric energy services (lighting, other, transportation) to all other areas • Air conditioning in MDMU when not supplied by district cooling (exception only)
Policy Direction	•	Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide services for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Policy Message	•	Ontario's long-term policy commitment to support the rapidly growing portion of locally sourced power and efficiency is a key assumption of the CEP.
Technical Functionality	•	Interconnects electrical sources and users. • Manages optimized balance between generation, storage, and usage. • Integrates "behind-the-meter" processes & equipment. • Creates clear picture of electric vehicle (EV) usage profiles.
Benefits/Challenges	•	Supports low carbon energy systems including DE. • Manages peak loads. • Can optimize energy system cost, efficiency, and emissions. • Smaller micro grids can be combined to macro grids. • Facilitates increased local power supply resilience. • Identifies areas for continuous improvement.
CEERP Interpretation	•	Not analytically included – part of overall CEERP narratives.
CEP Relevance	•	Multiple measures to facilitate the creation of microgrids including data interoperability and confidentiality standards.
Spatial Impact	•	Accommodation of linear infrastructure in the municipal right of way. • Grid connections to buildings • Location of transformer station
Regulatory land use planning tools	•	Not applicable
Other municipal tools & instruments	•	Not applicable

25. Natural gas

Energy Parameter	•	**Energy Services – Supply Portfolio**
Definition	•	Natural gas supplied by Enbridge
CEP Recommendation	•	Natural gas limited to neighbourhood energy centres and industry.
2051 Outcome	•	No retail natural gas is available for LRA, with heating and hot water supplied by electricity and solar thermal • No retail natural gas is available for MDMU and HDMU, which will receive heating and hot water services from the thermal utility • No natural gas is available for light industrial customers who will receive process heating, space heating and hot water services from the thermal utility. There may be exceptions if the industry's process requires the chemistry of natural gas • Natural gas will only serve the district energy centres to efficiently create heat and some local electricity[89]
Policy Direction	•	Enbridge will supply natural gas to district energy centres and some industry.
Policy Message	•	By limiting distribution to district energy centres and some industry, the GHG emissions from the Heritage Heights Community's use of natural gas drops from 2051 Base Case total of 264kt to an Efficiency Case total of 22kt.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	High emissions
CEERP Interpretation	•	Included
CEP Relevance	•	Transitional only
Spatial Impact	•	Limited accommodation of linear infrastructure in the municipal right of way • Limited connection of building to natural gas network
Regulatory land use planning tools	•	Community Block Plan • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	•	Integrated Energy Master Plan

[89] From 2023, the natural gas used by the district energy utility has a progressively lower carbon index as Enbridge adds biogas and hydrogen to their network.

26. Solar PV

Energy Parameter	• Energy Services – Supply Portfolio
Definition	• Conversion of light into electricity.
CEP Recommendation	• Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	• Solar PV will supply 12% of the Heritage Heights total electricity demand • All homes and building in all areas will include solar PV, mostly for their own use
Policy Direction	• Builder/developers are expected to integrate solar PV and supporting battery storage into all buildings. • It is the City of Brampton's intention to explore and develop incentives for developers to include renewables. • Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide interconnection, information, and other services to qualified users and operators for the restructured SPA demand resulting from increased efficiency, building integrated solar PV, local CHP, and electric transportation.
Policy Message	• Ontario's long-term policy commitment to support the rapidly growing portion of locally sourced power and efficiency is a key assumption of the CEP. • Building integration of solar PV at time of construction is more cost-effective. • District energy ready design frees up rooftop space for solar PV, green roofs, and recreational use.
Technical Functionality	• Converts solar radiation to power. • Building or floor mounting possible. • Power usage in buildings. • Power feed-in into distribution grids.
Benefits/Challenges	• Easy to integrate in roofs of new buildings. • Decreasing installation cost. • Battery storage possible to align generation and usage. • Combination with E-vehicle charging and heat pumps to maximize decentralized usage. • Feature for optimized microgrids. • Carbon free power generation.
CEERP Interpretation	• Supply 8% of Brampton's electricity with locally generated solar power.
CEP Relevance	• Multiple immediate measures to maximize solar PV integrated into all new developments.
Spatial Impact	• Physical form on the building or ground • Connections to electricity grid
Regulatory land use planning tools	• Community Block Plan • Zoning By-law • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Integrated Energy Master Plan

27. Solar Thermal

Energy Parameter	•	**Energy Services – Supply Portfolio**
Definition	•	Thermal energy captured from solar radiation.
CEP Recommendation	•	Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	•	Solar thermal will supply one-third of the service hot water needs of LRA
	•	All homes and buildings in LRA will include solar thermal for their own use
	•	Centralized solar thermal as a district energy heating source may be added in the later years. This will be an operational decision of the thermal utility.
Policy Directions	•	Builder/developers are expected to integrate solar thermal into all LRA homes and buildings.
	•	It is the City of Brampton's intention to explore and develop incentives for developers to include renewables
Policy Message	•	Solar thermal service hot water for LRA homes and buildings cannot be viewed in isolation from the multiple measures included in the CEP to substantially reduce the GHG emissions from the use of natural gas for service hot water and heating and cooling of homes and buildings.
	•	In the business-as-usual case, the use of natural gas is the second largest source of GHG emissions in 2051 at 264kt (38% of total), falling to 22kt (17% of total) in the Efficiency Case.
Technical Functionality	•	Converts solar radiation to heat.
	•	Installation mainly on building roofs.
	•	Usage for service hot water and heating system support.
	•	Possible asset for generation 4 and 5 district heating systems.
Benefits/Challenges	•	Easy to integrate in roofs of new buildings.
	•	Decreasing installation cost.
	•	Can be the only heating source in summer months.
	•	Carbon free heat generation.
CEERP Interpretation	•	Serve 10% of hot water and heating needs in homes not served by district heating with solar hot water.
CEP Relevance	•	Multiple immediate measures to maximize solar thermal integrated into residential developments in non-DE areas.
Spatial Impact	•	Physical form on the building or ground
	•	Potential connections to district energy system
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning By-law
	•	Draft Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Integrated Energy Master Plan (if not located on building)

29. Combined heat and power (engines)

Energy Parameter	•	**Energy Services – Supply Portfolio**
Description	•	Combined heat and power (CHP) (or cogeneration) is an energy efficient technology that generates electricity and captures the heat that would otherwise be wasted to provide useful thermal energy – such as steam or hot water – that can be used for space heating, cooling, domestic hot water, and industrial processes.
Recommendation	•	Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	•	CHP will supply 19% of SPA total electricity requirements.
	•	CHP will be part of the supply portfolio for MDMU, HDMU, IND and HOS areas.
Policy Direction	•	The City of Brampton intends to explore options to immediately provide comprehensive district heating and cooling services in Heritage Heights.
	•	Alectra (the distribution company) in coordination with Hydro One (the transmission company) and IESO will provide interconnection, information, and other services to qualified users and operators for the restructured demand in Heritage Heights resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric transportation.
Policy Message	•	Combined heat and power operated by a thermal utility provides an efficient way to produce both heat and electricity.
Technical Functionality	•	An internal combustion engine generates both electricity (power) and thermal energy from a single fuel source usually natural gas or biogas.
	•	Heat is recovered from engine exhaust and engine cooling
	•	Available from a few kW to approximately 10 MW per unit.
Benefits and Challenges	•	Higher efficiency than separate heat and power generation.
	•	Cost effective way to generate local energy.
	•	Zero or low carbon emissions dependent on fuel used.
	•	Increases local power and heat supply resilience.
	•	When electricity is generated in large scale regional gas-fired power plants, as much as 60% of the energy value is lost (most as heat at the point of generation and the remainder during transmission). This systemic inefficiency can be addressed by generating electricity within the community and capturing the heat for use in a district energy system.
CEERP Interpretation	•	Analytically about 220 MWel is included in CEERP city-wide in 2041.
CEP Relevance	•	Immediate strategic component of energy centres for district energy including host developments.
Spatial Impact	•	Location of facility
	•	Connections to building, thermal system and electricity grid
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning By-law
	•	Draft Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Integrated Energy Master Plan

30. Waste heat

Energy Parameter	•	**Energy Services – Supply Portfolio**
Definition	•	Use of heat from local processes or exhausted air.
CEP Recommendation	•	Reduce (capture and use) waste heat.
2051 Outcome	•	12% of DE supplied heating will be sourced from waste recovery
Policy Direction	•	None – these are operational decisions and negotiations between the thermal utility and the waste heat source
Policy Message	•	Modern district energy systems provide the flexibility to integrate low-carbon waste heat if it is available in reasonable qualities at reasonable costs.
Technical Functionality	•	Uses heat from processes or exhaust air. • Replaces cooling towers. • Direct heat use is possible depending on temperature. • Heat pumps can be used to adjust to required temperature.
Benefits/Challenges	•	Carbon free energy • Possible sources include power plants, industrial processes, waste to energy plants, data centres, ice rinks and swimming pools.
CEERP Interpretation	•	Not analytically included.
CEP Relevance	•	High-probability future part of energy supply portfolio facilitated by district energy and smart energy network including Industrial Park.
Spatial Impact	•	Connections to building/thermal system
Regulatory land use planning tools	•	Not applicable
Other municipal tools & instruments	•	Integrated Energy Master Plan

31. Environmental (air-based)

Energy Parameter	•	**Energy Services – Supply Portfolio**
Definition	•	Thermal energy from the air
CEP Recommendation	•	Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	•	18% of all source energy used in the SPA will be captured from the atmosphere or the ground • Heating, cooling, and hot water needs of low-density residential areas are met with air-based heat pumps with supplementary solar thermal, electric induction heating
Policy Directions	•	Builder/developers are expected to integrate high-efficiency air-based heat pumps into all LRA homes and buildings. • It is the City of Brampton's intention to explore and develop incentives for developers to include heat pumps. • It is the City of Brampton's intention to ensure the electrical infrastructure supports all-electric LRA homes and buildings.
Policy Message	•	The CEP assumes that LRA homes and buildings will be all-electric. • Heat pumps in LRA homes and building cannot be viewed in isolation from the multiple measures included in the CEP to substantially reduce the GHG emissions from the use of natural gas for service hot water and heating and cooling in homes and buildings. • In the business-as-usual case, the use of natural gas is the second largest source of GHG emissions in 2051 at 264kt (38% of total), falling to 22kt (17% of total) in the Efficiency Case
Technical Functionality	•	Heat pumps (HP) transfer outside air to a usable temperature level for heating and service hot water. • Principle is the reverse refrigerator. • HP can also be used for cooling. • Generally driven by electricity (natural gas HPs are available).
Benefits/Challenges	•	High efficiency (1 kWh electricity generates up to 3.5 kWh heat). • At lower outside temperatures (<-2°C) additional heating is required (boiler or direct electric heating). • Combination with solar thermal collector and solar photovoltaics (PV) are recommended. • Combination with high-efficiency envelope and hydronic heating and cooling distribution in buildings maximizes overall efficiency. • Emissions dependent on sources of electricity from the grid and local renewables.
CEERP Interpretation	•	Not analytically included.
CEP Relevance	•	High-probability heating and cooling source for most buildings not served by district energy. • Potential future part of energy supply portfolio facilitated by district energy and smart energy network.
Spatial Impact	•	Physical form on the building
Regulatory land use planning tools	•	Community Block Plan • Zoning By-law • Draft Plan of Subdivision/Condominium • Site Plan Control

	• Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Not applicable

32. Environmental (ground-effect)

Energy Parameter	Energy Services – Supply Portfolio
Definition	Thermal energy from the ground
CEP Recommendation	Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	• 18% of all source energy used in Heritage Heights will be captured from the atmosphere or the ground • Some heating, cooling and hot water needs of all areas may be supplied by ground source systems, operating either as stand-alone, or as an element of the SPA DE Services
Policy Direction	• Builder/developers may include ground-effect geothermal exchange heating and cooling systems in all areas. • The Thermal Utility may include ground-effect geothermal exchange heating and cooling arrays as a supply asset. • All Ground-effect geothermal exchange heating and cooling systems in medium and high-density areas will be capable of being integrated into the DE network.
Policy Message	• The default for all low-density residential areas will be air-based heat pumps and on-site renewables. The permitting process could include a development using ground-effect geothermal (geothermal) exchange combined with water-based thermal-exchange pumps. This would require a geological assessment.[90] • The default for all medium- and high-density development will be district heating and cooling supplied by a portfolio of thermal sources managed by the utility. The permitting process could include a development using geothermal exchange if the technical design allows for future integration into the wider district energy system. • The thermal utility could include centrally managed geothermal exchange arrays as part of the overall thermal supply portfolio.
Technical Functionality	• Heat pumps (HP) are transferring energy from water to a usable temperature level for heating and service hot water. • The principle is the reverse refrigerator. • HP can also be used for cooling. • Driven by electricity (natural gas HPs are available). • Sources with typical temperature of about 10 to 20°C include: 1) water cycled through ground array, 2) ground water / sewage water and 3) cold district energy systems.
Benefits/Challenges	• High efficiency (1 kWh electricity generates up to 5 kWh heat). • Combinations with solar thermal collector and solar PV are possible. • Combination with high-efficiency envelope and hydronic heating and cooling distribution in buildings maximizes overall efficiency. • Carbon emissions are dependent on the GHG index of the grid. • Ground effect geology and configuration is critical in higher density areas since neighboring systems can have negative interference. • Open space is needed.

[90] Ground effect arrays require a geological assessment to ensure their long-term thermal performance. Depending on the geology, the surrounding rock can warm up over time.

	• Drillings may require geologic assessments and specific permissions.
CEERP Interpretation	• Not analytically included.
CEP Relevance	• Low-probability heating & cooling source for a few buildings not served by district energy. • Potential future part of energy supply portfolio facilitated by district energy and smart energy network.
Spatial Impact	• Location of system • Connection to thermal system and buildings
Regulatory land use planning tools	• Community Block Plan • Zoning By-law • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Integrated Energy Master Plan

33. Electricity storage (battery)

Energy Parameter	•	**Energy Services – Supply Portfolio**
Definition	•	A cell or connected group of cells that stores electrical energy as chemical energy.
CEP Recommendation		Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	•	Battery storage implemented across the SPA to match supply and demand and mitigate reliability issues
Policy Direction	•	It is the City of Brampton's intention to create guidelines to include building integrated battery storage, including battery electric vehicle connectivity.
	•	Builders/developers are expected to consider offer integrated battery storage and battery electric vehicle connectivity as a standard option.
	•	Alectra (the distribution company), in coordination with Hydro One (the transmission company) and IESO will include highly distributed battery storage in their demand management planning for Heritage Heights.
Policy Message	•	Battery storage optimizes the timing of available low-carbon electricity supply to meet consumer demand.
	•	Using a battery-electric vehicle as a back-up resource for the electricity system creates community value for the 90% of the time it is not being used.
	•	Benefits are potential upsides to the CEP simulation.
Technical Functionality	•	Electrochemical storage of electricity.
	•	Store when generation is higher than demand.
	•	Use when demand is higher than generation.
	•	Storage can be either an end-user or a grid asset.
	•	Connected Battery Electric Vehicles (BEVs) can be part of storage system.
Benefits/Challenges	•	Optimizes usage of renewable electricity.
	•	Supports carbon free electricity system.
	•	Currently relative expensive.
	•	Can be cost-effective use of old BEV battery packs.
	•	Unresolved debate of lifetime environmental impacts.
	•	Increases local power supply resilience.
CEERP Interpretation	•	Not analytically included.
CEP Relevance	•	Multiple approaches to optimize electricity usage and emissions.
	•	Interoperable protocols to integrate battery storage.
Spatial Impact	•	Location of facility (if not in building or battery-electric vehicle)
	•	Connections to building, vehicles and/or electricity grid
Regulatory land use planning tools	•	Community Block Plan
	•	Zoning By-law
	•	Draft Plan of Subdivision/Condominium
	•	Site Plan Control
	•	Development Design Guidelines
	•	Sustainability Metrics Program
Other municipal tools & instruments	•	Integrated Energy Master Plan

34. Thermal storage (cisterns)

Energy Parameter	• Energy Services – Supply Portfolio
Definition	• Storage of thermal energy in water.
CEP Recommendation	• Increase local energy (thermal and electricity) generation and storage.
2051 Outcome	• Thermal storage (heat and cold) in MDMU and HDMU areas as part of the district energy system • Thermal storage implemented by the thermal utility to match supply and demand and mitigate reliability issues
Policy Direction	• None – other than land use. The size and timing of implementing thermal storage is an operational and commercial decision of the thermal utility. Typically, thermal storage would be integrated into a district energy centre or on a mutually agreed location on a customer site. Theoretically, this can include stormwater ponds and pools when combined with an appropriate conversion system.
Policy Messages	• Thermal storage optimizes the timing of available low-carbon heat supply to meet consumer demand. • Benefits are potential upsides to the CEP simulation.
Technical Functionality	• Stores conditioned water for later use. • Adjusts different loads of generation and usage. • Possible variants include hot water mainly for service hot water, cold water mainly for air conditioning and ice storage for all kind of cooling purposes.
Benefits/Challenges	• Stores surplus energy from renewable energy generation, e.g., service hot water form solar collectors for night usage. • Supports low carbon and carbon free energy systems in terms of load management and peak requirements.
CEERP Interpretation	• Not analytically included.
CEP Relevance	• Immediate strategic component of energy centres for district energy including host developments.
Spatial Impact	• Location of facility • Connections to building and/or thermal system
Regulatory planning tools	• Community Block Plan • Zoning By-law • Draft Plan of Subdivision/Condominium • Site Plan Control • Development Design Guidelines • Sustainability Metrics Program
Other municipal tools & instruments	• Integrated Energy Master Plan

35. Smart energy network

Energy Parameter	•	**Energy Services – Efficient Energy System Management**
Definition	•	The integrated use of information technology to manage energy performance.
CEP Recommendation		Establish a smart energy network (power and thermal, built environment, and transportation).
2051 Outcome	•	Continuous improvement in the efficiency of the built environment and transportation through optimisation • Implement inter-operable smart metering for all energy services • Comprehensive traffic count and vehicle activity metering systems implemented • Inter-operable protocols to enable neighbourhood-level building automation created • Integrated “Smart Energy Community” analysis and reporting platform developed
Policy Direction	•	See Building End Use Efficiency Policy Direction relative to efficient building management and smart metering. • It is the City of Brampton’s intention to develop information and equipment guidelines to capture relevant transportation data. • It is the City of Brampton’s intention to develop “Smart Community” system architecture guidelines to enable qualified users to optimize their operations. • It is the City of Brampton’s intention to develop an institutional structure to capture and report the energy performance of the Heritage Heights Community on a routine basis.
Policy Message	•	The Smart Energy Community architecture for Heritage Heights will be the template for the wider City of Brampton.
Technical Functionality	•	Not applicable
Benefits/Challenges	•	Optimization of energy performance at a community level.
CEERP Interpretation	•	Included in narrative
CEP Relevance	•	Yes
Spatial Impact	•	Not applicable
Regulatory land use planning tools	•	Not applicable
Other tools & instruments	•	Community Consultation

Appendix 14 – Alternate pathways

1. End-use Efficiency Only

A simulation including end-use efficiency measures only reconfirmed the findings of the Community Energy and Emissions Reduction Plan (CEERP) - i.e., to achieve a near-net zero community within the Heritage Heights Secondary Plan Area as recommended by the CEERP, it must also consider building heating and cooling, and energy generation and distribution. While a necessary component of the Heritage Heights CEP, end-use efficiency will not be sufficient to achieve the near-net zero goals established by the City of Brampton for the community (Table 1).

Table 1: Comparative performance of the Efficiency Case and only considering end use efficiency only relative to the Heritage Heights CEP Goals

Performance	**Efficiency Case**	**End-use efficiency only approach**	**Heritage Heights Framing Goals[91]**
SPA[92] site energy (GJ)	5.9M	7.1M	Not applicable
SPA source energy (GJ)	10.4M	12.8M	Not applicable
SPA greenhouse gas emissions (metric tonnes)	137,000	290,500	Not applicable
Source energy efficiency (GJ/capita)	84	104	45
Greenhouse gas emissions per capita index (tonnes/capita)	1.1	2.4	1.1
2051 annual utility costs – lower range and carbon tax	$350M	$460M	Not applicable
2023-2051 total avoided costs (B$)	$8B	$ 6B	$8B

Local energy supply and distribution, also referred to as Distributed Energy Systems (DES), is the local operation and generation of energy close or next to its point of use. DES includes both power and thermal generation and distributed energy management. Elements of DES can include power from rooftop solar panels, storage with electric batteries and thermal tanks, electric microgrids, district heating and cooling networks, and interactive building energy management. This is compared to the traditional centralized energy supply utilized today. Today, power is sourced from larger generator facilities outside the community (e.g., in Ontario: Bruce Nuclear Power Plant or Niagara Falls Hydro-electric generation plant) and is sent

[91] These goals are aligned with the CEERP and used to measure simulation performance.
[92] SPA means Secondary Plan Area.

through large transmission and distribution grids before reaching the end user. Natural gas is sourced from well outside the community and sent through a large pipeline network to the end-user.

Distributed Energy Systems offer communities the following benefits:

- lowering the carbon impact of meeting the heating, cooling, and hot water needs of buildings and industrial processes, through the distribution of heating and cooling supplied from a range of lower carbon thermal sources
- reducing system losses associated with the current centralized power and natural systems; and
- increasing the security, resiliency, and flexibility of local energy supply.

The use of natural gas to heat buildings contributes 38% of Brampton's GHG emissions, second only to the emissions impact of diesel and gasoline use in vehicles. This underscores the need to identify measures that address the heating, cooling, and hot water needs of buildings. The CEERP calls for the incorporation of modern district heating and cooling in major growth areas, such as the Heritage Heights Community.

Modern district energy systems facilitate the use of many kinds of low carbon heat sources including:

- Combined heat and power (CHP) using natural gas and biogas
- Boilers using natural gas and biogas
- Boilers using renewable electricity
- Geothermal arrays
- Large solar-thermal arrays
- Sewage waste heat recovery
- Industrial and other waste heat

Of the district energy heat sources noted above, only natural gas fired CHP and boilers were in the CEERP's recommended simulation.[93] Inclusion of other low carbon heat sources will further reduce the GHG impacts of heating and cooling. Other local carbon heat sources have been phased into the Heritage Heights CEP simulation.

In Brampton, the highest energy system losses are associated with electricity use.[94] Increasing local electricity generation will reduce the economic and environmental impact of these losses on the community. In 2016, locally generated solar power supplied less than 0.5% of Brampton's electricity needs. Traditionally, municipalities have had a limited role in solar supply. There is opportunity for the City of Brampton to encourage the integration of solar PV into buildings from the start in the Heritage Heights Community. This is reflected in the CEP Efficiency Case simulation.

Local utilities, both existing and new, will play a major role in managing the migration of energy supply to a more decentralized system. Partnerships with and between local industry will also be needed to capitalize on the best opportunities within the city for distributed energy systems (DERs).

[93] This was a set of assumptions established in 2016 prior to the Climate Emergency motion and was agreed by to by the PWT as being a reasonable high efficiency but conservative assumption. The potential for the DE infrastructure to further reduce the GHG impact was covered in CEERP narrative. In HH CEP this has been quantified and simulated.
[94] Source: CEERP

2. Electric Heat Only

A simulation was conducted to examine the claim that the only way to decarbonize heating (the second largest cause of GHG in Brampton after transportation) is to electrify every building using heat-pumps (air or ground-effect geothermal) using power from the grid and local renewable sources. This concept is usually associated with a concurrent mass electrification of all forms of transport using either batteries or green hydrogen, so any assessment of electrification must consider the overall impacts from all sectors. Implicit in this approach is the assumption that the power from the grid will be nearly 100% from zero carbon sources (nuclear, hydro, wind, solar) for the foreseeable future.

On the building side, it should be noted that this is the approach adopted in the Heritage Heights CEP simulation for all low-density areas, supplemented by local (on-building) solar PV and solar thermal. The CEERP, and by extension the Heritage Heights CEP, takes a more nuanced approach to decarbonize heating and hot water use over the 20 to 30 years of the plan for medium- and high density-mixed use, and industrial areas.

In the CEERP, Heritage Heights is designated as an area to implement a comprehensive district energy system. This is reflected in the CEP simulation for all new development classified as medium and high density-mixed use and industrial. The district heating network will be initially energized with natural gas fired combined heat and power and heat-only boilers, located in neighborhood energy centres. This interconnected structure has an immediate positive effect on heating GHG emissions by being technically more efficient than the typical current alternative of thousands of individual furnaces and water. The use of CHP also reduces the marginal GHG impact from the use of natural gas peaking plants on the provincial grid. The district heating network also creates an infrastructure that allows for stepwise decarbonization of heating in flexible and cost-effective ways. The steps simulated over the CEP timeframe include the combination of:

- Reduction in GHG content of natural gas network as Enbridge adds biogas, and hydrogen to the network
- Use of heat traditionally wasted from chillers, industrial processes, water treatment, sewer networks *etc*.
- Substituting natural gas fired combined heat and power and heat only boilers for biofuel fired alternatives in some of the energy centres
- Substituting natural gas fired sources for electric boilers using renewable power as it becomes available at suitable cost and in sufficient quantities
- Substituting natural gas fired sources for industrial-scale, high-efficiency heat-pumps using renewable power as it become available at suitable cost in sufficient quantities

The implementation of district energy systems from the start allows these sources to be mixed and matched over time to achieve the best balance between cost, GHG emissions, and the demands on the larger grid for nuclear and renewable power.

On the transportation side, the CEP simulation assumes that by 2051, the majority of vehicles of all categories will be electrified either directly with on-board batteries, or indirectly using hydrogen created using low-carbon electricity.

A comparison of an “all-electric” approach with the CEP Efficiency Case also supports the latter (Table 1). An all-electric approach underperforms the Efficiency Case.

Table 1: Comparative performance of the Efficiency Case and an "all-electric approach relative to the Heritage Heights CEP Goals

Performance	Efficiency Case	All-electric approach	Heritage Heights Goal
SPA[95] site energy (GJ)	5.9 million	4.7 million	Not applicable
SPA source energy (GJ)	10.4 million	10.6 million	Not applicable
SPA greenhouse gas emissions (metric tonnes)	137,000	200,000	Not applicable
Source energy efficiency (GJ/capita)	84	85	45
Greenhouse gas emissions per capita index (tonnes/capita)	1.1	1.6	1.1
2051 annual utility costs – lower range and carbon tax (million $ avoided)	350M	413M	Not applicable
2023-2051 total avoided costs (billion $)	$8B	$6.8B	$8B

Understanding the implications of large-scale electrification of Canada's stationary and mobile energy systems is an important consideration in evaluating energy transition pathways. Modelling by Trottier Energy Futures suggest that Canada's power infrastructure would need to more than double[96]. This is the equivalent of building 150 projects of the size of the Site C hydropower project in British Columbia in the next thirty years. There is the technical challenge and cost of building this many large-scale projects but also many "soft factors" to take into consideration like community opposition and legal challenges which can delay projects as was the case for the Site C hydropower project.[97]

The risk for any community considering the electrification of heating is how many other communities will join them on that path and the demand on the provincial electricity grid. The opportunity and challenge for Brampton is to provide a new energy service – a thermal utility – to the Heritage Heights Community.

[95] SPA means Secondary Plan Area
[96] Source: https://www.mcgill.ca/tised/files/tised/final_report_on_tefp_canadas_challenge_and_opportunity_transformations_for_major_reductions_in_ghg_emissions.pdf
[97] Reference sourced at: https://www.uottawa.ca/positive-energy/sites/www.uottawa.ca.positive-energy/files/canadas_energy_future_design_rd_web.pdf

Appendix 15 - Land Use Planning Tools for Energy Planning

The following table provides a comprehensive guide to policy considerations to be addressed by the Secondary Plan through regulated land use planning tools.

Planning Tools	Description	Heritage Heights Planning and Policy Framework Considerations	Recommendations for specific policies and approaches
Policy Tools			
Official Plan	▪ Provides general land use policies that support low-carbon and/or net-zero communities and energy conservation and efficiency objectives.	▪ Develop general policies regarding energy and emissions to be included through the municipal comprehensive review process based CEERP recommendations.	▪ Embed a climate lens throughout the Official Plan to ensure all City policies are guided by climate change mitigation considerations.
Secondary Plan	▪ Provides vision and intent for a defined “secondary” geographic area and more detailed refinement of Official Plan policies that support near net zero communities and energy conservation and efficiency objectives.	▪ Develop land use planning policies informed by the CEERP and CEP ▪ Indicate potential location for future energy infrastructure (e.g., district heating and cooling centres, and energy services distribution networks) ▪ Set out development phasing and implementation measures, including all energy considerations for precinct plans and development review (e.g., responsibilities for and timing of energy services infrastructure)	▪ Include policy identifying energy considerations for Section 37 Community Benefits
Policy Implementation Tools			

Precinct Plan	▪ For smaller geographic areas within the Secondary Planning area, Precinct Plans assist in the:
	  o co-coordination of the delivery of services and infrastructure
	  o allocation of development priority
	  o layout of roads and the location and configuration
	  o character, size and urban form of parks, institutional, commercial, and industrial sites
	  o layout/function of open space corridors, valleylands, woodlots and other natural features
	▪ Community Design Guidelines are produced for each Precinct Plan detailing the physical design of the area to confirm and supplement the City's Development Design Guidelines (see below)
		▪ Include detailed community structure and infrastructure considerations
		▪ Physical plan indicated for district heating and cooling centres and local energy distribution infrastructure
		▪ Infrastructure easements identified
		▪ Ensure policies complement adjacent land uses
		▪ Recognize the importance of natural heritage features that support carbon sequestration
		▪ Include requirement for an Integrated Energy Master Plan to implement the CEP (see below)
			▪ Align Precinct Plans with each SPZ (i.e., CEP energy zone) to coordinate implementation of CEP and Secondary Plan policy
			▪ Add utilities section of application to include energy considerations

Zoning By-law	▪ Used to control the development of land within a community. It states exactly: ▪ how land may be used ▪ where buildings and other structures can be located ▪ the types of buildings that are permitted and how they may be used	▪ Include zoning regulations to achieve policy objectives of the Secondary Plan. ▪ Include energy regulations by zone, especially related to height and setbacks of energy infrastructure (e.g., renewable energy technology, ground source geo-thermal systems, etc.)	▪ Include energy-related performance standards ▪ Exempt solar PV, wind and other infrastructure on roofs and outside of building envelopes from height and massing regulations ▪ Include parking standards for bicycle and car-share

	▪ the lot sizes and dimensions, parking requirements, building heights and setbacks from the street	▪ Include direction for providing on-site renewables “as of right” while ensuring appropriate setbacks and mitigating potential land use conflicts.	parking spaces as well as private car parking spaces ▪ Include requirements for EV plug-ins (low-density res. as well as high and medium-density zones) ▪ Consider expanded drop off/pick up areas to facilitate ridesharing ▪ Consider whether zoning permits expanded permissions for home occupations to limit commuting ▪ For LD areas, confirm secondary unit as of right ▪ Anticipate use of Holding By-laws: allow future uses for land or buildings but delay development until local services, such as district energy facilities are in place (i.e., zoning by-law with a holding symbol (“H”) restricts future uses until conditions for removing “H” are met).
Plan of Subdivision/ Plan of Condominium	▪ Developers must obtain approval from the City for plans, studies, and/or drawings of proposed development	▪ Include CEP implementation objectives. ▪ Include requirement of Energy Management Strategy ▪ Provide incentives for applications that achieve low-carbon and/or net-zero objectives through the municipal	▪ Site Plan Control to include CEP-related facilities including district energy ▪ Ensure responsibilities between City Energy Utility and condominiums/ building owners is clear

		approvals process (see CIP and voluntary standards) ▪ Identify rights-of-way for public energy infrastructure	
Site Plan Control	▪ for commercial, industrial, institutional, and multiple residential development prior to issuance of building permit	▪ Where Community Benefits, including energy services, are determined ▪ Development agreement items identified and listed during Site Plan Review Process	▪ Section 41 of the *Planning Act*
Community Benefits	▪ Increases in permitted height and/or density may be authorized by the City of Brampton in return for Community Benefits, such as district energy facilities and energy services	▪ Determined through Site Plan Control process	▪ Section 37 of the *Planning Act*
Community Improvement Plan	▪ Provides the City the opportunity to provide financial incentives for the provision of energy efficient uses, buildings, structures, works, improvements, or facilities	▪ See “Financial incentives” below	▪ According to Section 28(1) of the *Planning Act*, a “community improvement project area” is defined as “a municipality or an area within a municipality, the community improvement of which in the opinion of the council is desirable because of age, dilapidation, overcrowding, faulty arrangement, unsuitability of buildings or for any other environmental, social or community economic development reason.” ▪ Section 28(1) of the *Planning Act* defines

"community improvement" as "the planning or re-planning, design or redesign, re-subdivision, clearance, development or redevelopment, construction, reconstruction and rehabilitation, improvement of energy efficiency, or any of them, of a community improvement project area, and the provision of such residential, commercial, industrial, public, recreational, institutional, religious, charitable, or other uses, buildings, structures, works, improvements or facilities, or spaces therefore, as may be appropriate or necessary."

- Section 28(7.1) of the *Planning Act* further specifies that the eligible costs of a community improvement plan for the purposes of Section 28(7) may include costs related to environmental site assessment, environmental remediation, development, redevelopment, construction and reconstruction of lands and buildings for

			rehabilitation purposes or for the provision of energy efficient uses, buildings, structures, works, improvements, or facilities.
Development Review Process Tools			
Development Design Guidelines (DDG)	▪ Provide a minimum design standard that is expected in planning, designing, and constructing new communities or projects in Brampton. Through the planning and design process, the City of Brampton will evaluate projects to ensure that standards are met. ▪ Sustainable Community Development Guidelines form a chapter of the DDG and, along with other considerations, provide guidance to the placement, mass and orientation of buildings and infrastructure.	▪ Increase guidance on sustainable building and neighbourhood design and materials, as well as location and scale of on-site renewable energy and district energy interconnections. ▪ Community Design Guidelines for each Precinct Plan will confirm DDGs are addressed and include any additional physical design considerations. ▪ Include guidance on integrating low-carbon transportation outcomes into the built form.	▪ Consider adding guidelines to ensure future solar energy access for new buildings; require solar setbacks to ensure future potential for solar PV is not limited on any building, as appropriate. ▪ Focus on achieving CEP goals through design of the transit hubs, special character areas (e.g., MTSAs), roadways, general design of mixed-use areas, trails, easements, etc.
Sustainability Metrics Program (SAT)	▪ Sustainability Metrics Program is completed by developers to generate the Sustainability Score of proposed developments. ▪ The program uses a series of questions to objectively quantify the sustainability attributes of a development application to support the development review process.	▪ Incorporate CEP performance metrics into Sustainability Metrics.	▪ Consider possible detailed performance standards and targets derived from CEP for inclusion in Sustainability Metrics.

Appendix 16 – Other Spatial Planning Tools and Instruments for Energy Planning

The following table provides a comprehensive guide to policy considerations to be addressed by the Secondary Plan through other spatial planning tools and instruments.

Non-*Planning Act* Tools/Instruments	Description	Heritage Heights Planning and Policy Framework Considerations	
Transportation and Transit Master Plan	▪ Long-term vision and strategic plan for Brampton's transportation network to address travel demand associated with future growth and manage transportation impacts while accommodating all modes of transportation (e.g., public transit, commuter travel, commercial vehicles, and active transportation).	▪ Include CEP goals and targets.	▪ Focus on supporting the shift to sustainable modes of transportation by reducing large parking lot areas
Active Transportation Master Plan	▪ Long-term transportation strategy emphasizing walking, cycling, and transit, creating a connected cycling and pedestrian network across the City of Brampton (and connecting to neighbouring municipalities).	▪ Include CEP goals and targets.	▪ Repurposing streets as public spaces to include car free zones which will reduce the dependence on vehicles and promote walkability.
Transit Master Plan	▪ Often project-based for larger routes	▪ Consider Transit Master Plan for HH, given Mainstreet vision. ▪ Include CEP goals.	▪ Consider increasing sustainable modes of transportation such as walking, cycling, and transit
Low Emissions Vehicle Zones	▪ Establish zones for ultra low emissions vehicles (e.g.,	▪	

	London, England's congestion charge for non-LEV vehicles)		
Parks & Recreation Master Plan/ PathWays Master Plan	▪ A large recreational trails system that connects parks and valleys, and provides convenient pedestrian and cycling routes across Brampton	▪ Consider designing parks that contribute to the quality of life and respond to emerging climate change issues ▪ Consider inclusion of parks in local energy production, such as solar PV in parking areas, bio-waste, and geo-exchange.	▪ New parks should consider being located around existing urban and/or rural greenspace, where possible. ▪ Cooling amenities such as wading pools or splash pads should be including where possible.
Ontario Building Code	▪ Specific set of standards applied to the construction of buildings and other structures.	▪ All development in Ontario is required to meet the minimum building code requirements. Heritage Heights should anticipate future Code probabilities. ▪ The Federal government has committed to developing a net-zero energy ready Building Code by 2030. ▪ Non-Canadian Codes can inform / anticipate probable future Canadian Building Code evolution ▪ Municipal policy and guidelines can encourage the achievement of standards greater than the building code. However, these are difficult to monitor/ enforce. Incentives through Community Improvement Plan (CIPs) can be explored to close the gap.	▪

Integrated Energy Master Plan/Energy Strategy	▪ Equivalent of a Community Energy and Emissions Reduction Plan (CEERP) but developed at the scale of a community, subdivision, or major site. In addition to identifying opportunities to improve the energy efficiency of the built form, they also identify options for integrating local supply and distribution at a neighbourhood or community scale.	▪ Require an energy strategy and energy modelling to be addressed through Precinct Plans or other development approvals, especially for SPZs where energy centres and DE network connections are required.	▪ Given the need to ensure the establishment of DE and to ensure the robustness of the network, Integrated Energy Master Plans at the Precinct Plan stage should be required to support integration; an additional requirement at development approval stage may also be desired to detail anticipated emissions and power consumption
Financial Incentives	▪ Grant programs and fee rebates to encourage energy efficiencies, electric vehicles, on-site renewables.	▪ Develop programs for new construction. ▪ Provide information and support processes for grant applications. ▪ Include in Community Improvement Plans/Project Areas (CIPs)	▪ Development Charge Grant/Reduction ▪ Development Charge Deferral ▪ Tax Increment Equivalent Grant (TIEG) (offset increment increase in property tax assessment resulting from the construction of new office development) ▪ Cash-in-lieu of Parkland Exemption/Reduction (potential discount on parkland fees for residential units in mixed-use buildings that include a minimum m^2 of office space)
Voluntary Standards and Ratings	▪ Includes ENERGY STAR, GreenHouse, Built Green, LEED standards, Net Zero Ready, ecoENERGY (for low-rise	▪ CIP can provide incentives for development applicants achieving certification	▪ Note that development companies also have their own Corporate Sustainability Reporting requirements to

	residential housing and commercial and institutional buildings through Canada's National Energy Code) and others, including globally recognized, non-Canadian codes and ratings, and vehicle and fleet performance ratings.		satisfy shareholders of positive climate action and environmental performance
Public Education/ and Community Consultation	▪ Includes opportunities to address themes such as: ▪ Construction cost of above-code district energy connected homes and buildings can be the same or lower than individually supplied building code buildings. ▪ Construction cost of above-code stand-alone homes and buildings can be higher than building code buildings. ▪ Operating cost of all above-code homes and buildings will be less than code construction. ▪ Need guidance to help developer understand different economics of DE connected construction. ▪ Need to help developers position market benefits and owners to appreciate both immediate and lifetime benefits.	▪ New governance approaches to support a fundamentally different planning and permitting approach to all aspects of the built environment	▪ Focus on identifying resources and opportunities to promote and support sustainable consumption and development ▪ Create strategies to increase community resilience and emergency preparedness ▪ Apply an equity lens to prioritizing and supporting climate change adaptation and mitigation strategies

Appendix 17 – Utility Implications

A description of Brampton's existing energy services is provided in Appendix 1.

The Heritage Heights CEP recommends several measures to increase the end-use efficiency of buildings and transportation and to increase the generation and distribution of energy (including electricity and thermal energy) within the boundary of the Secondary Planning Area (SPA). The sum of these measures will change the demand and supply profile for electricity and natural gas within the Heritage Heights Community.

1. CEP Implications for Alectra

Alectra (the distribution company), in coordination with Hydro One (the transmission company), will provide grid electricity to all homes and buildings within the SPA. The following CEP policy directions will be of particular interest to Alectra:

- Above Ontario Building Code energy efficiency for all homes and buildings.
- Electrification of heating in low density residential areas (i.e., deployment of heat pumps with supplementary electric induction heating).
- Electrification of transportation (i.e., battery electric personal and transit vehicles)
- Increased in-boundary electricity generation (i.e., solar PV and combined heat and power).

1.1 Demand & Supply Profile

In the Base Case simulation, the Heritage Heights annual demand and supply profile for site electricity in 2051 is as follows, based on: at-code building efficiency, no heat pumps, no in-boundary solar PV, no combined heat and power, and limited battery electric vehicle penetration:

	Electricity demand (GJ) in 2051	Electricity supply (GJ) in 2051
Total	4,000,000	Not applicable
Homes and Buildings	3,910,000	Not applicable
Transportation	90,000	Not applicable
Grid	Not applicable	4,000,000
Combined heat and power	Not applicable	0
Solar PV	Not applicable	0

In the Efficiency Case, the Heritage Heights annual demand and supply profile for site electricity in 2051 is as follows, based on: above-code buildings, extensive heat pump deployment, significant in-boundary solar PV, combined heat and power, and very high battery electric vehicle penetration, this is:

	Electricity demand (GJ) in 2051	Electricity supply (GJ) in 2051
Total	4,000,000	Not applicable
Homes and Buildings	3,570,000	Not applicable
Transportation	430,000	Not applicable
Grid	Not applicable	2,830,000
Combined heat and power	Not applicable	735,000
Solar PV	Not applicable	435,000

Total site demand is the same (4 million GJ) for the Base Case and Efficiency Case in 2051. Increased electricity demand for heating and transportation is balanced out by end-use efficiencies. While the total site electricity is the same, the share of electricity in the community's total source energy is higher in the Efficiency Case.

The share of total power demand on the provincial grid drops from 100% in the Base Case to 72% in the Efficiency Case. This is the site energy picture. Electricity source energy would be less in the Efficiency Case due to the in-boundary electricity generation (i.e., combined heat and power and solar PV). The combined heat and power is associated with the provision of heating for the District Energy services in the medium and high-density areas, and is sized and operated according to the estimated heating demand.

In-boundary electricity generation (i.e., combined heat and power and solar PV) provides about 30% of the annual average electricity demand in 2051. This translates to nominal electric capacities of $55MW_{el}$ for combined heat and power and 100MW for solar PV. The CEP is based on annual averages.

The transportation demand assumes all vehicle kilometres travelled (VKT) within the SPA boundary are powered by electric vehicle charging done within the boundary. This will probably be conservative due to the high level of transit traffic anticipated on the Urban Boulevard.

In 2051, Heritage Heights will be about 15% of Brampton's estimated total population. As the CEERP is applied across the whole City, there will be similar effects in the reconfigured electricity balances.

1.2 Policy Considerations

Based on the CEP recommendations, the following summarizes the secondary plan policy direction implications for Alectra in coordination with Hydro One (the transmission company):

CEP Energy Supply Measures	CEP Policy Direction
Grid electricity	Alectra will provide services for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric vehicle transportation.
Microgrid electricity	Alectra and IESO will provide interconnection, information, and other services to qualified users and operators for restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric vehicle transportation.
Energy services to electric vehicles	Alectra will provide services for the restructured SPA demand resulting from increased efficiency, building integrated solar PV, local combined heat and power and electric vehicle transportation.
Solar PV	Alectra will provide interconnection, information, and other services to qualified users and operators, for the restructured SPA demand resulting from increased efficiency, building integrated solar PV, combined heat and power, and electric vehicle transportation.
Combined heat and power	Alectra will provide interconnection, information, and other services to qualified users and operators, for the restructured demand in Heritage Heights resulting from increased efficiency, building integrated solar PV, local combined heat and power, and electric vehicle transportation.
Battery storage	Alectra will include the impact of highly distributed battery storage in their demand management planning for Heritage Heights.

1.3 Technical Considerations

Heritage Heights will have many of the aspects that are implicit in Alectra' s strategic objective to build a modernised distribution grid. Additional infrastructure investment may be needed to accommodate the significant distributed energy resource penetration.

Comprehensive smart-metering will be needed actively manage and optimize the distribution network operation. This will include interactive smart metering with the operation of the district energy system(s), which will have both electricity generation from combined heat and power, and electricity consuming assets, including centralized heat pumps, compression chillers and potentially electric boilers. The electrification of the transport sector will also require new stationary and mobile smart metering. The emerging role of stationary EV's providing battery back-up capacity will be a factor in designing future smart metering networks.

The use of smart-marketing to facilitate optimal electricity service management to all classes of customers, is implicit in Alectra' s strategic objective to improve the customer experience.

The current CEP simulation analysis is based on annual averages. To estimate the required peak capacity at the city-gate transformers will require another level of analysis granularity. In the Efficiency Case, there

are more tools available to manage load shaping and timing, so it is reasonable to assume the peak to average and base-load ratios will be less than in the Base Case.

1.4 Business Development Considerations

The CEP engagement with Alectra and this report is primarily focussed on the impact of the Heritage Heights CEP on Alectra' s role as a regulated Local Distribution Company (LDC). In this role, Heritage Heights presents a rare large-scale opportunity in Ontario (or, in fact, North America) to evaluate the changes in investment and operating practices that will be needed as community energy systems transition to a net-zero future.

The CEP recommendations also present many new potential market opportunities to the deregulated branch of Alectra' s operations, Alectra Energy Solutions. Alectra has a strategic objective to grow the enterprise. Again, Heritage Heights presents a scale opportunity to pilot new business possibilities, for potential wider deployment.

Possible business development areas have not been discussed in any depth during the engagement process. Clearly the implementation of large-scale electric heating in the low-density area, the implementation of district energy with multiple thermal sources in the other areas, the installation of large quantities of solar PV and thermal, and the electrification of transportation create multiple areas where new business models are likely to emerge.

1.5 Regulatory Considerations

The current regional energy planning process for electricity relies on Local Distribution Companies (LDCs) providing demand forecasts for their service territories to the Independent Electricity Supply Operator (IESO).

The Heritage Heights CEP provides guidance on the impact of the energy density of the planned development on regional energy planning. Notably, planned increases in electricity demand for heating and transportation are balanced out by end-use efficiencies and in-boundary electricity generation.

The Ministry of Energy, Northern Development and Mines and the Independent Electricity System Operator (IESO) are conducting a study to identify and protect a corridor of land for future electricity infrastructure in the Northwest Greater Toronto Area (GTA). The project's study area aligns with the Ministry of Transportation's (MTO) Focused Analysis Area for HWY 413. The current expectation is that the transmission corridor would parallel the transportation corridor. However, the status of the transportation corridor is currently unclear. Brampton City Council has expressed concerns over the environmental assessment process. The IESO continues to consult with the City of Brampton and other stakeholders, in exploring routing and technology alternatives to a transmission corridor through Heritage Heights.

The Heritage Heights CEP is based on the current Conceptual Land Use Planning developed by the City of Brampton. This recommends an Urban Boulevard transportation corridor roughly following the route of the of the proposed Highway 413. This ensures there remains a close integration of local neighbourhoods and all modes of local transportation, while retaining a reasonable high through-traffic flow. The current Heritage Heights land use planning does not include allocation of available land for a high-voltage above ground transmission corridor.

2. CEP Implications for Enbridge

The recommendation is to establish a thermal utility to serve the heating, cooling, and hot water needs of homes and buildings located in medium- and high-density mixed use, industry, and hospital areas. The

recommendation in the low-density residential areas is to serve the heating and hot water needs of homes and buildings with on-site combinations of heat-pumps, electric induction heating, and solar thermal. Both these recommendations have significant implications for reduced natural gas demand in the SPA.

2.1 Demand and Supply Profile

In the Base Case simulation, the Heritage Heights annual demand and supply profile for site electricity in 2051 is as follows, based on at-code building efficiency, no in-boundary solar thermal, no combined heat and power, and no district heating.

	Natural gas (GJ) supply in 2051	**% 2051 heat supply**	**CO2e (tonnes) in 2051**	**% 2051 heating emissions**	**Comment**
Network natural gas with blended H_2/biogas	5,200,000	100	265,000	100	
Electricity	0	0	0	0	
Total heating	**5,200,000**	**100**	**265,000**	**100**	Delivered end-use

In the Efficiency Case simulation, the Heritage Heights annual demand and supply profile for site electricity in 2051 is as follows, based on above code buildings, direct electric heat heating, in-boundary solar thermal, combined heat and power, heat-only boilers, and district heating.

	Natural gas supply (GJ) in 2051	**% 2051 heat supply**	**CO2e (tonnes) in 2051**	**% 2051 heating emissions**	**Comment**
Direct heating					LRA service only[98]
Electricity	800,000	32	4,000	8	
Solar thermal	100,000	4	0	0	
Total direct heating	900,000	36	4,000	8	
District heating					Non LRA service areas[99]
Network natural (with blended H_2/biogas)	200,000	8	23,000	47	Heat only boilers & heat side of combined heat and power
Electric	450,000	18	2,000	4	
Solar thermal	200,000	8	0		
Local biofuel & other low carbon fuels (TBD)	550,000	22	20,000	41	Any local alternative fuel heat only boilers & heat side of combined heat and power
Waste heat recovery	200,000	8	0	0	
Total District Heating	1,600,000	64	45,000	92	
Total Heating	**2,500,000**	**100**	**49,000**	**100**	Delivered end-use

The energy to provide adequate heating and hot water services drops from 5.2 million GJ to 2.5 million GJ or 52%, and the natural gas (network) share of heating energy used drops from 5.2 million M GJ to 0.2 million GJ or 96%. The GHG emissions to provide adequate heating and hot water services drop from 265,000 to 49,000 tonnes CO2 or 82%; and the natural gas (network) share of heating GHG drops from 265,000 to 23,000 tonnes or 91%

2.2 Policy Considerations

Natural gas for heating and service hot water is the second largest cause of energy related GHG emissions after the use of gasoline and diesel. Decarbonizing heating is a global challenge in the urban environment and is both a major business threat and/or opportunity for all major natural gas companies including Enbridge.

The CEP recommends that natural gas supply be limited to energy centres for district heating and industry. Easements for routing the distribution network to these centres will have to be identified through neighbourhood land use planning.

Natural gas distribution in the Heritage Heights Community will be limited to district energy centres and some industry. As a result, Heritage Heights GHG emissions from the use of natural gas drops to 23,000 tonnes (2051 Efficiency Case) from 264,000 tonnes (2051 Base Case). The resulting infrastructure is flexible enough to eliminate heating related GHG emissions over the plan period. From 2023, the natural

[98] LRA – Low density residential areas.
[99] Includes medium-density mixed-use, high-density mixed-use, hospital and industrial areas.

gas used by the district energy utility will have a progressively lower carbon index[100] as Enbridge adds biogas and hydrogen to their network.

2.3 Technical Considerations

The most obvious technical consideration is what is not needed. No retail network is required except for some specific industrial users where their process many require natural gas because of its chemistry. The network structure will be restricted to siting and routing for the energy centres.

The thermal utility will also supply a significant amount of cooling in the medium and high-density mixed-use areas. In the early years, this may increase the summer demand for natural gas as CHP may be dispatched by the thermal utility to provide local power for compressor chillers and local heat for absorption chillers.

2.4 Business Development Considerations

Heritage Heights presents a rare opportunity for Enbridge to explore new business opportunities that will result from the transformation of community energy systems to net-zero future. District Energy in some form will have a major role in decarbonising heating, cooling and hot water services in hundreds of cities in Canada and the USA. The thermal utility called for in the CEP is a clear opportunity for Enbridge participation.

2.5 Regulatory Considerations

The regulatory frameworks under which both Alectra as the LDC, Hydro One as the transmission company and Enbridge operate are complex and long-standing. Both organizations are committed to working with the Ontario Energy Board as they adapt to a transitioning energy market this is represented by the future defined in the Heritage Heights CEP.

[100] The CEP used the same assumptions for the natural gas network emission index in both the Base Case and the Efficiency Case. The assumption is that Enbridge will be successful in partial decarbonization of their network through the injection of biogas and hydrogen.