City of Toronto Real Estate Portfolio Net Zero Carbon Plan

HEALTHY · LOW CARBON · CIRCULAR

September 20, 2021

TORONTO

PURPOSE

City of Toronto Real Estate Portfolio Net Zero Carbon Plan

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Mandate

Toronto's 2019 Corporate Strategic Plan establishes Toronto's vision as a clean, green, sustainable city.

The City of Toronto declared a Climate Emergency in October 2019 for the purpose of naming, framing, and deepening its commitment to protecting the City's economy, ecosystems and community from climate change. In Member Motion MM10.3 – Declaring a Climate Emergency and Accelerating Toronto's Climate Action Plan by Mayor John Tory, seconded by Councilor Mike Layton, Council adopted endorsement of a net zero greenhouse gas emissions target that is in line with keeping global average temperature rise below 1.5 degrees Celsius, immediately strengthening Toronto's goal of becoming net zero before 2050. City Council also requested that the Director, Environment and Energy report back by the fourth quarter of 2020 on the feasibility of actions that could achieve net zero by 2040.

Council's Climate Emergency Declaration supports and accelerates the ambitious City-wide TransformTO climate action strategy which was unanimously approved by City Council in July 2017.

In line with this declaration, Corporate Real Estate Management (CREM) has developed this Net Zero Carbon Plan for City of Toronto assets to accelerate carbon emission reductions in line with but ahead of TransformTO targets and lead by example in pursuit of net zero emissions.

This Plan is delivered by the City's Corporate Real Estate Management (CREM) Division in consultation with other City Divisions. It applies to all City of Toronto corporate real estate buildings and any buildings that come into the corporate real estate portfolio. Where other City groups may be managing buildings, their portfolios should also align with this Plan to meet TransformTO and corporate strategic targets.

Executive Summary

Cost and Impact Forecast

City of Toronto operates a real estate portfolio of approximately 9.5 million m^2 in 2,500+ facilities across 15 portfolios.

Sustained operation of the portfolio currently involves an annual utility budget estimated at $240 million and greenhouse gas emissions of 206,000 tonnes[1]. Without action, this will likely grow 15% by 2040 to match expected City population growth and resulting service demands.

This Energy and Carbon Management Plan describes a path to achieve a zero carbon portfolio. A guiding principle of this plan is to efficiently allocate capital by aligning investment in low carbon retrofits with building system renewal cycles (i.e.. at equipment end of life). With this approach, the City[1] will:

- Invest an average incremental increase in capital until 2040 of $125 million annually above what is required to build new and maintain existing facilities (including replacement of building systems at typical end of service life) to retrofit about 80% of buildings, focusing on switching to low carbon energy sources (electricity, low-carbon district energy and/or renewable natural gas);
- Temporarily rely on zero carbon renewable natural gas produced in City facilities to heat the 20% of buildings that remain to be retrofitted after 2040, as well as an estimated 7% of buildings where electrification may not be feasible;
- By 2040, reduce annual City facility emissions by 114,000 tonnes (56%) vs today and utility costs by $90 million (exclusive of off-site renewables) while increasing asset resilience, reducing air quality contaminants emitted by combustion equipment, and supporting the local economy by growing GDP and creating new jobs.
- By 2040, procure 100% zero carbon renewable electricity from on-site generation and off-site power purchase agreements;
- After 2040, invest an additional $660 million incremental capital to complete the balance of the retrofit work;

Retrofit activities could be accelerated ahead of equipment renewal cycles and be completed by 2040. This would increase the cost of the program by about $1.5 billion.

[1]Excluding Toronto Community Housing Corporation (TCHC) portfolio and Exhibition Place portfolios

Executive Summary

Recommended Plan Initiatives

The Recommended Initiatives[1] which will support the City in achieving a net zero emissions building portfolio by 2040 are:

1	**Fuel Switching and Efficiency Retrofits**	Transition the City's existing buildings away from systems that rely on high-carbon fossil fuel combustion to highly efficient systems that use low-carbon energy sources.
2	**Lower Carbon New Builds**	Design and construct City-owned new developments to TGS v3 Tier 4 carbon emissions targets or equivalent.
3	**Strategic Divestment**	Divest low-value assets and acquire, retrofit existing and/or construct new lower-carbon buildings to replace them.
4	**On-Site Renewables and Storage**	Install additional on-site renewable energy generation and storage.
5	**Training and Education**	Commit to consistent operational improvement processes and training across all assets.
6	**Enhanced Use of Building Performance Data**	Establish internal mandates and management processes fundamental to the Plan.
7	**Carbon Offsets and Off-Site Renewables**	Purchase carbon offsets to balance remaining operational emissions and plan to contract long-term PPAs.

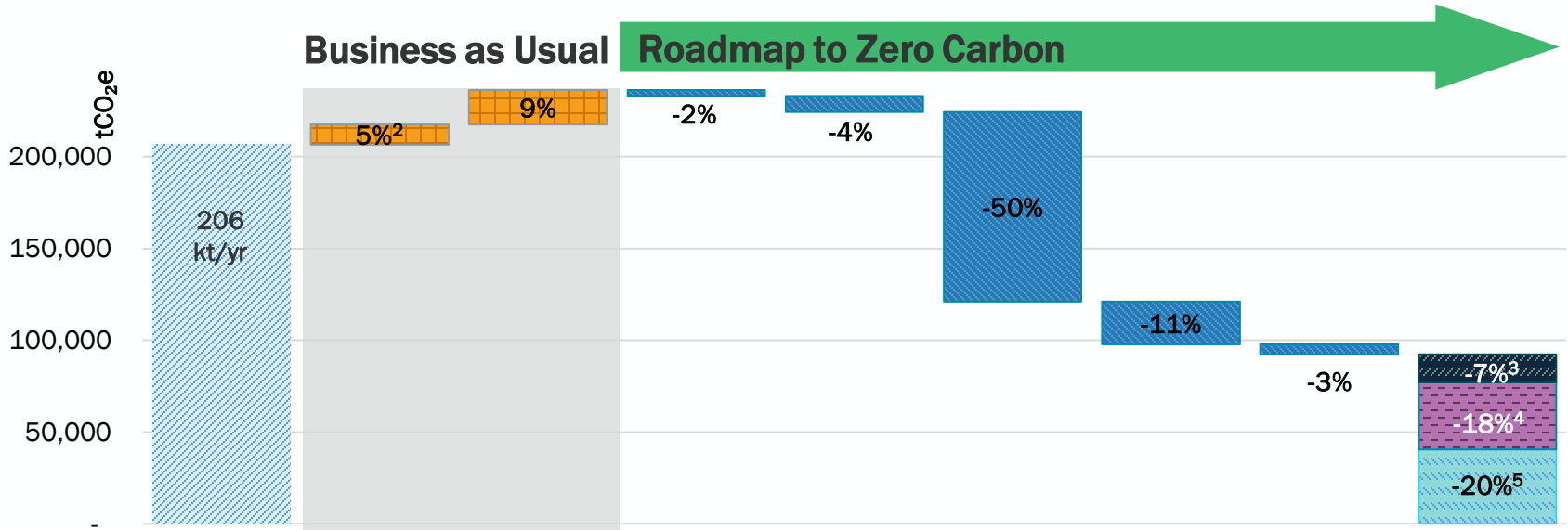
[1]*Initiatives complement one another when completed together at a facility. The Plan budget and benefit anticipate Initiatives are generally implemented in the following order: 6, 3, 2, 1, 5, 4, 7.*

Executive Summary

The impact of each initiative on City portfolio carbon emissions is shown. The largest reductions come from Fuel Switching + Efficiency Retrofits.

Initiatives are performance driven and technology-agnostic, allowing for innovation. Assumptions are based on technologies available today.

Implementing this Plan will require an incremental capital cost estimated at $2.5B (includes 25% contingency) by 2040, plus an additional $660M beyond 2040 to complete remaining fuel-switching.



Initiative	Today	Growth, Divestment, Scheduled Efficiency[1]	Grid Emissions & Carbon Price	Strategic Divestment & Replacement	Lower-Carbon New builds	Fuel Switching + Efficiency Retrofits	Continuous Improvement	On-site Renewables & Storage	Offsets and Off-site Renewables
Emissions Reduction (kt)	-	11 *increase*	19 *incr.*	3	9	100	23	6	92
Emissions (kt)	206	217	236	233	224	121	98	92	-

[1]Includes planned reduction efforts (2019-2024 Energy Conservation & Demand Management Plan), anticipated portfolio growth, planned divestment
[2]Percent values are vs CO_2 emissions today
[3]Renewable natural gas generated off-site replaces unavoidable natural gas use
[4]Fuel-switching and efficiency retrofit work required beyond 2040, offset by City-generated RNG until retrofits are complete (see Appendix A11).
[5]Carbon offsets are purchased until Power Purchase Agreements are available

1 | Context and Alignment

1. Context and Alignment

1.1 Mandate

The City of Toronto declared a Climate Emergency in October 2019 for the purpose of naming, framing, and deepening its commitment to protecting the City's economy, ecosystems and community from climate change. In Member Motion MM10.3 – Declaring a Climate Emergency and Accelerating Toronto's Climate Action Plan by Mayor John Tory, seconded by Councilor Mike Layton, Council adopted endorsement of a net zero greenhouse gas emissions target that is in line with keeping global average temperature rise below 1.5 degrees Celsius, immediately strengthening Toronto's goal of becoming net zero before 2050. City Council also requested that the Director, Environment and Energy report back by the fourth quarter of 2020 on the feasibility of actions that could achieve net zero by 2040.

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In line with this declaration, Corporate Real Estate Management (CREM) has developed this Net Zero Carbon Plan for City of Toronto assets to accelerate carbon emission reductions in line with but ahead of TransformTO targets and lead by example in pursuit of net zero emissions.

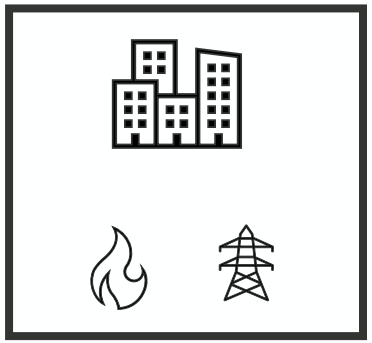
This Plan is delivered by the City's Corporate Real Estate Management (CREM) Division in consultation with other City Divisions. It applies to all City of Toronto corporate real estate buildings and any buildings that come into the corporate real estate portfolio. Where other City groups may be managing buildings, their portfolios should also align with this Plan to meet TransformTO and corporate strategic targets.

1. Context and Alignment

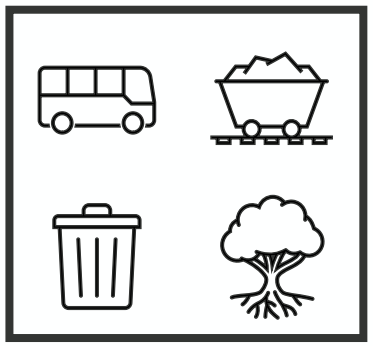
1.2 Plan Scope

This Plan will address emissions related to facility utility consumption. It will not include emissions from fleet vehicles, land use, waste processing, embodied carbon or other sources. This Plan recommends that embodied emissions reduction targets are set in the future.

Included:



Not included:



This Plan will encompass both new and existing facilities and include the City of Toronto portfolios listed in the table at right.

Please note that Exhibition Place and Toronto Community Housing Corporation portfolios are excluded.

Portfolio	Scope
Affordable Housing Office	Included
Exhibition Place	-
Lakeshore Arena Corporation	Included
Long Term Care, Homes and Services	Included
Parks, Forestry and Recreation	Included
Facilities Management and Real Estate	Included
Shelter, Support and Housing Administration	Included
Toronto & Region Conservation Authority	Included
Toronto Community Housing Corporation	-
Toronto District School Board[1]	Included
Toronto Parking Authority	Included
Toronto Police Services	Included
Toronto Port Lands Company	Included
Toronto Public Library	Included
Toronto Transit Commission	Included
Toronto Zoo	Included

[1]*Includes Toronto District School Board sites shared with the City only.*

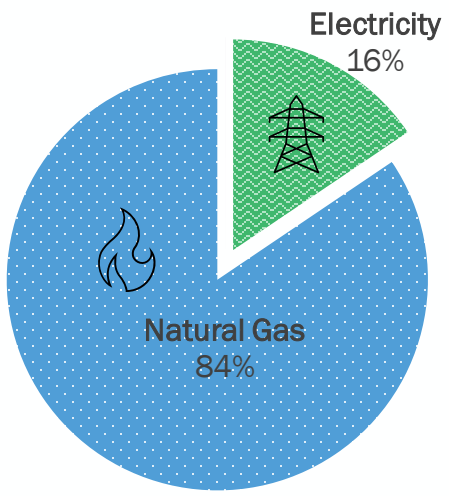
1. Context and Alignment

1.3 Current Portfolio Performance

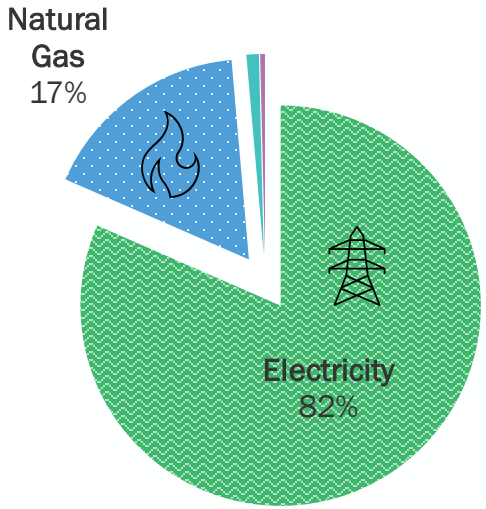
Natural gas combustion contributes 84% of the City's real estate portfolio emissions.

Electricity is responsible for 82% of portfolio energy costs.

Steam (high-carbon fuel) and chilled water (low-carbon fuel) each represent less than 1% of portfolio emissions and cost.



CO_2 Emissions by Utility



Cost by Utility

[1]*Portfolio emissions were evaluated based on available data.*

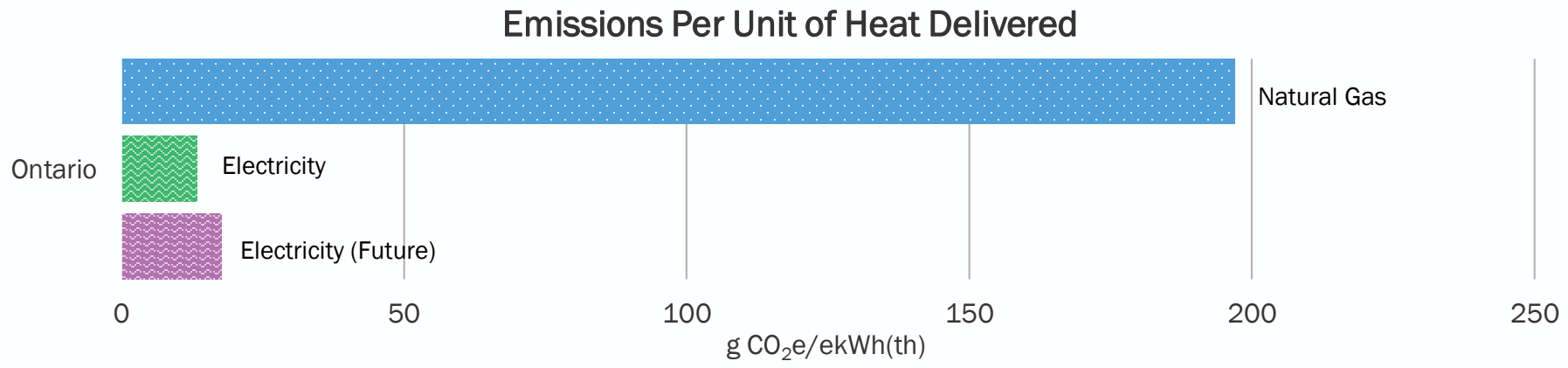
1. Context and Alignment

1.4 Impact of Heating Fuel Selection

Fuel switching is necessary to significantly reduce carbon emissions. The Fuel Switching strategy is modeled on high-carbon fossil fuels being replaced with low-carbon electricity using heat pump to provide a significant efficiency gain in addition to carbon reductions.

The graph below titled “Emissions Per Unit of Heat Delivered” illustrates the emissions that result when 1 kWh of thermal energy (typically heated water) is produced by a:

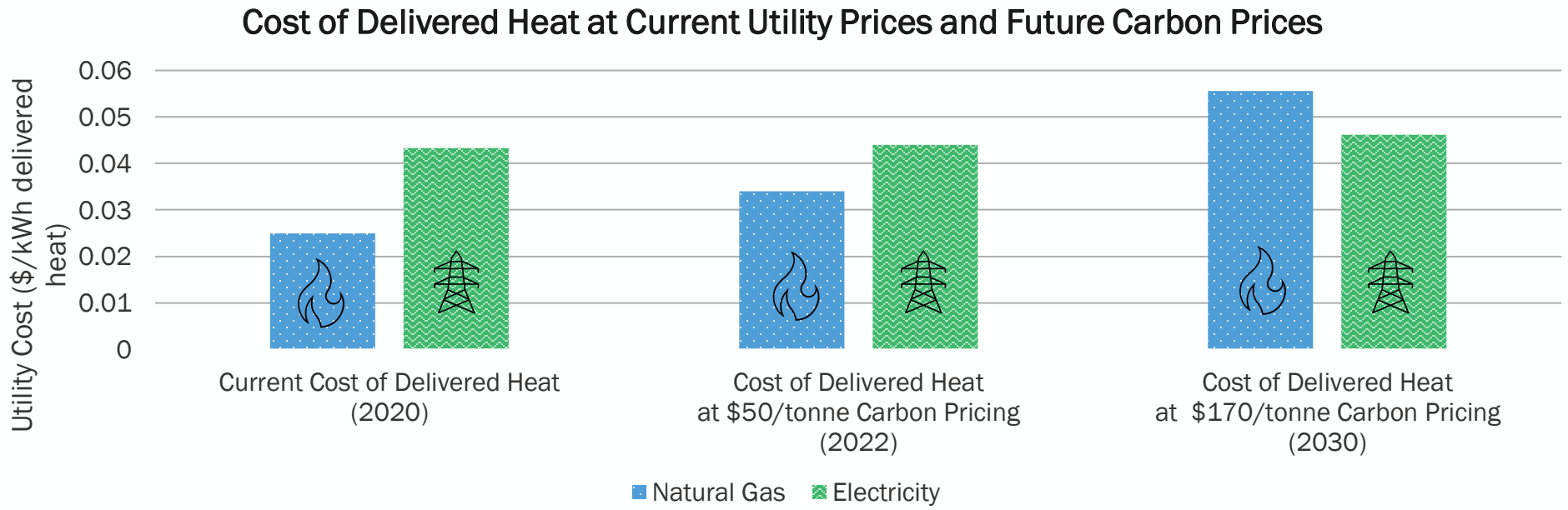
- Natural gas boiler/District steam;
- Electric heat pump with today’s grid carbon intensity;
- Electric heat pump with the expected grid intensity in 2040



1. Context and Alignment

1.5 Impact of Rising Carbon Prices

In 2020, the carbon price in Canada is $30/tonne, increasing to $40/tonne in 2021. In December 2020, the Federal Government announced that carbon will be priced at $170/tonne[1]. High-carbon fossil fuels will grow significantly more expensive as the price on carbon increases. The graph below titled "Cost of Delivered Heat at Current Utility Prices and Future Carbon Prices" illustrates the expected cost of one kWh of thermal energy after considering today's utility prices and the impact of future carbon price. By 2030, heating with fossil fuel combustion is expected to be more expensive than with electric heat pump technology.



[1]*The federal carbon price of $170/tonne in 2030 appears to be a post-inflation value while this Plan reports pre-inflation values in $2020 CAD throughout. The direction and magnitude of the Plan and federal government carbon price value are consistent and drive the core recommendations of the Plan. For context, if inflation averages 0-2% by 2030, the $160/tonne carbon pre-inflation value used in this Plan might be $160-$195/tonne by 2030. The federal carbon price announced in December 2020 sits in the lower middle of this range.*

1. Context and Alignment

1.6 Net Zero Definition

“Net zero emissions”, “net zero carbon” and “zero carbon” are used interchangeably throughout the Plan to refer to net zero greenhouse gas emissions.

The City’s current definition of a net zero greenhouse gas emissions building is:

> **“A net-zero emissions building is one that is highly energy-efficient and produces onsite, or procures, carbon-free and or renewable energy in an amount sufficient to offset the annual carbon emissions associated with its operations or simply eliminates carbon emissions altogether”.**

This Plan provides detail to the City’s definition, for clarity of intent and outcome.

1. Context and Alignment

1.7 Key Definition Components

The key components of the City's zero carbon definition that require clarity are:

1. What **emissions** are considered in the carbon balance?
   - Operational carbon includes the emissions associated with the energy used to operate the building
   - Embodied carbon includes emissions that are associated with manufacturing, transport, installation, use and end-of-life of building materials
   - Other emissions may be related to refrigerants, water, waste, transportation to and from the building, etc.
2. How is **efficiency** addressed?
   - How is efficiency measured?
   - Are there targets that must be met, such as Energy Use Intensity (EUI) or Thermal Energy Demand Intensity (TEDI)?
3. What options are acceptable for **carbon free or renewable energy**?
   - On-site vs. off-site renewables
   - Renewable energy credits, carbon offsets
   - Quality (local, impact, etc.)
   - Is there an acceptable limit to the amount of offsets applied?

1. Context and Alignment

1.8 Recommended Requirements

For the purpose of this Plan, the following definition details are chosen:

1. **Emissions**
   - Operational carbon – Report all emissions related to energy consumed at the site over the course of a year and include in the zero carbon balance. The approach used by the CaGBC's Zero Carbon Building Standard (v2) is recommended.
   - Embodied carbon – Report embodied emissions for new building projects (for structure and cladding as a minimum). Consider setting future reduction targets and offsetting embodied emissions.
   - Set an internal price on carbon when evaluating financial returns that appropriately reflects future carbon price risk, initially referencing the federal government plan value ($170/tonne) or higher.

2. **Efficiency**
   - New construction projects – meet TGS Tier 4 energy efficiency and carbon emissions targets or equivalent, and targets are applied to all facility types.
   - Renovations of existing buildings – deliver fossil-fuel free heating via fuel-switching to heat pump electrification, or renewable natural gas, low carbon district energy or other zero carbon options.
   - Existing building energy efficiency projects – generate economic returns to fund the fuel-switching activities.

3. **Carbon-Free Renewable Energy**
   - Maximize economically viable on-site solar PV at each site.
   - Source/develop renewable natural gas (RNG) supplies, and purchase/distribute this to City buildings where other low carbon options are not technically viable or economically preferred over the long term.
   - Procure high quality carbon offsets to create an annual zero operational carbon balance as a transition strategy to renewable energy
   - By 2040, all energy at all buildings is purchased/supplied from renewable sources, and energy storage is installed to manage grid impact and costs.

1. Context and Alignment

1.9 Rationale

The definition proposed in this document is designed to deliver net zero carbon for each asset at the lowest life cycle cost. The intent is to direct limited capital such that it delivers the greatest benefit. Given the duration of this plan, setting a path forward requires that assumptions be made about the future. Some of the key decisions, and the assumptions that support them, include:

1. **No existing building energy reduction target.** The definition focuses on enabling the transition of buildings from natural gas heating to low carbon options, primarily heat pump technologies. Heat pumps deliver a step change in carbon emissions (on the order of a 90%+ reduction compared to fossil fuel boilers and 75% reduction on a whole-building basis). The definition assumes that the primary value of energy efficiency is its ability to generate financial returns to help cover the less financially attractive transition to low carbon fuels.

2. **No peak electricity demand target.** Converting a natural gas heated building to heat pump heating often increases peak electricity demand. At-scale, this may create a need for more electric grid transmission or generation capacity. This will be one of many changes the grid must address over the 20 year term of this plan, along with electrification of transportation, growth in battery storage and renewables, and other changes. Electricity cost and availability will be driven by these changes as well as the policies and grid infrastructure applied in response. The City cannot confidently predict the most economical response - whether addressed by grid infrastructure, changes to buildings, technology innovation or otherwise. Therefore, the City's Plan is to
    a) Not include explicit peak electricity demand targets as part of the Plan
    b) Monitor the situation over time and update this Plan as the situation becomes clearer
    c) Apply a "Peak Demand Management Allowance" in the budget forecast of Fuel Switching activity (increasing fuel switching cost forecast by 40%), to permit a flexible response given the uncertainty of how this will play out

1. Context and Alignment

1.9 Rationale cont'd

3. **Option but no requirement to accelerate cladding retrofits (re-skinning) of buildings.** Envelope (wall, window, roof) replacements help reduce the risks of failure, property damage and obsolescence. They are generally implemented only once risk of these occurrences is imminent. For example, according to the State of Good Repair (SOGR) budget, the City currently anticipates replacing 4% of facility walls in the next 10 years (0.4% per year average), implying a 250 year service life for facility walls. While wall, window and roof insulation upgrades can improve energy efficiency, peak energy demand, operational emissions, resilience and occupant comfort, they are not always financially viable today on the basis of utility cost savings alone, and they carry an embodied carbon penalty from materials used. For these reasons, this plan considers accelerated cladding retrofits an option, not a requirement. However, a high-performance upgrade should be required when any cladding replacement does occur, due to the long service life and expectation that benefits will become increasingly important over time.

4. **Requirement to procure clean power.** This definition proposes that the City actively participate in cleaning the grid by promoting, facilitating and enabling renewable power purchase agreements (PPAs) in the region. This is a critical leadership activity that can help mobilize the market to deliver low carbon energy for the City and others at competitive rates. If renewable PPAs remain inaccessible as a path to low carbon electricity the City may have to reconsider focusing on building energy/carbon reduction interventions such as envelope retrofits.

2 | Related City Strategies, Standards & Plans

2. Related City Strategies, Standards & Plans

2.1 Background

Development of the City of Toronto Real Estate Portfolio Zero Carbon Plan began with a review of existing City policies. This review summarizes relevant existing City strategies, standards and plans and identifies their potential implications to the Plan, which is being developed to accelerate City-owned facilities towards a zero carbon target. Additional detail can be found in Appendix A2.

Relevant takeaways from each document reviewed are summarized by: Desired Outcomes; Proposed Actions; Progress; and Considerations for the Plan. Documents were also reviewed for potential funding opportunities.

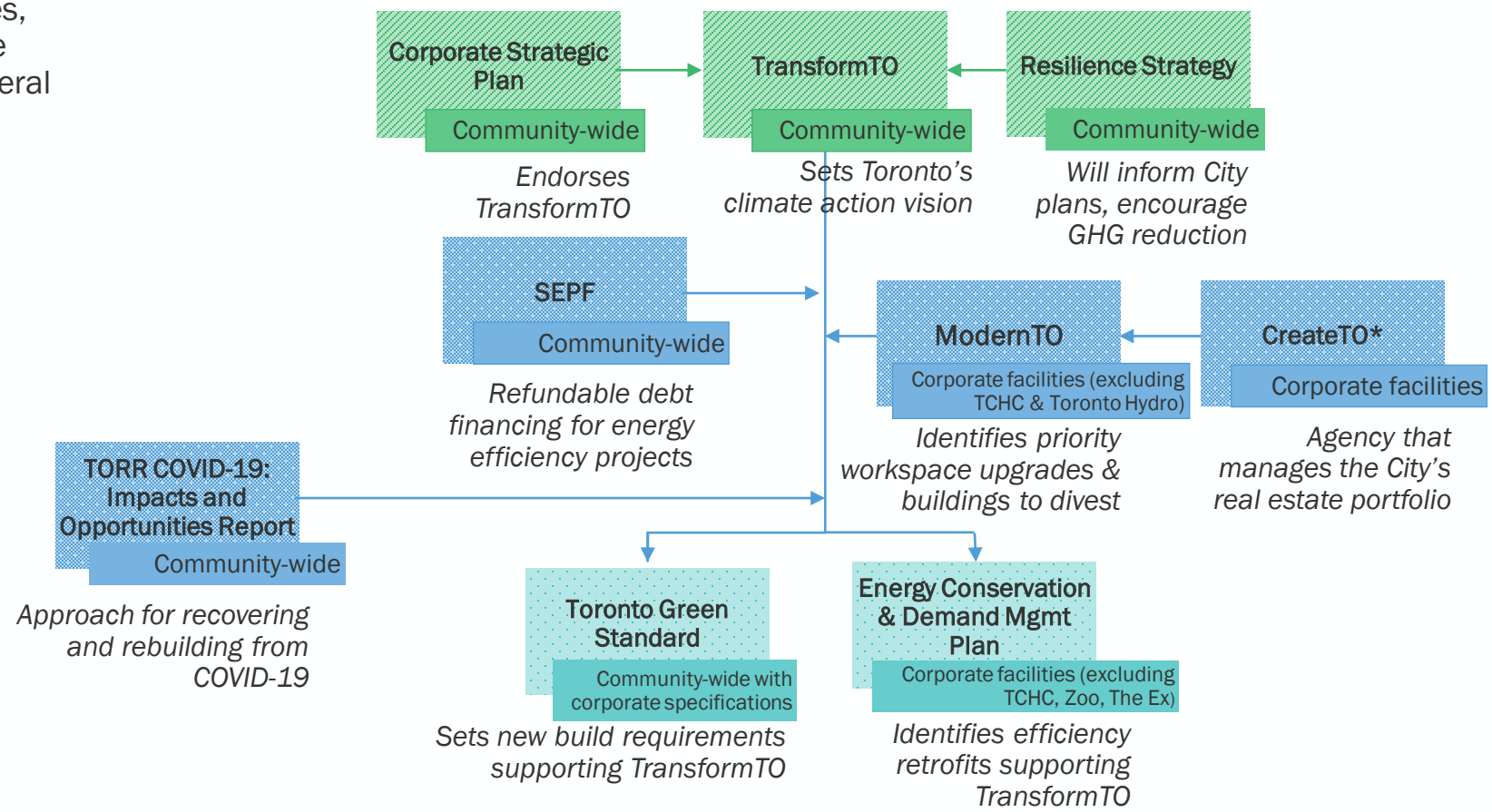
The strategies, standards and plans reviewed are:

- TransformTO: Climate Action for a Healthy, Equitable and Prosperous Toronto (2019);
- City of Toronto Corporate Strategic Plan;
- Toronto Green Standard version 3 (2018);
- ModernTO: City-Wide Real Estate Strategy and Office Portfolio Optimization (2019);
- City of Toronto Resilience Strategy (2019);
- City of Toronto 2019-2024 Energy Conservation & Demand Management Plan (2018); and
- City of Toronto Sustainable Energy Plan Financing Program Enhancement

2. Related City Strategies, Standards & Plans

2.2 How Strategies, Standards & Plans Connect

The flowchart illustrates how strategies, standards and plans connect with one another. Arrows are used to reflect lateral and vertical connections.



*Not a strategy, standard or plan

2. Related City Strategies, Standards & Plans

2.3 Gaps Identified

Based on the review of these existing strategies, standards and plans, the following gaps were identified as items which should be revised to align with the City's updated long-term target of net zero emissions by 2040:

1. TransformTO sets targets to reach net-zero emissions by 2050 or sooner. TransformTO puts forward the concept that City-owned facilities should "Lead by Example" but specific targets aligned with zero by 2040 are not included.
2. The 2019-2024 ECDM targets and actions were selected to meet the current TransformTO target. A 40% energy reduction target exists, with no existing carbon target for retrofits.
3. The City currently implements efficiency using an ESCO model. The scale and volume of projects and scope of contracts have not to-date been aligned with achieving zero by 2040.
4. The City is implementing 24 MW of renewable energy by end of 2020. A new round of renewable projects beyond 2020 could be considered to stay on track to achieving net zero emissions by 2040.
5. No policy yet exists to prohibit the use of fossil-fuel based systems (e.g. in retrofits, ESCO contracts, or other specific scenarios). A significant reduction in the use of fossil fuels will be required to get to zero emissions.
6. Toronto Green Standard prescribes performance of new buildings and additions. There is no similar standard for retrofits.
7. The Corporate Strategic Plan endorses TransformTO and the Toronto Green Standard without endorsing any prescriptive actions or targets.
8. The City of Toronto Resilience Strategy calls for climate resilience to be incorporated into all City plans where it is not explicitly addressed already.
9. ModernTO's objective to reduce the City's corporate real estate footprint will reduce its emissions footprint and create capital. The strategy should be completed by 2040 to align with this Plan.
10. Assets which ModernTO proposes to upgrade should target zero carbon. Assets proposed for divestment likely do not merit efficiency investment.
11. The Sustainable Energy Plan Financing Program is limited in its usefulness as it does not consider carbon savings.

3 | Recommended Plan Initiatives

3. Recommended Plan Initiatives

3.1 Purpose

A list of seven Recommended Plan Initiatives[1] was developed. Together, these initiatives will enable the City to achieve a net zero emissions portfolio by 2040.

The following pages present a brief description of each Initiative, followed by a narrative describing the need for change to the City's existing processes and policies. Suggestions for the implementation of each Initiative are then identified and the key forecasted emissions and financial outcomes are presented. The Initiatives are:

1	**Fuel Switching and Efficiency Retrofits**	Transition the City's existing buildings away from systems that rely on high-carbon fossil fuel combustion to highly efficient systems that use low-carbon energy sources.
2	**Lower Carbon New Builds**	Design and construct City-owned new developments to TGS v3 Tier 4 carbon emissions targets or equivalent.
3	**Strategic Divestment**	Divest low-value assets and acquire, retrofit existing and/or construct new lower-carbon buildings to replace them.
4	**On-Site Renewables and Storage**	Install additional on-site renewable energy generation and storage.
5	**Training and Education**	Commit to consistent operational improvement processes and training across all assets.
6	**Enhanced Use of Building Performance Data**	Establish internal mandates and management processes fundamental to the Plan.
7	**Carbon Offsets and Off-Site Renewables**	Purchase carbon offsets to balance remaining operational emissions and plan to contract long-term PPAs.

[1]*Initiatives complement one another when completed together at a facility. The Plan budget and benefit anticipate Initiatives are generally implemented in the following order: 6, 3, 2, 1, 5, 4, 7.*

3. Recommended Plan Initiatives

3.2 Initiative Descriptions

RECOMMENDATION 1: FUEL SWITCHING AND EFFICIENCY RETROFITS

Transition the City's existing buildings away from high-carbon fossil fuel combustion to highly efficient low-carbon equipment to achieve the City's target of a net zero emissions building portfolio by 2040.

1.1 The Need for Change

Most City facilities currently use combustion heating systems fueled by fossil-fuels. When this equipment reaches end-of-life, it is generally replaced by a similar (perhaps marginally more efficient) combustion systems under the State of Good Repair (SOGR) program, which conflicts with the City's goal to reach net zero emissions. Switching away from fossil-fuel based systems across the existing building portfolio is necessary to meet a net zero carbon emissions target.

The SOGR program tends to spread funding over time, tackling end-of-life equipment replacements one at a time rather than at the system level, which limits the ability to upgrade whole systems and switch to lower-carbon fuels.

Switching away from fossil fuel combustion systems and towards high-efficiency heat pump technologies and bundling in other efficiency retrofits, supports the City's emissions goals by:

- Replacing carbon-intensive fossil fuel with low- or zero-carbon electricity,
- Significantly reducing energy use since heat pump technology is much more efficient than the highest efficiency combustion equipment, and
- Reducing the risk of future cost burden by retaining carbon-intensive equipment which will become increasingly costly to operate as prices increase for fossil fuels alongside carbon prices, carbon offsets and a limited renewable natural gas (RNG) supply.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

1.2 How You Should Do It

Create a **Zero Carbon Transition Plan** for each facility by 2025 and carry out each action. Define a City of Toronto template or follow the CaGBC's Zero Carbon Building Standard framework in developing Zero Carbon Transition Plans. Any buildings with major renewal occurring before then should develop this plan prior to completion of this work. The transition plan should:

a) Present the non-combustion alternate to the asset's current system, foreseen challenges to fuel switching (such as existing high-temperature systems, electrical infrastructure limits, space constraints etc.) and a plan which overcomes these challenges while aligning with natural renewal cycles where possible to reduce cost and disruption.
b) Conduct a life cycle costing analysis using a consistent template and inputs across the organization considering emissions savings, operational costs, capital costs, equipment life, internal carbon price, and other relevant factors.
c) Consider efficiency and peak demand reduction improvements (for example: upgrading HVAC, lighting, building roof, windows, walls) and on-site renewables that will be implemented alongside fuel switching either for financial benefit, or (where funding exists) for co-benefits like building resilience.
d) Include the cost of conducting zero-carbon transition studies in Divisional and Agency budget-planning.
e) Define a retrofit and funding timeline aligning with retrofit schedules in the existing annual Building Condition Assessment process which identifies combustion systems approaching end-of-life.
f) (Optional) Consider retrofitting or installing equipment which reduces fugitive emissions and embodied carbon (example: use refrigerants with low Global Warming Potential, use cellulose or other low-carbon insulation for envelope upgrades).
g) (Optional) Consider expanding the scope of this Plan to include LED streetlight retrofits, which could significantly reduce streetlight energy consumption.

Carry out each facility's Zero Carbon Transition according to the facility's Plan.

In the cases where complete electrification is not viable (estimated to be 10% of facilities), procure renewable natural gas (RNG) to replace all remaining combustion fuel use. The City currently has plans to generate enough RNG from waste to supply 1.5% of the community's current natural gas consumption. This Plan assumes that enough RNG will be available to meet 10% of the City's current gas consumption in 2040 but the City will need to actively develop future sources.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Update each facility's transition plan every 5 years until the facility completes its lower-carbon retrofit, as recommended by the Canadian Green Building Council (CaGBC) Zero Carbon Building Standard (v2).

Update City **funding programs** to support fuel-switching + efficiency projects in place of like-for-like replacements by:

a) Bundling SOGR funding into deeper projects to holistically address combustion fuels and efficiency (refer to Recommendation #1.4 – Align City Processes with the Net Zero Emissions Goal).
b) Locking-in scheduled building envelope upgrade timelines to occur ahead of fuel switching where possible, and downsizing fuel-switch systems based on a corresponding updated design heating load.
c) Requiring that the program recognize and commit funding based on life cycle costing analyses which incorporate operating costs and a carbon price (refer to 1.3 – Set an Internal Price on Carbon).
d) Committing additional funding to the SOGR program for the capital cost premium of fuel switching retrofits over conventional like-for-like replacements.
e) Updating the SEPF program financial evaluation to compare cost against a fossil-fuel free baseline, not a conventional combustion-based baseline.
f) Where applying an Energy Service Company (ESCo) model, setting, and enforcing carbon emissions requirements for each contract which are consistent with this Plan.
g) Incorporating applicable asset resilience or other co-benefit considerations (for example: accelerating building envelope renewal and upgrading) if supported by additional corresponding funding. The City is currently developing a "Climate Lens" to address resilience.

This Plan's success relies on and assumes the City's current capital replacement program is effective. City staff noted the program is currently insufficient - scheduled replacements are regularly deferred and equipment performance (whether conventional or low-carbon) degrades, leading to higher life cycle costs for the City. Investigating and recommending solutions to stabilize the City program may be valuable, but are beyond the scope of this Plan. if scheduled capital replacements are delayed, this plan (to upgrade instead of replace) will also be delayed and the City will fail to meet its emissions reduction timeline.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

RECOMMENDATION 2: LOWER-CARBON NEW BUILDS

Design and construct every City-owned new build project currently in pre-construction to meet the City's net zero emissions definition - TGS v3 Tier 4 carbon emissions targets[1] or equivalent.

2.1 The Need for Change

New construction for City-owned Facilities is currently required to achieve Toronto Green Standard version 3 (TGS v3) Tier 2 requirements for non-residential City Agency, Corporation & Division-Owned Facilities. This does not achieve a zero emissions target.

City Council has yet to adopt a mandate that City-owned facilities to meet TGS v3 Tier 4 by 2026, which would obligate commercial office buildings to perform in-line with a net zero emissions target.

TGS v3 does not set greenhouse gas intensity targets for building types other than office, MURB and retail. As a result, TGS v3 does not enforce zero emissions targets for the majority of City facilities which fall into other categories like warehouse, transit garage, etc. A zero emissions requirement is necessary for these City-owned facilities to achieve net-zero emissions operation.

The cost premium for building a new low-carbon building is lower than the cost of building now and fuel-switching before 2040. New construction projects which do not align with lower-carbon targets now will require a low-carbon retrofit before 2040 (to meet the City's goals). Systems will not likely have reached end of service life before then (large HVAC systems tend to last for 30+ years), requiring additional lifecycle investment to replace systems early. Therefore, building new facilities to net zero emissions now is the most cost-effective long-term investment choice in support of the City's goal of a net zero emissions building portfolio by 2040.

[1] The embodied carbon impact of building new is outside of the scope of this Plan but will become more significant as operational emissions are reduced and should be considered.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

2.2 How You Should Do It

City Council can approve and adopt the pathway to zero that was outlined in the City's Zero Emissions Building Framework and continue requiring that new City-owned facilities achieve one TGS Tier above the City-wide minimum TGS Tier requirement. This would require City-owned facilities to meet TGS v3 Tier 4 performance levels by 2026, which aligns with the TransformTO approved climate target that City Agencies, Corporations and Division-owned facilities to be net-zero energy and emissions by 2026.

Update **construction processes and policies** to include:

a) A definition of "net zero emissions" construction.
b) A requirement to construct to TGS v3 Tier 4 for building types with defined performance targets, otherwise 50% energy efficiency improvement over the Ontario Building Code, SB-10 Division 3 (2017).
c) A process allowing exemptions to be made due to technical feasibility, such as a high-temperature requirement for process loads.
d) A method to identify a net zero emissions target as a project requirement in design/construction procurement document
e) A process to regularly identify planned facility construction projects and monitor compliance

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Update associated processes and policies including:

a) Adding a TGS Tier 4 target for building types without defined performance metrics to improve 50% in energy efficiency over the Ontario Building Code, SB-10 Division 3 (2017).
b) Review and revise the current capital plan. Secure and commit additional funding for planned and future construction projects.
c) (Optional) Consider offering accelerated approvals process for net zero emissions projects to save project cost. These savings could support the incremental cost premiums for net zero emissions design and construction. The current approvals process can result in significant project delays, which in turn stretch project budgets.
d) (Optional) Update standard lease agreements and new lease requirements to target or mandate achieving the City's definition of net zero emissions (this is beyond the scope of this current plan, but will be necessary for the City to achieve true zero-carbon operation).
e) (Optional) In the Master Planning process, require that projects evaluate opportunities for moving the entire district to carbon neutrality or carbon positivity.

Implement these processes now and apply them to all construction projects in pre-construction or earlier phases.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

RECOMMENDATION 3: STRATEGIC DIVESTMENT

Divest low-value assets and acquire, retrofit existing and/or construct new lower-carbon buildings to replace them.

3.1 The Need for Change

ModernTO aims to reduce total office locations while modernizing municipal work environments by investing in primary office facilities, unlocking or repurposing under-utilized assets, establishing flexible workplace policies and tools, and consolidating office locations into primary office buildings. The ModernTO Plan supports the City's goal of a net zero emissions portfolio by reducing emissions associated with divested assets.

ModernTO can further support this goal if:

- Lower-carbon (fuel-switching) retrofits are included in the renewal of retained primary facilities.
- The cost and effort of lower-carbon retrofit (fuel-switching) are considered when selecting assets for divestment versus retention. Some older assets using high-temperature heating systems will likely be more economical to divest than upgrade. The forecast assumes that 20% of the City's current portfolio will meet these criteria.
- Each City portfolio is strategically evaluated. The office portfolio strategy is set and ModernTO is next turning its attention to City warehouse and industrial properties for divestment.
- A portion of unlocked funds from divested asset sales and reduced operating cost is directed to this Plan.

3.2 How You Should Do It

Continue ModernTO's survey of City assets and flag opportunities for divestment. Expand ModernTO's mandate beyond office assets, to all City assets. Update ModernTO divestment processes and policies to include:

a) A method for ModernTO to evaluate cost and effort of lower-carbon retrofit (fuel-switching) when selecting assets for divestment versus retention,
b) A requirement to include lower-carbon retrofits in the renewal of retained primary facilities,
c) A mandate to allocate a portion of unlocked funds from divested asset sales and reduced operating cost to this Plan, and
d) (Optional) Consider low-carbon development sale conditions when divesting to support community-wide emissions reductions.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

RECOMMENDATION 4: ON-SITE RENEWABLES AND STORAGE

Install additional on-site renewable energy generation and storage at the City's new and existing real estate assets.

4.1 The Need for Change

The City can play an active role in cleaning the grid by developing renewables and in making renewables more viable and valuable by adding storage.

4.1.1 On-Site Renewables

City-owned new construction projects are currently required to install a minimum amount of on-site renewable energy as part of TGS v3 for non-residential City Agency, Corporation & Division-Owned Facilities, and some existing buildings within the City's portfolio have already installed photovoltaic solar arrays. The scale of installation can be expanded to increase the amount of low cost, zero carbon electricity available for use at City assets.

To be successful, renewable energy assets require: space for the equipment, and demand for the energy they generate. City real estate assets can offer both.

Photovoltaics (PV) are currently the most feasible renewable energy technology in urban settings and tend to have acceptable payback timeframes, even at the higher cost of installation at existing buildings. For these reasons, this Plan forecasts the cost of renewables based on the costs of PV technology. Other renewable energy technologies such as solar thermal can diversify the City's renewable resources and should be considered.

Unlike Power Purchase Agreements (PPAs) (see Recommendation #7 – Offset and Off-site Renewables) which are not yet permitted in Ontario, on-site renewables can be installed without delay.

4.1.2 On-Site Energy Storage

Electricity grid strain is expected to increase as more (variable) renewable energy generation comes on-line.

Facilities that install energy storage alongside renewable energy generation are good "grid citizens" - reducing grid strain by flattening the peaks of demand and supply, and increasing the amount of generated renewable energy that can be used directly on-site.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

This is already economically viable at some facilities, while elsewhere market electricity rate structures and/or storage technology costs need to change - both are expected to occur as technology matures and utilities restructure rates to recover costs associated with variable energy generation.

Battery storage is currently the most feasible and scalable energy storage technology for most buildings in an urban environment and so has been used as the basis of cost in this Plan. Thermal storage and other storage technologies should be considered where applicable.

On-site energy storage is not unknown to new and existing City facilities, but it is uncommon. Toronto Paramedic Services Station at 105 Cedarvale Ave is one successful pilot project where the combination of on-site renewable energy and battery storage replaced the need for a fossil-fuel generator at the site and increased asset resilience.

4.2 How You Should Do It

Update construction processes and policies to include:

a) A method to evaluate the maximum feasible amount of renewable energy generation at the facility.
b) A requirement to install the maximum feasible renewable energy at the facility.
c) A method to evaluate feasibility of energy storage at the facility.
d) A requirement to incorporate feasible energy storage if feasible, or an "energy-storage-ready" design if not.

Update existing building condition assessment (BCA) and capital planning processes as follows:

a) Assign a team to support the implementation of renewable energy installation and define the parameters by which a building's renewable energy potential is evaluated.
b) Require an evaluation of site renewable energy and battery storage potential, including electrical infrastructure, challenges and opportunities, to be incorporated in each facility BCA.
c) Where backup power is being added, a fossil-free option should be evaluated, and implemented where viable.
d) Obtain capital cost estimates based on the evaluations.
e) Update each asset's capital plan to include implementation where feasible, between now and 2040.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

RECOMMENDATION 5: TRAINING AND EDUCATION

Commit to consistent operational improvement processes and training across all assets in support of the net zero emissions target.

5.1 The Need for Change

The City does not currently have a uniform, portfolio-wide process for maintaining efficient building operations and achieving incremental efficiency improvements. Operations and incremental efficiency alone will not meet the City's emissions goal, but are nonetheless necessary to

- maintain facility performance over time,
- deliver interim and future operational cost savings, and
- support a culture of efficiency and low-carbon operation.

Building operators need to understand the City's goals and relevance to their role and day-to-day work. Operators have always needed to regularly develop new expertise to effectively operate new technology, software, and systems. The pace of change necessary to convert to lower-carbon facilities requires training beyond what has recently been provided.

5.2 How You Should Do It

Implement and maintain <u>continuous improvement processes and technology</u> including:

a) Investigate continuous improvement opportunities at large assets (e.g. 10,000ft^2+) at regular intervals by way of energy audits, retro commissioning studies or otherwise.
b) Conduct post-occupancy commissioning following construction of each new facility to align with design goals and optimize operations.
c) Implement building automation system infrastructure at properties where existing infrastructure does not support a fulsome understanding of building operations and energy consumption.
d) Implement energy management tools including software analytics, real-time data collection, and fault detection and diagnostics (FDD) systems.
e) Implement frequent operator review of facility utility consumption data.
f) Establish energy management roles and responsibilities sufficient to promptly evaluate and act on identified opportunities at all facilities.
g) Consolidate building automation systems across facilities where practical or assign operations teams to facilities based on experience with BAS interface(s) in use.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Support operators with training including:

a) The City's goal of net zero emissions facilities and their role in supporting it,
b) The software that the City uses to track and report on building energy (currently CREM uses EnergyCAP) to support understanding of energy project impact on facility energy use,
c) Operating and maintaining newer technologies like heat pumps,
d) Operating and maintaining facilities efficiently, and
e) Forming working groups for operators of similar facility types or system types to share experiences, best practices, and lessons learned.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

RECOMMENDATION 6: ENHANCED USE OF BUILDING PERFORMANCE DATA

New internal management processes and procedures are needed to remove barriers to achieving the portfolio goal of net zero emissions by 2040 and to simplify City staff decisions in this pursuit.

To be effective, significant changes to the City's current management processes should be made. The key enabling procedures listed as a)-d) below will support the Plan, along with an overarching communication strategy.

a) **Consolidate Building Portfolio Information**
b) **Adopt Key Carbon Performance Indicators**
c) **Set an Internal Price on Carbon**
d) **Align City Processes with the Net Zero Emissions Goal**

Each of these are discussed in more detail on the following pages.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Examples of processes that will require alignment with this Plan may include those listed in Table 3[1] here.

Table 3: Major City Plans Influencing City-Wide Real Estate Needs

Direct Demand for Real Estate	**Service Plans, Facility Plans, and Master Plans** • PF&R Master Plan 2019-2038 • Parkland Strategy: Growing Toronto Parkland • Children's Services 2015-2019 Service Plan • HousingTO Action Plan 2020-2030 • Housing Now Initiative • Open Door Affordable Housing Program • SSHA: Stability Service Planning Framework 2014-2019 • Long-Term Care 2016-2020 Service Plan • Paramedic Large Multi-Function Station Plan • TTC Corporate Plan 2018-2022 • Police Action Plan: The Way Forward • Fire Master Plan 2015-2019 • Transit in TO: Transit Expansion • Libraries Facilities Master Plan • Toronto Parking Strategic Outlook: Enabling Mobility		

Strategic Alignment & Support (Guiding Real Estate Plans)	**Planning Frameworks**
	• City of Toronto Official Plan
	• Secondary Plans:
	  ○ Port Lands Planning Framework
	  ○ TOcore – Planning Downtown
	  ○ Midtown in Focus
		Corporate Strategies
		• City of Toronto Strategic Actions
		• Operating Budget & Capital Plan
		• City of Toronto Long-Term Financial Plan
		• Talent Blueprint
			Social, Economic & Environmental Directions
			• Transform TO: Climate Action Plan
			• Toronto Strong Neighbourhoods Strategy 2020
			• Collaborating for Competitiveness

[1] From Appendix 1: City-Wide Real Estate Portfolio Strategy of the Real Estate Strategy and Office Optimization Plan

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

6.1 Consolidate Building Portfolio Information

Create one easily-accessible platform that includes up-to-date building information for all assets in the portfolio.

6.1.1 The Need for Change

Managing facility carbon emissions requires consistency across facilities, and coordination across data sets including:

1) **Energy consumption** from utility bills
2) **Carbon emissions** calculated from energy consumption
3) **Portfolio planning** by facility including scheduled construction, demolition, relocation, etc.
4) **Project planning** by facility including asset condition, scheduled equipment renewal, conservation, renewable energy installations, etc.
5) **Carbon reduction program progress** by facility including assessments completed, opportunities identified, fuel-switching completed, etc.

These are not all currently being delivered consistently across the City portfolio.

Energy Consumption data represents the most established City database as one output of the utility bill management software EnergyCAP, which stores utility consumption and related data. EnergyCAP software is available to all City groups. Some groups, like TCHC, maintain an independent database within the software, which is not consolidated. Some City Agencies, Boards and Commissions (ABCs) use the software for accounting purposes but not to support facility operations. Data gaps exist where software databases are not consolidated, or other software is also used.

As a result, portfolio-wide energy consumption data is difficult and time-intensive to aggregate, especially for assets under ABCs and TCHC. Managing this Portfolio Energy Plan, the City's regular Energy Conservation & Demand Management Plan, and Portfolio-wide comparisons and analyses currently require excess manual intervention, and increases the risk of data gaps and reporting inaccuracy. In the case of this Plan, the entire Toronto Community Housing Portfolio (TCHC) was excluded because adequate data could not be obtained.

Carbon emissions are not currently included in the data but could easily be calculated based on energy consumption.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Portfolio Planning and **Project Planning** data is distributed across multiple databases which are not integrated with EnergyCAP. **Carbon program progress** will need to be tracked comprehensively and consistently once this Plan is adopted.

A review of best carbon management practices supports the need to centralize and standardize data. Doing so will:

- Provide up-to-date, easily accessible, and complete data,
- Support employees across the organization to take greater responsibility for their role,
- Reveal insights that are otherwise invisible,
- Increase speed and accuracy of planning processes, and
- Enable ongoing tracking of key performance indicators, benchmarking, and progress reporting towards net zero carbon goals.

6.1.2 How You Should Do It

The City should undertake a project to:

a) Identify and align datasets under a single platform while preserving the current regulatory and bill payment processes currently used in the EnergyCAP software.
b) Implement continuous consolidation across portfolios
c) Implement continuous consolidation across data types (utility, portfolio planning, project planning, carbon program progress etc.)
d) Centralize, update, and maintain entries for each building in the City's portfolio, and fill relevant data gaps (current and historic)
e) Maintain the unified database over time

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

6.2 Adopt Key Carbon Performance Indicators

Set carbon-related Key Performance Indicators (KPIs) for City employees and organizational groups (Divisions, ABCs etc.) to align targets and goals.

6.2.1 The Need for Change

The City's current annual performance review process is used to assess employee performance on Key Performance Indicators (KPIs) related to that employee's role within the Organization. City Division KPIs currently include energy efficient building operations (energy consumption) targets.

Neither employee nor Division KPIs currently align with the City's net zero emissions buildings target and the declared Climate Emergency to which it responds.

Setting carbon-related KPIs for all employees and organizational groups that exert control over asset carbon emissions (funding allocation, new and existing building project planning, day-to-day operations etc.) will formalize the importance of the City's Plan, support employee comprehension and motivation, and reveal any conflicting directives that may require resolution. For example, where performance is measured by both operational cost and carbon emissions, priority must be determined.

KPIs are relevant to:

- Employees (e.g. leaders, managers, operators)
- Organizational Groups (Divisions and ABCs)
- The City (e.g. public communications, Council reports, Toronto Progress Portal)

Examples of carbon-related KPIs may include:

- the percentage of facilities that have successfully undergone fuel-switching,
- emissions reduced compared to a target,
- renewable energy installed,
- number of new gas systems installed,
- carbon emissions compared to an annual carbon emissions budget,
- carbon emissions compared to a cumulative multi-year declining-balance budget.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

6.2.2 How You Should Do It

Update internal policies and processes to:

a) Assign internal responsibility for developing and implementing KPIs.
b) List the necessary and possible KPIs (e.g.: GHGI), the audiences requiring a KPI (e.g.: Division Director; City Council).
c) Include flexibility in KPIs to acknowledge events outside of an employee or organizational group's control that might impact carbon emissions reduction.
d) Describe the mechanism by which KPIs will be implemented (e.g.: Division budget approvals, project budget approvals, employee performance reviews).
e) Engage relevant management teams in adopting the selected KPIs.
f) Monitor effectiveness of the program and update the process as-needed.
g) (Optional) Consider linking Executive carbon-related KPIs to compensation, as is occurring in the private sector.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

6.3 Set an Internal Price on Carbon

Consistently apply a price for carbon across internal City business cases and accounting practices which informs decision-making but does not require any transfer of money.

6.3.1 The Need for Change

The City does not currently consistently consider the future price of carbon when evaluating financial options. Operating cost savings are quantified while carbon impact is noted but not weighed against other benefits. As a result, long-term asset decisions are made without considering the risk associated with investing today in carbon-intensive building infrastructure that will still be here for decades or longer.

The City can set an internal price on carbon to support long-term decision-making. This means the cost of carbon is accounted for in financial evaluations (no money is exchanged), making carbon reduction activities more financially favourable. An internal price aligns City decisions with its net zero emissions target and insulates the City against the cost of owning and operating fossil fuel combustion systems in the future.

Examples of current and future carbon price forecasts include:

- The carbon price in Canada is set to increase to $50/tonne by 2022.
- The Federal Parliamentary Budget Office projects a rise to $117/tonne in 2030 per their report dated October 8, 2020[1].
- The Intergovernmental Panel on Climate Change (IPCC) currently predicts that a $160/tonne ($CAD) minimum price on carbon will be required by 2030 to limit global warming to 1.5 degrees Celsius and avoid catastrophic climate change.
- Sweden's current carbon price is approximately $160/tonne ($CAD).
- New York City has passed a law which places annual emissions limits on buildings and requires Owners to pay $268 per each metric tonne of CO2 exceeding the limit[2].

[1] Carbon Pricing for the Paris Parget: Closing the Gap with Output-Based Pricing

[2] File # Int 1253-2018: Commitment to achieve certain reductions in greenhouse gas emissions by 2050.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Examples of internal prices on carbon already set by other organizations include:

- Treasury Board of Canada's "Greening Government Strategy: A Government of Canada Directive" sets a $300/Tonne price on carbon to be considered when evaluating all new construction and major retrofit decisions[1].
- City of Vancouver have set an internal carbon price of $150/Tonne[2].

City staff describe the funding approval process for efficiency projects as inconsistent, sometimes related to payback periods of varying length, and at other times being unrelated to payback period. Formalizing funding approval criteria will further support the City's goals.

6.3.2 How You Should Do It

a) Set an internal carbon price consistent with achieving the goals of this plan.
b) Revise building capital investment decision-making processes to apply this price, with uniform methodology, across all Divisions and Agencies.
c) Update this internal carbon price and carbon financial accounting methodology over time as needed.
d) (Optional) Update and communicate funding approval processes to adopt a replicable evaluation approach to capital funding requests which values benefits to the City (such as climate risk response, resilience, etc.) alongside cost. The City is currently developing a Climate Lens which will require that the climate impacts for all major City decisions (including financial) be evaluated using a systematic approach and drive consideration of the climate into City processes.

[1] Greening Government Strategy: A Government of Canada Directive

[2] City of Vancouver Corporate Policy – Internal Corporate Carbon Pricing (Policy Number ADMIN-019)

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

6.4 Align City Processes with the Net Zero Emissions Goal

Update City processes to support achievement of the City's net zero emissions building portfolio goal.

6.4.1 The Need for Change

Stakeholder Engagement revealed that City processes themselves have been a barrier to moving quickly towards net zero emissions building.

City decisions are process-driven. Without supportive policies and procedures applied consistently across Organizations and City leadership, low-carbon solutions will not be implemented at the rate required to achieve the City's goal. The City's internal policies and processes can align with the goal of a zero emissions building portfolio, to make it easier for City employees to make decisions that support the City's net zero carbon buildings goal.

City stakeholders shared examples of City processes which can better align with the goal of achieving a net zero emissions building portfolio by being updated to support other City priorities, goals, and desired outcomes.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

Specific examples include:

- The current State of Good Repair (SOGR) program does not provide funding to support decarbonization when systems reach end of life.
- The current State of Good Repair (SOGR) program encourages frequent piecemeal projects spread over several years, as opposed to occasional deep retrofit projects making it difficult to bundle individual equipment replacements into a low-carbon systems renewal.
- The Sustainable Energy Plan Financing (SEPF) program's 20-year payback limit makes funding inaccessible to many facility carbon reduction and fuel-switching projects. This is particularly true where past projects are already delivering significant cost savings, leaving only the complex costly fuel-switching projects remaining.
- Some groups within the City choose not to use the SEPF program to support funding for energy efficiency projects while also noting funding as a barrier. The reasons for this are not clear.
- The City's current IT policy prevents some energy efficiency measures from being implemented. As an example, anti-idling systems for ambulances used Wi-Fi protocols which were not compatible with the City's IT Firewall.
- City organizational groups currently lack operating agreements which could expedite low-carbon buildings. As an example, the Parks, Forestry and Recreation Division could explore opportunities to provide other City Divisions and Agencies with access to ground underneath Parks land for the accommodation of low-carbon geothermal systems.
- Carbon goals are not prioritized during the current procurement process. That is, a net zero emissions target (currently optional) is not evaluated as a fundamental procurement requirement.
- Low-carbon pilot projects should be tracked, and outcomes should be shared across the Organization.
- Training related to the overall net zero emissions goal for City staff would support understanding and accomplishment of this target.
- Training on BAS systems would support operators in better sharing and using building data.
- The City's Capital Project team and Operations team do not consistently work together to align expected and actual building performance.
- City organizational groups which share space within a facility do not always coordinate on planned retrofits to shared systems, which could create an opportunity for efficiency and consolidating projects.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

6.4.2 How You Should Do It

Establish a team to manage the emissions reduction program associated with the City's net zero emissions building portfolio goal. This team will:

a) Organize the implementation of training
b) Drive engagement across the Organization
c) Coordinate and align work related to emissions reduction planning and execution across the City, including the in-process City-wide emissions reduction plan and community-wide emissions reduction plan. The City should ensure that its portfolio leads the community and delivers at or above the level of emissions reduction required of the private sector.
d) Develop educational programs about the Plan and City's zero emission portfolio target for both internal City staff and the broader community
e) Provide support to others toward achieving net zero emissions buildings.
f) Determine barriers to use of the SEPF program when funding need exists to meet the carbon reduction schedule from this plan. Take action to remove any barriers identified.
g) Create internal resources to share lessons learned and best practices across organizational groups
h) Update existing City processes to align with new program requirements
i) Track and report progress against the City's net zero emissions portfolio target
j) Periodically update this Portfolio Energy Plan
k) (Optional) Have dedicated emissions reduction champions across City organizational groups to support colleagues in implementing emissions reduction actions, tracking organizational group progress, and acting as a resource for City requirements and available funding streams

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

RECOMMENDATION 7: CARBON OFFSETS AND OFF-SITE RENEWABLES

Purchase carbon offsets to balance remaining operational emissions and plan to contract long-term Power Purchase Agreements for off-site zero carbon energy.

7.1 The Need for Change

The City is working with Enbridge to procure renewable natural gas (RNG). The City of Toronto is not currently procuring zero carbon electricity or offsetting operational carbon emissions.

Once previous recommendations of this Plan are implemented, City operational emissions will be greatly reduced but emissions will remain associated with grid electricity consumption and fossil fuel still used at some facilities. Remaining emissions will need to be addressed by purchasing carbon offsets or working with regulators to allow long-term Power Purchase Agreements (PPAs) for off-site zero carbon energy.

PPAs are expected to be preferred on the basis of cost and stability, if made possible by local regulator. Purchasing carbon offsets is not recommended as a long-term strategy due to potential price volatility outside of the City's control.

The cost of offsets is expected to rise as demand increases and lower-cost carbon reduction projects become unavailable.

As PPAs are not currently readily available, current carbon offset costs have been used to estimate the increase in operational costs.

Renewable natural gas (RNG) produced by the City's solid waste, wastewater operations, emissions-neutral bio-fuels and future carbon-free sources provides a source of low-carbon heat when combusted. Solid waste RNG pilot projects have already proven successful and RNG production capacity has been accelerated. Initially, the majority of captured RNG is planned for use in the City's converted diesel fleet vehicles. A portion of the City's facility natural gas consumption is expected to be RNG by 2022 as two new RNG projects are completed.

3. Recommended Plan Initiatives

3.2 Initiative Descriptions cont'd

7.2 How You Should Do It

Take the following actions and implement the operational process updates:

a) Work with Toronto Hydro and IESO to revise existing regulatory frameworks and allow the City to enter into long-term Power Purchase Agreements (PPAs) for zero carbon energy.
b) Once regulations allow, require that the City enter long-term agreements for zero carbon energy (electricity and natural gas).
c) By 2040, purchase high-quality carbon offsets to balance any City annual operational emissions not met through PPAs and off-site renewables.
d) (Optional) Consider exploring an agreement with Toronto Hydro to install City-owned PV on Toronto Hydro corridor lands.
e) (Optional) Explore opportunities for retaining and selling environmental benefits associated with the emissions reduction actions that the City will undertake as part of this Plan.
f) (Optional) Purchase carbon offsets prior to 2040 to align the City's rate of building portfolio decarbonization with Science-Based Targets.

4 | Cost and Impact Forecast

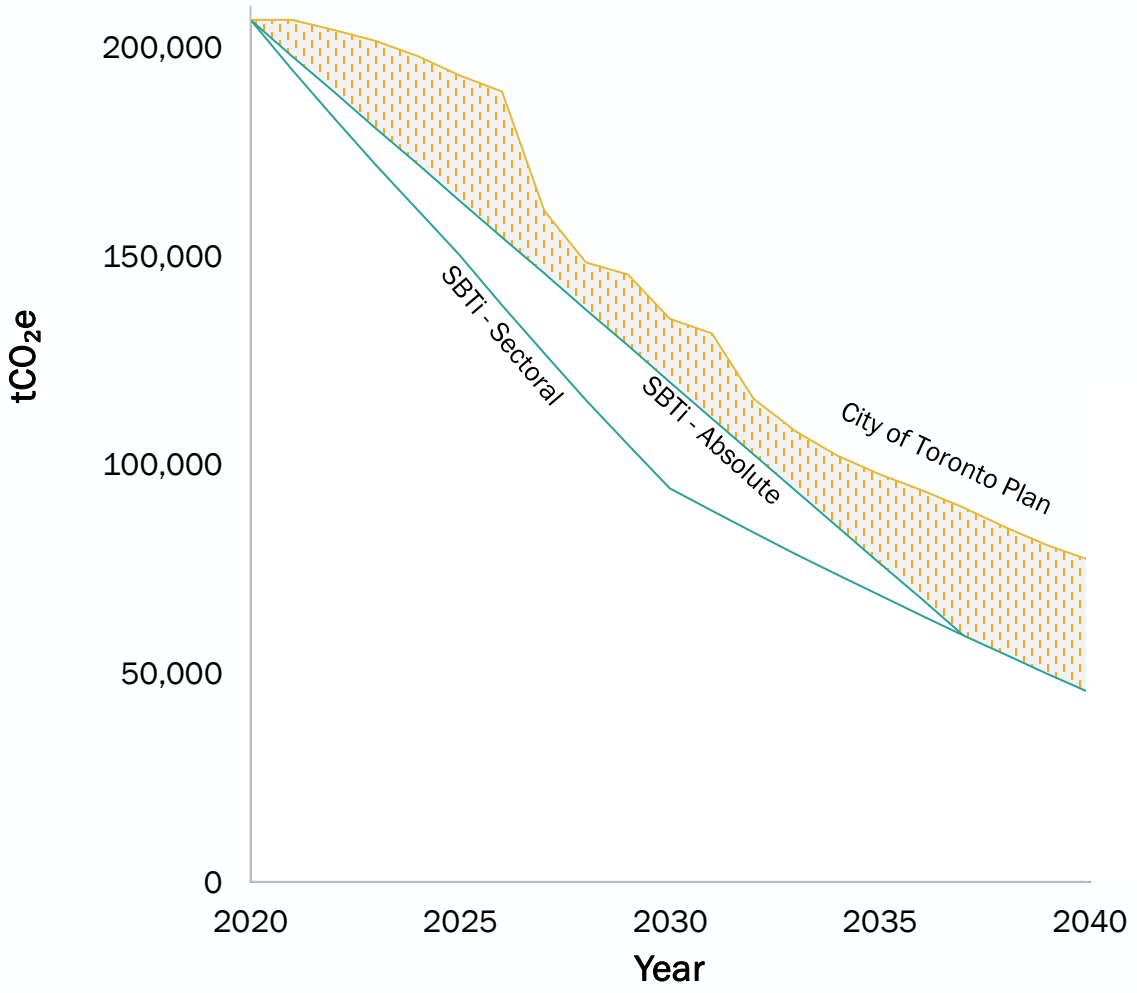
4. Cost and Impact Forecast

4.1 Carbon Reduction Curves

The City's goal is to set a target that is in line with keeping global average temperature rise below 1.5 degrees Celsius. Doing so requires not only a final performance target, but also a pace of progress.

Science Based Targets initiative (SBTi) helps organizations (like the Corporation of the City of Toronto) chart a course consistent with IPCC guidance by defining the rate of carbon reduction necessary to maintain 1.5°C maximum warming.

This Real Estate Portfolio Energy Plan presents a path for the City to achieve net zero carbon emissions by 2040, ahead of the 2050 global target. The pace of emissions reduction, with on-site measures only, is insufficient to prevent global temperature from rising more than 1.5°C without overshoot, when measured against a Science Based Target (either Absolute or Sectoral Approach)[1].



[1] Two approaches are available to set a Science-based target: Sectoral Decarbonization Approach and Absolute Contraction Approach. The Sectoral Decarbonization Approach reflects the rate of carbon emissions reduction that should be adopted specifically by the Office and Service Buildings Sector in order to keep global temperature from increasing more than 1.5C.

4. Cost and Impact Forecast

4.1 Carbon Reduction Curves cont'd

Three (3) approaches are available to close this gap and fully respond to the global climate emergency:

1. Purchase sufficient carbon offsets annually between 2020-2040 to meet the Science Based Target emissions, at an additional estimated cost of $13 million over the next 20 years
2. Accelerate the pace of fuel-switching in existing buildings over the next 5 years at an additional cost of $1.4 billion over the next 20 years.
3. Procure sufficient renewable electricity and/or renewable natural gas (RNG) between 2020-2040 to meet the Science Based Target (14 million MWh of renewable electricity or 350 million m^3 of renewable natural gas or a combination), at an additional estimated cost of $140-210 million (depending on the mix of renewable commodities purchased).

A combination of approaches[1] is possible.

As scientific guidance on the necessary pace of progress evolves, the City should regularly reassess targets, anticipating urgency will increase in the coming years.

[1] Two approaches are available to set a Science-based target: Sectoral Decarbonization Approach and Absolute Contraction Approach. The Sectoral Decarbonization Approach reflects the rate of carbon emissions reduction that should be adopted specifically by the Office and Service Buildings Sector in order to keep global temperature from increasing more than 1.5C.

5 | Plan Implementation Strategy

5. Plan Implementation Strategy

5.1 Purpose and Activity Timing

A phased implementation strategy has been developed to outline when each **Recommended Plan Initiative** will be implemented during the 20-year plan period.

The plan has been divided into **3-Year** (2021-2023), **5-Year** (2021-2025), **10-Year** (2020-2030) and **20-Year** (2031-2040) interim Plans, each with focus areas and progress targets. Each interim Plan reflects expected emissions reductions, capital investments, and implementation progress. This provides metrics against which the City can track progress.

Below, the table with columns representing the 3-Year, 5-Year, 10- & 20-Year interim plans and Beyond show a snapshot of the Plan Implementation Strategy:

	3-Year 2021-2023	5-Year 2024-2025	10 & 20-Year 2026-2039	Beyond 2040
1. Fuel Switching & Efficiency Retrofits	Establish	Full	Full	Full
2. Lower-Carbon New Builds	Establish	Full	Full	Full
3. Strategic Divestment	Full	Full	Full	Full
4. On-Site Renewables & Storage		Establish	Full	Full
5. Training and Education		Establish	Full	Full
6. Enhanced Use of Building Performance	Establish	Full	Full	Full
7. Carbon Offsets & Off-Site Renewables	Partial	Partial	Partial	Full

5. Plan Implementation Strategy

5.2 Options for Plan Implementation

Fuel Switching + Efficiency Retrofits of existing buildings drives implementation strategy for the largest initiative and the resulting carbon reductions. Three implementation options were considered:

Phasing Option	Considerations
1. Asset Size Begin with fuel-switching the largest existing assets	**Pro**: Carbon emissions are quickly reduced early in the Plan since larger assets are often higher emitters.
	Con: It is more costly to fuel switch assets when systems are not at end-of-life.
2. Portfolio Implement fuel-switching Portfolio by Portfolio across the City	**Pro**: This is an organized approach fuel switching the City's extensive real estate portfolio.
	Con: Some portfolios will not see fuel switching implemented for many years. It is more costly to retrofit assets when systems that are not at end-of-life.
3. System Renewal Cycles Fuel-switch when existing heating systems reach end-of-life and need to be replaced	**Pro**: The cost of fuel switching is minimized and becomes an incremental cost premium on top of a required end-of-life systems replacement.
	Con: Not all existing heating systems will reach end-of-life and be fuel-switched by 2040.

5. Plan Implementation Strategy

5.3 Selected Plan Implementation Approach

Phasing by **System Renewal Cycles** is most achievable (technically and financially) and is therefore reflected in this Plan.

Existing building systems will undergo fuel-switching when major systems reach the end of their serviceable life, avoiding early replacement and therefore limiting the cost of fuel-switching to the incremental cost premium of installing low-carbon systems instead of conventional combustion technology at the time of replacement.

Often, equipment failure leads to an urgent replacement decision with little time to consider options and plan strategically. In these situations, upgrades are unlikely, particularly selection of a low-carbon system.

To accomplish fuel switching aligned with system renewal, the City should create a *Zero Carbon Transition Plan* for each existing property. These plans will outline each asset's approach to fuel switching and address potential challenges such as system temperature design, space requirements, and electrical supply capacity. When heating systems then approach end of life, a path to fuel-switching is in place and detailed retrofit design and planning can begin.

If building heating systems reach end of life before a *Zero Carbon Transition Plan* is developed, the City should assess replacements on a case by case basis and elect to fuel switch wherever possible.

As fuel-switching retrofits are undertaken, costs should be periodically reviewed to allow for budgets to be adjusted if-needed, over the course of this 20-year Plan.

5. Plan Implementation Strategy

5.4 The 3-Year Plan

The initial 3-Year Plan involves the following (See the *Recommended Plan Initiatives* for detail on each of these activities):

- Establishing fundamental New Enabling Procedures
- Prioritizing Lower-carbon New Builds and Fuel Switching + Efficiency Retrofits
- Deferring Continuous Improvement and On-site Renewables and Storage, if necessary, to allow focus to remain on previous initiatives.

During the initial 3-year period, before processes are established:

- List existing building renewal and new construction projects that are underway or imminent in the next 3 years. Determine which projects align with this Plan, and either defer or adjust projects that are not aligned.
- Continue to review facilities to identify low-value assets that could be strategically divested and replaced with lower-carbon buildings.
- Continue developing renewable natural gas sources for the City's use and begin discussion to change regulatory structures to secure renewable power purchase agreements (PPAs) in the future.

5. Plan Implementation Strategy

5.5 The 5-Year Plan

Fundamental New Enabling Procedures established by 2023 will continue to be applied and maintained.

All new construction projects are now pursuing/completed to be Lower-Carbon New Builds.

Zero Carbon Transition plans are completed for each existing building asset by 2025. Buildings with systems which reach end-of-life before a Zero Carbon Transition plan is developed continue to be evaluated on a case-by-case basis and fuel switched whenever possible or deferred if necessary.

Planning for continuous improvement and on-site renewable and storage begins and extends through the 5-Year plan alongside partial implementation.

Continue developing renewable natural gas sources for the City's use and work towards securing future power purchase agreements (PPAs) for renewable electricity.

5. Plan Implementation Strategy

5.6 The 10-Year Plan

The end of the 10-Year plan marks the halfway point of the City's Real Estate Zero Carbon Plan. By 2030, the majority of *Recommended Plan Initiatives* are being fully implemented.

Existing buildings will use the Zero Carbon Transition plans completed during the first five years to implement fuel switching + efficiency retrofits at times of building renewal.

Focus on implementing Continuous Improvement and On-site Renewables initiatives fully during the latter half of this phase. Implement On-site Storage installations and other peak reduction initiatives at sites as it becomes economically viable. Electricity rate structures and/or storage technology costs are expected to be favourable at some point.

As renewable natural gas from the City's sources become available for building use, replace fossil gas consumption at City-owned facilities. Prioritize using renewable natural gas in facilities with process loads for which fuel switching retrofits are unfeasible.

Continue developing renewable natural gas sources for the City's use and work towards securing future power purchase agreements (PPAs) for renewable electricity.

5. Plan Implementation Strategy

5.6 The 20-Year Plan

Internal City processes will have been updated during previous phases. Continue to implement all *Recommended Plan Initiatives.*

On-site Energy Storage is expected to become economically viable at most facilities post 2030. Install batteries and other energy management strategies where viable to maintain good grid citizenship.

During the last phase of this plan, all facility recommendations will be fully implemented at all buildings. Some existing buildings will not undergo a Fuel Switching + Efficiency Retrofit by 2040. Fuel Switching + Efficiency Retrofits will occur at these buildings post 2040 as they are renewed. Use renewable natural gas as a “bridge fuel” at a portion of these facilities, if available, until fuel switching is implemented.

By 2040, the City should aim to have successfully secured power purchase agreements (PPAs) for renewable electricity and actively worked to develop all available renewable natural gas sources.

6 | Next Steps

Next Steps

Respond to the City's climate emergency declaration, and fulfil relevant obligations of the City of Toronto Corporate Strategic Plan:

1. **Approve this Portfolio Zero Carbon Plan** including
   a) Redeploy staff to support the Plan
   b) Update development, retrofit/repair, acquisition and funding/financing processes
   c) Provide staff development, training & education
   d) Set an Internal Price on Carbon to focus decisions on lifecycle cost/benefit
2. **Approve Budgets** for
   a) Lower Carbon Development (the incremental cost premium beyond conventional development / construction) Section 6.2.2 & 6.2.3
   b) Fuel Switching + Efficiency Retrofits (the incremental cost premium beyond adequately funded conventional state of good repair spending) Section 6.2.4
   c) Continuous improvement (ongoing facility efficiency) Section 6.2.5
   d) On-site renewables and storage for new development and retrofits Section 6.2.6
   e) Interim carbon offsets and off-site renewables Section 6.2.7
3. **Engage with Partners**, per the Corporate Strategic Plan, including other governments, institutions, and both private and non-profit sectors, to
   a) Obtain relevant funding
   b) Enable mechanisms for reliable long-term access to renewable energy (e.g.: Power Purchase Agreements) Section 6.2.7
4. **Launch the Initial 3-Year Plan,** begin delivering Lower-carbon New Builds and developing Zero-Carbon Transition Plans for each existing facility

Appendices

Appendices

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A1 | Net Zero Definition Appendix

A1. Net Zero Definition Appendix

A1.1 Four Steps to Net Zero for Renovation Projects

Between now and the target year to achieve net zero (2050 or 2040 if possible), the following four steps are recommended to move toward net zero for every asset:

ELIMINATE FOSSIL FUEL COMBUSTION

Fuel switching to electricity significantly reduces emissions because natural gas is about 4 times more carbon intensive than Ontario's current electric grid. Replacing a natural gas boiler with heat pumps greatly increases efficiency and further reduces emissions.

RIGHT EFFICIENCY INVESTMENT

Invest in efficiency upgrades that have a positive financial return. Prioritize improvements that reduce electrical peak demand. Investing in efficiency will generate savings that can pay for the investment in fuel switching.

SHORT-TERM CARBON OFFSETS

Purchase carbon offsets to offset the remaining carbon emissions after fuel switching and efficiency measures are implemented. This is an intermediate step until the regulatory infrastructure is in place to purchase renewable PPAs.

LONG-TERM RENEWABLE ENERGY

Discuss a Power Purchasing Agreement (PPA) with Toronto Hydro for the long-term. Plan a contract with renewable energy with storage that allows you to fully utilize renewable energy generation.

A1. Net Zero Definition Appendix

A1.2 General Approach to Net Zero for Renovation Projects

Purpose recommends developing an evaluation protocol to assess the options and costs associated with applying the four steps to achieving net zero carbon. This protocol will be developed for application on major and small renovations, which are defined as follows:

- **Major renovations** involve the replacement, renovation or upgrade of multiple building systems or components in a single project. They may require the building to be vacant. A major renovation may be an end-of-service-life upgrade or a deep retrofit with aggressive energy and carbon savings that goes beyond code requirements or both.
- **Small renovations** include replacement or upgrade of one or more energy-consuming equipment items or systems, which typically would not affect other building systems.

The following pages describe the evaluation protocol which both major and small renovation projects are to follow to assess options to achieve net zero carbon.

A1. Net Zero Definition Appendix

A1.3 General Approach to Net Zero Major Renovations

The key decision required as part of the general four-step approach in section 5.2 is **what level of efficiency delivers the best long-term value.** The following process is structured to allow the right decision for each property.

Purpose have scanned the market for examples of protocols use by others to evaluate zero carbon retrofit plans and recommend developing design, energy/carbon performance and costing of the following three options for each of the City's major renovation projects:

1. **Baseline**: Meet current minimum energy and carbon requirements (TGS Version 3 Tier 1 for most developments, and Tier 2 for non-residential City-Owned Facilities at this time)
2. **Carbon Neutral**: Meet the proposed net zero carbon definition
3. **Best Achievable with 20-Year Cost Neutrality**: If the Carbon Neutral option (#2) has a 20-year life cycle cost which exceeds the 20 year LCC of the Baseline option (#1), then develop this Option for best achievable carbon emissions reduction that has no net life cycle cost increase compared to the baseline.

For each Option, report annual and lifecycle capital cost, operating & maintenance cost/savings, energy use and carbon emissions, incremental lifecycle cost vs baseline, risks and benefits.

Use a $160/tonne internal price for carbon plus current utility rates in the life cycle analysis. Apply additional City guidance where provided (e.g. escalation rates). Present the results to decision makers for review.

A1. Net Zero Definition Appendix

A1.4 General Approach to Net Zero Small Renovations

Purpose suggests a simplified process for small renovations. Purpose recommends that design teams working on small renovations develop design and costing of the following options:

1. Like-for-Like Baseline: Reflect existing conditions and operations
2. High Performance: Target maximum emission reduction and meet the proposed net zero carbon definition for the equipment/system under review
3. Best Achievable with Life Cycle Cost Neutrality: If the high performance option does not have a simple payback that is shorter than the expected service life of the equipment, propose a high performing option that delivers the greatest carbon reduction while achieving life cycle cost neutrality.

For each Option, report annual and lifecycle capital cost, operating & maintenance cost/savings, energy use and carbon emissions, incremental lifecycle cost vs baseline, risks and benefits.

Use a $160/tonne shadow price for carbon and current utility rates in the life cycle analysis. Apply additional City guidance where provided (e.g. escalation rates). Present the results to decision makers.

A1. Net Zero Definition Appendix

A1.5 Green Power and Carbon Offsets

The certification systems reviewed (see page 9) require that annual carbon emissions be offset to achieve a zero carbon balance. This may be accomplished with Green Power products or Carbon Offsets.

Green Power Products

Green power products involve the purchase of bundled green power or green power environmental attributes. Each kilowatt hour of procured green power products offsets an equivalent amount of grid electricity.

The Green Power options provided in the numbered list below are listed from highest to lowest quality. Not all types of Green Power products provide the same level of additionality but products with higher levels of additionality are considered to be of higher quality. Additionality refers to the likelihood that the procurement of a Green Power product will result in new renewable electricity generation capacity that would not have otherwise been installed.

1. **Exported Green Power:** On-site or off-site renewable energy is generated in excess of building needs and environmental attributes (RECs) are retained. The roof area available for PV is generally not sufficient to offset all electricity use for high rise buildings, however, low-rise building with a large available area for PV and low annual energy consumption may expect excess generation.
2. **Power Purchase Agreements (PPAs):** This contract for green power and associated environmental attributes typically includes the purchase of a significant volume of electricity under a long-term agreement. This option is not available in Ontario at this point. However, Purpose recommends discussing this option with Toronto Hydro to plan a contact by 2040.

A1. Net Zero Definition Appendix

A1.5 Green Power and Carbon Offsets cont'd

Green Power (Continued)

3. **Utility Green Power:** Green power and its associated environmental attributes (RECs) are purchased together from a utility. Unlike with a PPA, these agreements do not typically require a volume purchase or fixed term. This option is not currently available from Toronto Hydro.

4. **Renewable Energy Certificates (RECs):** These market instruments represent the environmental benefits associated with a unit of electricity generated from renewable sources. They can be purchased through a third party.

Carbon Offsets

Carbon Offsets can be used to offset emissions from all sources, including grid electricity.

Carbon Offsets are credits for emissions reductions achieved by one party, that can be sold to another party to compensate for its emissions. Through recognized programs, projects and activities which reduce GHG emissions may certify Carbon Offset credits which may then be purchased by third parties. Projects or activities that produce Carbon Offset credits may include developing renewable energy to displace emissions from conventional power plants, capturing and destroying GHGs, or avoiding deforestation.

Carbon Offsets may come from anywhere in the world and from any project type.

A1. Net Zero Definition Appendix

A1.5 Green Power and Carbon Offsets cont'd

Carbon Offsets (Continued)

Carbon Offsets are generally recognized as a higher quality vehicle for offsetting emissions as compared to RECs. RECs do not have an additionality requirement. Additionally, permanence (the likelihood that emissions reductions are not canceled over time) and leakage (the risk that emissions reductions will result in increased emissions elsewhere) are quality considerations for Carbon Offsets.

Summary

Purpose recommend renewable power purchase agreements (PPAs) as the best long term option for decarbonizing the long term power needs of the City's portfolio. A renewable PPA provides a highly transparent version of additionality, the City procures the power. However, the current regulatory environment is not set up for such an agreement. Therefore, Purpose recommends purchasing carbon offsets in the short term while working with Toronto Hydro to advocate for the availability of Power Purchase Agreements in Ontario.

A2 | Cost and Impact Forecast: Methodology and Assumptions

A2. Cost and Impact Forecast: Methodology and Assumptions

A2.1 Cost of Carbon and Cost Escalation

Carbon Cost: Current (2020) carbon price cost is $30/tonne annually. By 2030, UN IPCC recommends minimum carbon pricing of about $160/tonne. Carbon pricing is built into existing utility rates, future utility rates are calculated for each facility using the future price of carbon. These rates are used to calculate cost savings, payback and simple incremental life cycle savings.

Subsequent to preparing this Plan, the federal government released a proposal to increase carbon pricing to $170/tonne by 2030. The federal price and the UN IPCC price are each based on separate models estimating Social Cost of Carbon (SCC). Both prices are within the range expected for a technologically advanced nation aiming to limit global temperature increase to between 1.5-2°C[1, 2].

The forecast conservatively assumes carbon cost does not rise further beyond 2030.

[1] *UN IPCC Report, 2018, "Mitigation pathways compatible with 1.5°C in the context of sustainable development", Chapter 2. https://www.ipcc.ch/sr15/chapter/chapter-2/*

[2] *Nature Climate Change article, 2020, "A near-term to net zero alternative to the social cost of carbon for setting carbon prices", https://www.nature.com/articles/s41558-020-0880-3?utm_source=nclimate_etoc&utm_medium=email&utm_camp*

A2. Cost and Impact Forecast: Methodology and Assumptions

A2.2 Uptake of Strategies

Strategic Divestment and Replacement: Assumed 10% of facilities undergoing a 50 year renewal cycle are difficult to retrofit and make sense to sell and replace with lower-carbon new builds. Performance of the divested buildings is assumed to be the average performance of these buildings. Assumed this applied to the following archetypes:

- Administrative Offices
- Ambulance Stations
- Child Care Facilities
- Community Centres
- Fire Stations
- Indoor Recreational Facilities
- Indoor Sports Arenas
- Indoor Swimming Pools
- Long-Term Care Homes
- Parking Garages
- Police Stations
- Public Libraries
- Shelters
- Storage Facilities
- Other

Solar PV Panels: Assumed 20% of sites are not suitable for PV due to nearby buildings shading.

A2. Cost and Impact Forecast: Methodology and Assumptions

A2.2 Uptake of Strategies cont'd

All Other Strategies:

Program Ramp Up: A portion of projects are expected to be unsuccessful, meaning these projects will not meet the new requirements as they are implemented. This is likely to occur during the first 5 years of plan implementation and have assume on average 25% of these projects will be unsuccessful.

Process Loads: Defined as loads for which fuel switching and efficiency retrofits is unfeasible. This includes facilities dominated by electric pumping loads and facilities with processes requiring high water temperatures, beyond what heat pumps are capable of providing.

Archetype	Typical Process Load	Impact on Uptake
Sewage Treatment Plants	Treatment processes requiring high water temperatures	Reduced by 20%
Water Treatment Plants	Pumping processes with limited efficiency opportunities	Reduced by 20%
Pumping Facility	Pumping processes with limited efficiency opportunities	Reduced by 20%

Data centres were also considered, as these facilities often use 10 to 100 times more energy per area than typical office space. However, it is feasible to improve efficiency of these data centre through heat recovery and within the City's portfolio the energy consumption is considered to be relatively small.

A3 | Cost and Impact Forecast: Sensitivity Analysis

A3. Cost and Impact Forecast: Sensitivity Analysis

A3.1 Sensitivity Scenarios Considered

Criteria Evaluated	Plan Forecast	Sensitivity Variations Reviewed	Outputs[1]	Conclusions
Utility Rates Escalate Beyond Inflation	0% - Utility rates do not escalate beyond inflation	Utility rates escalate 5% beyond inflation	Annual O&M cost increases by $240M	Capital plan budget unchanged. Lifecycle cost increases by $4.8 billion as efficiency savings are outpaced by increased utility costs
Offset Prices	$20/tonne CO_2	$160/tonne CO_2	Annual O&M cost increases by $11M	Plan capital budget unchanged. City's annual offset budget increases.
Biogas Availability	10% of current natural gas consumption	1.5% of current natural gas consumption	Annual O&M cost decreases by $2M Annual offset purchase increases by 10,000 tonnes CO_2	Plan capital budget unchanged. Increases the City's annual offset budget.
Incremental Capital Cost	Varies	+/-10%	Total Plan budget varies by +$180M or -$180M	Within the included $450M contingency (25%)
Achieved Efficiency	Varies	+/-10%	Annual O&M cost varies by +$11M or -$13M Annual offset purchase varies by +6,000 or -6,000 tonnes CO_2	Plan capital budget unchanged. Lifecycle cost and payback decrease as greater efficiency savings outpace capital costs and increase as efficiency savings decrease.

[1]Costs do not include contingency

A4 | Conditions of Use

A4. Conditions of Use

The scope of work and related responsibilities for this report are defined in Purpose Building's proposal and Terms and Conditions. Unless specifically recorded in the report, this scope and these responsibilities do not include:

- physical or destructive testing to evaluate conditions that cannot be quantified by visual observation;
- calculations or evaluations to check compliance with past or current building codes and design standards;
- responsibility to identify errors or insufficiencies in the information obtained from the various sources;
- responsibility for decisions made or actions taken as a result of this report unless Purpose Building are specifically advised and participate in such action, in which case the responsibility will be as agreed to at that time.
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A4. Conditions of Use (cont'd)

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- No portion of this report may be used as a separate entity. The report is written to be read in its entirety.
- Only the specific information identified has been reviewed.
- Conditions existing, but not recorded, were not apparent given the level of study undertaken. Only conditions actually seen during examination of representative samples have been appraised and comments on the balance of the conditions are assumptions based upon extrapolation. Purpose Building can perform further investigation(s) on items of concern, if so requested.
- Applicable codes and design standards may have undergone revision since the subject property was designed and constructed and visual evaluation is not sufficient to determine if those changes affect past or current compliance.
- Budget figures provided represent Purpose Building's opinion of a probable current dollar value of the work and are provided for approximate budget purposes only. If an actual construction budget is required for some or all of the work, Purpose Building can provide an additional service to establish a scope of work and receive quotes from suitable contractors.

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