# PACT

## Planning Actions for Climate Toolkit

March 2024

**Publishing Information**

TITLE: Planning Actions for Climate Toolkit (PACT)
AUTHOR: The City of Calgary
STATUS: DRAFT
PRINTING DATE: XXX

# Table of Contents


WOLFF
EllisDon

# Introduction

With the declaration of the climate emergency in 2021 and the approval of the Calgary Climate Strategy - Pathways to 2050 (The Strategy), climate action is a clear priority for The City of Calgary (The City). The City is working to both reduce the production of greenhouse gas (GHG) emissions and preparing for and adapting to the changes to come. Not only is addressing climate change a critical priority for Council, The City, and Calgarians, but many climate actions also:

- Bring significant economic opportunities;
- Support equity objectives by reducing housing unaffordability, energy poverty, and climate vulnerability; and,
- Protect and enhancing natural environments

Planners and other city builders, by guiding the growth and development of Calgary, have both the significant ability and responsibility to participate in efforts to reduce greenhouse gas emissions (climate mitigation) and fostering climate resilience (climate adaptation). The Strategy includes a fulsome list of actions needed to meet these objectives; however, as a non-statutory document, the Strategy itself cannot mandate regulations and standards.

One of the implementation tools highlighted in the Strategy is aligning land use planning to support climate objectives, ensuring the way we grow, move, and develop supports climate action. This document provides guidance and information on how to integrate climate objectives into the Planning continuum through application review and approval.

## Key Definitions

**Climate Change:** A long-term change in global average weather patterns due to greenhouse gas emissions produced by humans.

**Climate Mitigation:** Actions that reduce and prevent greenhouse gas emissions from being produced, and actions that remove greenhouse gases from the atmosphere.

**Climate Adaptation:** Actions that reduce the negative impacts of climate change on people and places.

**Greenhouse gases (GHGs):** Gases that absorb and emit energy in the atmosphere, driving climate change. While there are numerous greenhouse gases of various intensity, greenhouse gases are often measured using $tCO_2e$, or the amount of carbon dioxide required to produce an equivalent amount of heating.

**Net-Zero:** The state in which GHGs emitted into the atmosphere are equal to the removal of carbon from the atmosphere.

**Climate Resilience:** The ability of people, communities, or the environment to cope with a climate hazard.

# What is the PACT?

Planning Actions for Climate Toolkit (PACT) is an information resource, detailing opportunities to reduce GHG emissions and integrate climate adaptation features at multiple stages of the planning approvals continuum, from land use to post occupancy (Figure 1). The guidance in PACT provides details about when climate actions should be included and how language can be crafted to meet climate objectives.

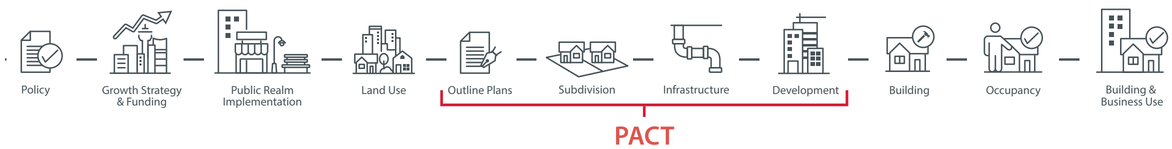



Figure 1: Areas of the Planning Approvals Continuum Covered by PACT

Users of this document include:

- **City planners and other City staff** who review pre-applications, outline plans, subdivisions, and development permits can find information about what measures to encourage, when they are applicable, and how to structure recommendations.
- **Applicants, developers, and builders** who may be unsure what they can do to include climate features in their development or want more information about what The City considers to be good climate planning.
- **Homeowners and building owners** who are curious about opportunities have to include climate change initiatives on their properties and save money, reduce liabilities, and protect their health and wellbeing.

> A Planner should use their discretion to determine which actions should be required, incentivised (e.g. granting certain variances such as increased height or reduced setback distances granted in exchange for climate performance), or encouraged.

## What PACT is not

PACT is not policy and the contents within this document are not statutory. The City's current direction is to work collaboratively internally and with our development industry partners to encourage and enable climate actions, including providing information on climate opportunities. PACT has been designed in alignment with The Strategy approved by Council and will be updated to align with future statutory plans, including the Municipal Development Plan.

PACT is not a technical document and should not be used to inform engineering and safety standards. PACT also does not override any code requirements, including but not limited to Alberta Building Code and National Energy Code. The intention of PACT is to provide guidance, recommendations, and best practices on climate action.

While PACT collects a number of features that are considered climate action best practices, the document does not include actions that are already captured in existing statutory documents. Instead, PACT actions cover gaps in Calgary's statutory framework where standards are either not present or could be improved.

## How to use the PACT

PACT is structured around the different aspects of the planning approvals continuum (Figure 1) to provide users working at a specific stage of the planning continuum the ability to see which climate actions can be integrated at each planning stage. Each climate action is accompanied by the following information:

- **Applicability:** Which communities and developments is this climate consideration most useful
- **Impact:** For climate mitigation, impact is determined based on the estimated amount of Greenhouse Gas (GHG) emissions abated. This value can be increased based on a combination of actions (e.g., Electric Vehicle (EV) charging plus renewable energy generation has a greater climate impact than EV charging alone). For climate adaptation, impact estimates how the action reduces the risks of climate change by addressing vulnerabilities or reducing the frequency or intensity of a hazard. This impact can depend on the location of the project (see Community Climate Risk Profiles for more information).
- **Costs:** Rough estimates of the financial implications of implementing the action, including a description of possible returns on investment. It is important to note that costs can change as market conditions adjust.
    - Where feasible, PACT breaks costs into financial implications for The City of Calgary, for the Applicants (developer/builder), and for occupants and owners.

When encouraging climate action, Planners are encouraged to consider the following factors:

- **The scale of GHG emissions reduced:** Larger and more energy intensive developments and uses should be subject to stronger standards as it represents a larger potential reduction in total emissions.
- **Climate risk impacts:** Certain climate adaptation measures may be prioritized to reduce the risks of climate hazards that are or will be most impactful in the community. Climate risk can vary by

community, including which hazards pose the greatest risk and which factors drive this risk. Climate adaptation prioritization needs to respond to local and specific climate risk factors.

- **The overall cost of development**: Larger and more expensive developments may be subject to higher standards, as climate features represent a smaller portion of total project costs and therefore climate requirements present less of an impediment to development.

Comments in **bold** (starting in section 1.0) can be directly pulled for comments on applications. A Planner should use their discretion to determine which actions should be required, incentivised (e.g. granting certain variances such as increased height or reduced setback distances granted in exchange for climate performance), or encouraged.

At the Development Permit stage, PACT helps guide the use of discretionary authority, applied when determining if the proposed development should be approved. City staff must consider climate adaptation and mitigation when making a decision on a development permit (Land Use Bylaw Section 35a.1) and have the ability to impose conditions for climate mitigation and adaptation (Land Use Bylaw Section 38a.1).

Reference to PACT does not replace Climate Specialist review; the Climate specialist should still be circulated on files requested and will be able to provide the most clear and specific climate action comments on a given parcel.

> City staff must consider climate adaptation and mitigation when making a decision on a development permit (Land Use Bylaw Section 35a.1) and have the ability to impose conditions for climate mitigation and adaptation (Land Use Bylaw Section 38a.1).

# Why does The City care about climate action?

Calgary is joining other municipalities, governments, and entities in reducing GHG emissions, as part of a collaborative effort to limit the acceleration of climate change. The net-zero target established in the Climate Emergency Declaration is aligned with the Government of Canada's target, which itself is aligned with over 120 countries committed to reaching net zero emissions by 2050[1]. Climate mitigation actions focus on an energy transition to a low-carbon economy, presenting several economic benefits like lower energy costs for Calgarians and creating jobs in clean technology. Calgary can save an estimated $60 to $80 billion by 2050 in energy saving through greater energy efficiency and renewable energy.

While reducing the pace and severity of climate change is critical, climate changes are already occurring and will continue, even if net-zero is achieved immediately, due to the ongoing impacts of GHG emissions already in the atmosphere. Climate adaptation helps protect Calgarians from the current and projected impacts of climate change, by anticipating climate change impacts, preventing how disruptive climate hazards are, and improving our ability to recover and improve during and after a climate hazard. A conservative estimate of climate change impacts on buildings, infrastructure, economy, environment, and health care estimates the costs of climate change to reach a staggering $2.6 billion annually by the 2050s and $7.8 billion annually by the 2080s[2]. Climate adaptation actions often present significant returns on investment by reducing the costs and impacts of climate change.

Integrating climate mitigation and adaptation into the city-building process is needed to ameliorate the impacts of climate change and achieve these co-benefits.

# Policy Direction

The City's mandate for climate action comes from the Municipal Government Act, Calgary City Charter, and Climate Emergency Declaration by City Council. The Strategy provides the basis for how The City will address climate change, including a fulsome list of actions needed to reach net zero by 2050 and foster climate resilience. The Mitigation and Adaptation Plans housed within the Strategy will be reviewed and updated every five years to keep current with the most recent scientific findings and best practices.

While the Strategy was approved by Council, the document does not have any statutory impacts on development and therefore must be implemented through other programs, policies, and tools. This direction is laid out in the Strategy, which specifically acknowledges the need to integrate climate action into the planning continuum through "Program Pathway H: Focus Land Use Planning to Prioritize Zero Emissions City Design". Distinct action in this pathway includes updating the Municipal Development Plan and Calgary Transportation Plan to incorporate net-zero emissions (currently in progress[3]), incorporate climate mitigation and adaptation into local area plans, and reviewing and updating existing planning policies, guidelines, regulations, and processes for alignment with the Strategy and to incentivize innovation. These updates to guiding policy are underway, such as the Municipal Development Plan, or completed, such as the Westbrook Local Area Plan. Additional work includes ensuring climate and energy planning is a strategic priority for new community growth and prioritizing climate mitigation and adaptation in the review of outline plan applications.

[1] *Net-Zero Emissions by 2050 - Canada.ca*
[2] *https://engage.calgary.ca/download_file/view/7054/1613*
[3] As of 8/28/23

Further direction was provided to Administration by Council through the establishment of the *Growth and Development Climate Framework*, which would integrate climate considerations and priorities into the Planning Approvals Continuum. Part of this work includes the establishment of a *carbon budget* which would ensure future decisions made by The City are consistent with the net zero target. To do so, a carbon budget tracks the GHG impacts of a decision and allocates a certain percentage of GHGs that can be produced in a given year. This ensures The City is on track to reach our net zero goal by 2050 and integrate climate consequences into core decision-making, encouraging the City to support more efficient designs.

Beyond the vision and direction provided by the Calgary Climate Strategy, many registered professional planners in Canada are mandated to consider climate impacts in their work through a Policy Goal set by the Canadian Institute of Planners (CIP). These responsibilities include creating urban areas that are compact, walkable, and reduce transportation emissions, creating net-zero buildings and developments, avoiding climate vulnerabilities through location and design choices, supporting circular economies, and integrating alternative, low-carbon energy options.

The key risk of climate change to health, lives, livelihoods, and economies, integrating climate action into planning decisions may be interpreted as an ethical responsibility, particularly as the magnitude of impacts are greater on communities experiencing increased vulnerability.

## CIP Policy on Climate Change Planning: Policy Goal

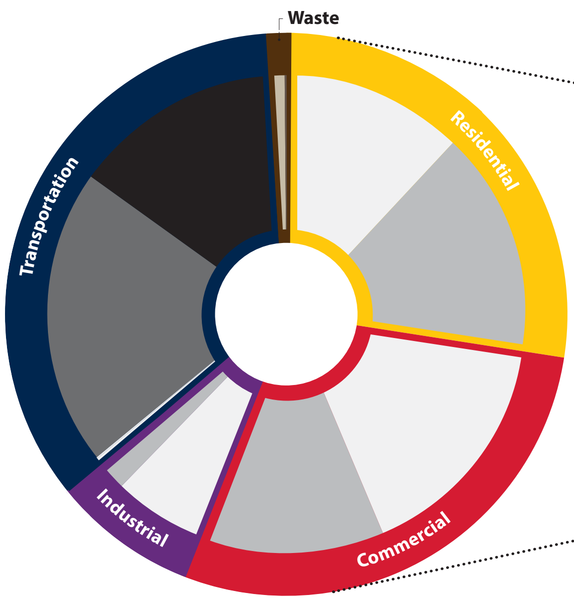
**CIP envisions a future in which Canadian communities are planned, designed, developed, and managed to contribute to climate stability and to be more resilient in the face of unavoidable changes in the climate, and in the process, to become more liveable, prosperous, and equitable.**

# Climate change in Calgary

## Greenhouse gas emissions in Calgary

The majority of GHG emissions produced in Calgary come from buildings, where natural gas is typically used for heating and both coal and natural gas produce most of the electricity used for lights and appliances. Roughly a third of GHG emissions produced in Calgary come from transportation, predominantly driven using gasoline powered private automobiles.

Buildings in the ICI (Industrial, Commercial, Institutional) sector produce a disproportionately high amount of carbon emissions. Within the residential sector, the per unit emissions show the most GHG intensive developments are large, single detached homes. These disparities reveal the need for targeted and strategic action to encourage climate mitigation measures on these high emission buildings to make the most meaningful impact per dollar spent on reducing GHG emissions.




| | | |
|---|---|---|
| Residential | Electricity | 1,954,002.00 |
| | Natural Gas | 2,529,244.00 |
| Commercial | Electricity | 2,651,245.00 |
| | Natural Gas | 2,023,066.00 |
| Industrial | Electricity | 1,021,309.00 |
| | Natural Gas | 244,582.00 |
| Transportation | Electricity | 38,943.00 |
| | Gasoline | 3,420,603.00 |
| | Diesel | 2,314,723.00 |
| Waste | Waste landfill | 124,603 |
| | Wastewater | 23,326 |

**Figure 1: Sectors contributions to GHG emmissions in Calgary**

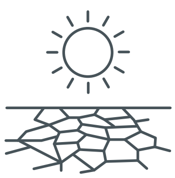
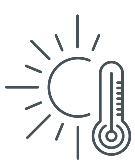
## Embodied carbon

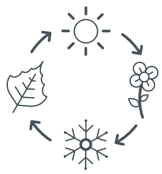
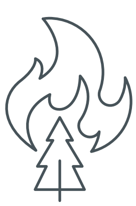
GHG emissions should also account for the carbon produced to extract, process, and transport materials used for buildings and infrastructure, as well as the carbon produced to recycle or dispose of materials. These GHG emissions are referred to as embodied carbon. Every piece of infrastructure and developments produce some amount of carbon, requiring The City to be conscious of every choice, from the width of components of a streetscape to the choice of locally sourced materials.

# Climate hazards and risks

Climate change is a risk multiplier with broad reaching impacts on environmental, social, and economic systems. The City has projected climate impacts in the short, medium, and long term, as well as monitor climate changes that are already impacting Calgary. For more information about the climate changes projected for Calgary, please see the *Climate Projections for Calgary Report*. A summary of climate hazards, and their impact on city building, are discussed in Table 1.

**Table 1: Climate Hazards in Calgary**

| Hazard | Summary | Impact on City Building |
|---|---|---|
| Drought  | Climate projections show that drought and water shortages are likely to increase in regularity. Drought will also affect the river flow, resulting in lower flow and decreased water quality in summer.<br>Drought can severely harm natural areas and resulting water restrictions can inconvenience and even damage residents and businesses that need water. Drought can also damage foundations and underground infrastructure.<br>While drought risk is rising, drought risk is relatively low compared to other hazards. | Designs can reduce the risk of drought in Calgary by reducing water demand from appliances like dishwashers and washing machines, irrigation for landscaping, and faucets and taps.<br>Creating drought resilient landscaping and restoring poorly performing natural areas can reduce the risk of damage from water restrictions. |
| Extreme Heat  | The number of extreme heat periods will increase dramatically, from once every few years to multiple times each year. Summers in Calgary are projected to get hotter and drier over time. The average hottest summer days will be about 3C hotter by mid-century, and night time temperatures will stay above 20C more often, resulting in sustained periods without significant temperature drops overnight. The number of days with temperatures 29C or above will quadruple, and we can expect a 1 in 20-year extreme heat event to happen once every 5 years.<br>Extreme heat can not only significantly damage infrastructure and buildings, but also brings significant risk of health impacts from heat-related illnesses, including death.<br>Extreme heat is one of the highest climate risks to Calgary. | To reduce the intensity of heat in Calgary, greenspaces and vegetation should be abundantly provided and dispersed, while hardscapes should be reduced.<br>To reduce the risk of heat related impacts, public spaces should provide shade and cooling amenities, including drinking water and cooling centres. Internal spaces should be cooled. |

| | | |
|---|---|---|
| Heavy Rainfall  | Climate projections show an increase in annual precipitation. The greatest increase in precipitation is short but intense rainfall events, where more rain falls in a short amount of time. Climate projections show that Calgary may experience an over 25% increase in the volume of heavy rainfall by 2050.<br><br>This type of rainfall causes the most damage as it is most likely to cause flooding by overwhelming the stormwater systems. Heavy rainfall is one of the highest climate risks to Calgary. | To limit the likelihood of stormwater systems being overwhlemed, new systems and systems redesigns should anticipate future climate needs.<br><br>To reduce the amount of water that enters the stormwater system and to improve water quality, on-site stormwater management features should be included in developments, especially where they reduce the permeability of an area. |
| Higher Average Temperatures  | In addition to an increase in annual temperatures, climate change will also cause a shift in seasons in Calgary. These impacts will impact natural ecosystems in Calgary. The increase in freezing and thaw events that can significantly damage to infrastructure.<br><br>Higher average temperatures are one of the highest risks to Calgary. | With higher average temperatures, development should consider maintaining thermal comfort through higher efficiency developments and landscaping should consider vegetation appropriate for future climate conditions |
| River Flooding  | While the Bow and Elbow Rivers will be experience lower flows during dryer seasons, changes in precipitation will increase the likelihood of river flooding events. As Calgary experienced in 2013, river flooding can cause significant economic, social, and environmental damage.<br><br>River flooding is a moderate risk to select areas in Calgary. | Development in the floodplain should be avoided, and where this is not possible, should include flooding mitigation measures.<br><br>Preserving and enhancing riparian areas is a critical part of reducing flood risk |
| Severe Storms  | Climate projections show an increase in the number of annual days where extreme wind exceeds 90 km/hr. High winds can cause significant damage to buildings and infrastructure, as well as creating unsafe and uncomfortable environments for Calgarians.<br><br>In addition, projections suggest an increase in the amount of lightning and hail in a given year, both of which can damage infrastructure and buildings and potentially harm Calgarians as well.<br><br>While severe storm risk is rising due to climate change, severe storm risk is relatively low compared to other climate hazards. | Developments should be built to reduce wind impacts, through building and vegetation orientation and design. |
| Wildfire  | Wildfires, both within and beyond the boundaries of the city, have significant impacts on Calgary, including creating low air quality that creates health impacts. Climate change is increasing the likelihood or wildfire in areas that will affect Calgary.<br><br>Smoke from wildfires is a high climate risk. | City design should seek to reduce the health impacts of smoke through better mechanical systems and provision of clean air shelter.<br><br>Design near high forested area should consider fire resistant designs and materials. |

# Community Climate Risk Profiles

While every Calgarian and Calgarian community will be affected by climate change, not every Calgarian will be affected equally. Climate risk is determined at the intersection of climate hazard information, exposure to climate hazards, and the antecedent conditions that make a person, household, or community more likely to be impacted by climate change and affect their ability to respond, recover, and change in response to or in anticipation of climate hazards.

The Community Climate Risk Profiles are intended to inform the design of climate adaptation measures in Calgary. Planners should refer to the Community Climate Risk Profile for the communities they are working in to understand which climate risks are the greatest and integrating risk reduction into their design.

The City produced Community Climate Risk Profiles to assess how climate risk will affect different communities in different ways and enabling planning actions target the drivers of climate risk. The profiles incorporate four datasets to understand climate risk:

- **Community Climate Risk Index (CCRI):** This dataset quantifies relative climate risk in Calgary's communities by assessing the community is exposed and vulnerable to climate hazards. The CCRI includes over 50 indicators of exposure and vulnerability that are intersected with relevant climate hazard data. Exposure and vulnerability information is categorised into three systems, social, built, and natural. The CCRI provides a relative risk score for the present time and projected forward to 2050, using current vulnerability conditions.
- **Urban Heat Island Analysis:** The Urban Heat Island Analysis investigates the phenomenon where contiguous paved and built spaces are warmer than nearby natural spaces. This effect occurs because paved surfaces and buildings hold heat more and for longer than natural infrastructure. The Community Climate Risk Profiles analyse satellite and ground data in the urban heat island map to determine which parts of the community are warmer than others and therefore require dedicated cooling relief measures and what land development patterns amplify heat risk.
- **Natural Asset Mapping:** Natural environments provide many resilience benefits to communities, from creating cooler spaces, absorbing rainwater, and reducing the effects of river flooding. The Community Climate Risk Profiles assess a map of natural assets to understand which communities and which parts of communities are underserved with natural assets.
- **Calgary Equity Index:** As existing structural inequalities exacerbate climate risks, the Community Climate Risk Profiles analyse the Calgary Equity Index to understand the presence of community members that may experience increased climate risk.

# Climate equity for adaptation and mitigation

The risks of climate change will exacerbate existing inequities, as equity denied community members are more susceptible to the impacts of climate change. Differences in income, educational opportunities, age, sex, gender, ability, sexual orientation, language, and immigration status all have an impact on how climate change impacts are experienced and the ability to recover from climate hazards. Not all people have the opportunity to have their voice represented in climate action design and goals, which can result in inequitable and inaccessible programs. The City is continually working to engage Calgarians and understand the intersections that influence and individual's climate risk, including establishing a diverse working group and working with equity-deserving communities.

Because climate change will exacerbate existing inequities, climate action is one of the most important things The City can do to foster equity and support equity-deserving peoples. While climate action inherently contributes to equity goals, actions can and should be designed to ensure they are accessible and maximise their support of equitable principles.

Critical considerations include income and wealth, which determine a household's or entity's ability to invest in tools to prepare for and ability to recover from climate hazards. Wealth and access to resources are also closely intersected with other factors. While almost all climate actions have long term economic benefits, they may include a capital cost that not everyone has access to. Planners should be cognizant of the costs of climate action and encourage proportionate measures to different uses (i.e. more expensive projects and projects from wealthier entities like big corporations should be held to higher standards for climate action).

As planners include climate considerations in their work, key considerations include accessibility, including physical, economic, and information, that limit the ability of some Calgarians to receive the benefits of climate action and how actions will be received and uniquely impact the drivers of climate risk.

# Climate Actions

## 1.0 Outline Plans

At the Outline Plan stage, planning efforts should focus on ensuring block alignment supports energy efficiency and climate risk reduction.

**Building and Site-Specific Comments at Outline Plan Stages: Guidance for City Staff**

Building and site specific comments can be provided as advisory comments at the Outline Plans and LOCs, prompting an Applicant to consider these features at latter stages of the continuum. There may also be opportunities to set requirement for climate actions through;

- Statutory plans, where a development that triggers an Area Structure Plan, Area Redevelopment Plan, or Local Area Plan amendment provides an opportunity to include climate action features as policy for that site in the statutory document.
- In cases where the Outline Plan Applicant is not the builder, The City should work with the applicant to investigate opportunities to establish requirements for future builders through conditions of sale, architectural controls, and/or restrictive covenants.

### 1.1 Urban Heat Island Prevention

| | |
|---|---|
| **APPLICABILITY** | All Communities |
| **COSTS** | Applicant: Low<br>City: Low, through increased maintenance of greenspaces<br>Occupant/owner: Costs savings through reduced cooling costs and reduced heat morbidity and mortality |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | Extreme heat, higher average temperatures |
| **CLIMATE MITIGATION THEMES** | None |

Urban heat islands are a phenomenon that is created when an urban area is significantly warmer than adjacent natural areas due to the propensity of pavements and buildings to retain more heat than vegetation and waterbodies. The urban heat island phenomenon is most prominent in areas with high amounts of pavement and built space and low amounts of greenspace and tree canopy. This effect significantly increases the risk of extreme heat, a hazard that will experience substantial increases in intensity and magnitude.

To reduce the effects of the urban heat island, communities should seek to maximise the amount and distribution of greenspaces and increase the albedo (reflective ability of the built area). Specific factors to consider are:

- Major roadways, such as arterials, should have trees in the furnishing zone adjacent to sidewalks and bike lanes to provide shade and cooling. Where trees are not feasible, shading structures should be included instead;

- Community design should incorporate vegetation throughout the community at all available spaces, including using vegetative ground cover instead of pavement where possible;
- Programmed (Municipal Reserve) and private greenspaces should be located frequently, within walking distance to all residential units; and,
- Greenspaces are encouraged to include water features where possible for a larger temperature reduction effect.

**Community design should include accessible greenspaces distributed through the community and prevent the formation of large swaths of paved spaces.**

**Development should:**

- **Retain existing, healthy tree stands wherever possible. Where not possible, trees should be replaced to ensure there is no loss to tree canopies.**
- **Ensure trees are planted along major roadways and throughout large, paved spaces, such as surface parking lots.**
- **Where trees cannot be provided, shade structures should be used to provide shade for pedestrian pathways and spaces.**

**Urban plazas and outdoor gathering spaces should be encouraged to include features that reduce heat, including shade structure, vegetation integrated into the plaza, and water features.**

**Greenspaces should be encouraged to include water features, such as fountains, wading pools, and ponds.**

**Additional resources:**
Calgary's Urban Heat Mapping Tool helps identify areas of the city that experience warmer temperatures:
*Urban Heat of Calgary | City of Calgary map gallery*

## 1.2 Passive Solar Design

| | |
|---|---|
| **APPLICABILITY** | Residential and residential mixed-use communities |
| **COSTS** | Applicant: Very low<br>City: None<br>Owner/Occupant: Will create long term energy savings |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Energy demand reduction |

Passive solar building design use the energy produced by the sun without the use of active mechanic equipment. By taking advantage of natural, free, and abundant solar energy, these methods are a simple and highly effective method for reducing demand for light and heat and thereby reducing emissions.

Aspects of passive solar design include both community and buildings scale measures. At the community design scale, critical actions include aligning blocks to maximise southern exposure to sunlight and ensuring that shadowing does not limit the passive solar gain of buildings nearby.

**Neighbourhood design should enable maximum passive solar gain of buildings, through measures that include, but are not limited to:**

- **Aligning buildings to maximise their south facing exposure;**
- **Maximising the transparency of south facing walls; and**
- **Establishing a building orientation that minimises shadows cast on adjacent buildings. This can include varying the setbacks for buildings to enable light penetration and locating taller buildings north where possible.**

For more information about how passive solar building design options included at the Outline Plan Scale should be followed up at the building scale, please see 3.8 Passive Solar Design.

## 1.3 District Energy

| | |
|---|---|
| **APPLICABILITY** | High Density Areas |
| **COSTS** | Applicant: High, due to the cost of creating dedicated space for a facility and connecting infrastructure<br>City: Varies, based on City's responsibility for connecting pipe infrastructure<br>Owner/Occupant: None |
| **IMPACT** | Moderate, through replacing building heating with more efficient systems. Can be high through use of renewable energy for heating. |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Energy efficiency |

District energy systems centralise heating for multiple buildings in an area in a single facility and reduce emissions by using more efficient machines for heating, resulting in less natural gas consumed for the same amount of heating. These systems can also employ technologies like geoexchange, combined heat and power, and ground source heat pumps that are often too costly or complex for individual buildings but can have significant impacts on reducing emissions. Additionally, using renewable technology can further reduce heating emissions. Beyond reducing GHG emissions, district energy systems increase the amount of usable floor space in buildings by eliminating the need for building heating systems (furnaces, boilers, etc.)

District energy facilities transfer heat using highly insulated pipes, often subterranean. Implementing district energy in the design of the community can ensure that this subsurface network is established alongside other subsurface infrastructure, greatly reducing the cost of establishing this network later.

District energy systems have been used successfully around the world, including in downtown Calgary. However, despite the potential emissions reduction possibilities district energy presents, establishing a system can be very challenging. Some issues include high initial costs, the need for a utility company to operate the district energy system, the amount of heating demand required to provide suitable returns on investment, and the inability to require nearby buildings connect to a district energy centre.

High initial costs are often cited as a significantly prohibitive factor for the establishment of these systems which can be addressed by ensuring the initial system is appropriately sized for the demand load. Centralized temporary boiler systems located in sea-cans have been employed as initial infrastructure in other jurisdictions as a tool to set up a low-cost viable district option, reducing the need for immediate permanent infrastructure at the initial outset of construction. Temporary boiler systems can also be modular in nature, allowing district energy system operators to expand the system over time, and is typically replaced with more permanent infrastructure with technology that has lower GHG emissions than typical boilers such as geothermal or sewer heat recovery as the system demand grows. Piping infrastructure costs can be reduced substantially by coordinating civil work with other deep utilities such as wastewater and water piping.

Features that support the use of district energy include locations where there are substantial and sufficiently concentrated amounts of heating demand and where the Applicant can ensure the connection of floor space, such as where the Applicant is also the long-term asset owner or where they are willing to require district energy connection through a condition of sale or restrictive covenant. The inclusion of district energy systems should also consider whether greater GHG and cost reductions would be possible with other systems, such as a heat pump.

At the application stage, The City should work closely with the Applicant to evaluate the feasibility of district energy, evaluate ownership models of the proposed district energy system, contact possible utility operators if appropriate, and support the establishment of needed infrastructure and address utility rights-of-way.

**The Applicant should consider establishing a district energy system to provide centralised heating for the buildings in the community. Initial steps include meeting with conducting a district energy feasibility studies and meeting with utility companies.**

**Community design should consider how buildings can be connected to the facility, including where pipe connections can be laid to connect the facility to buildings.**

## 1.4 Wind Risk Reduction

| | |
|---|---|
| **APPLICABILITY** | Communities with towers/tall buildings |
| **COSTS** | Applicant: None<br>City: None<br>Owner/Occupant: None |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | Severe storms |
| **CLIMATE MITIGATION THEMES** | None |

Calgary is the windiest city in Canada[4] and climate change may result in more intense winds. In order to protect residents, buildings, and power infrastructure from the impacts of severe wind, communities should be designed to reduce exposure and vulnerability to extreme wind. While severe wind poses a risk, urban winds are also critical to reducing air pollution through greater circulation and mitigate the risks of extreme heat. Community planning should endeavour to minimize severe wind impacts and utilise wind effectively for beneficial purposes.

**Developments are encouraged to complete a community wind impact assessment and include opportunities to mitigate negative wind impacts on pedestrians and capitalise on the cooling effect of wind.**

**Developments are encouraged to consider providing power and telecommunications infrastructure underground to reduce the risk of wind damaging utilities.**

## 1.5 Grid Based Street Networks

| | |
|---|---|
| **APPLICABILITY** | Any communities |
| **COSTS** | Applicant: None<br>City: None<br>Owner/Occupant: None |
| **IMPACT** | Dependant on transit service |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Low carbon transportation |

Mode switching from private automobiles to transit reduces emissions from transportation. Transit usage is limited by infrequent service and poor coverage, where potential users can be discouraged by the lack of access to transit and poor transit connections. Curvilinear streets make it challenging to provide transit access, requiring buses to travel further to reach the same number of residents compared to a grid-based street network.

**Outline plans are encouraged to employ a grid network for their streets, where possible with the topography and connections to existing, adjacent communities.**

**Where grid networks are not possible, street design is encouraged to provide mid-block pathways to enable pedestrians and cyclists to reach collector and arterial streets than can accommodate higher frequency transit.**

[4] Environment and Climate Change Canada - Weather and Meteorology - Wicked Winds from the West

# 2.0 Land Use Redesignation

## 2.1 Low Carbon Mobility Options

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | N/A |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Low carbon transportation |

Transitioning to low carbon transportation options is one of the most impactful methods to reduce greenhouse gas emissions in Calgary. When contemplating use changes, planners are encouraged to consider how the development will be accessed through different modes of transportation and how the development design can encourage more walking, wheeling, cycling, and transit.

Site design and alignment should enable and encourage pedestrian and cycling transportation by providing direct transportation routes, aligning buildings to pedestrian and cycling infrastructure.

**Higher density developments should be supported near transit stations.**

**Developments that increase the diversity of uses in a community may be supported due to their increased likelihood to encourage active transportation and are encouraged to include features that support active mobility, such as bike parking and end of trip facilities and buildings oriented to the street.**

# 3.0 Development Permits

At the development permit stage, applications review should focus on ensuring building structure, components, and landscaping enable greater efficiencies, clean energy use and generation, and reducing risk of damage to residents, structures, and natural elements. As building permit applications primarily focus on adherence to safety code requirements, the development permit stage is the last opportunity to provide commentary on occupancy level features, such as internal appliances and features.

### Informing the Use of Discretionary Authority – Guidance for City Staff

As per the Land Use Bylaw, the development authority must consider climate mitigation and climate adaptation when reviewing discretionary use development permits. The inclusion of climate mitigation and climate adaptation features, particularly high impact actions, should be considered as a positive contribution in deciding whether to grant approval of the permit. The Development Authority does have the ability to impose conditions on discretionary development permits with respect to climate mitigation and adaptation, outlined in the Land Use Bylaw, and are encouraged to do so to achieve The City's objectives as outlined in the Calgary Climate Strategy: Pathways to 2050.

## 3.1 Energy Efficient Buildings

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: High<br>City: None<br>Owner/Occupant: Upfront capital cost with substantial operational energy cost savings |
| **IMPACT** | Very high |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Energy efficiency |

Buildings consume energy through heating, which is primarily provided by natural gas in Calgary, and for electricity, which is currently mostly produced for fossil fuel sources in Alberta. One of the most effective ways to reduce building emissions is through greater energy efficiency, which reduce the amount of energy needed to maintain the same level of energy service (e.g. temperature of a building). Airtight construction, better insulation, high performance doors and windows, and air-sealing all reduce the energy needs for heating and cooling by preventing leakage, which also allows for the downsizing of HVAC equipment. High performance appliances, like washers, dryers, fridges, and washing machines reduce the electricity needed for household uses.

Building envelopes should be designed to reduce air leakage and thermal transfer. Measures to do so include increased quality and amounts of insulation on walls and attics, weather stripping and caulking, and high-performance windows. Double and triple pane windows improve insulative ability of windows, as can glazing on windows. Outside doors should have weatherstripping and be dense to minimise heat loss. The use of framing materials like fibreglass that have lower heat transfer can replace high heat transfer materials, like aluminum to reduce heat loss. Building envelopes can also employ a double skin façade, where the envelope includes two layers of glass separated by an empty space with air flow from air outside the building. Airflow in this gap can be passive or mechanically driven. This technique is particularly valuable for high rise buildings and plays a significant role in reducing heat transfer, reducing heating and cooling demand, as well as providing improved auditory comfort and indoor air quality.

**Developments should improve energy efficiency through a superior building envelope, including but not limited to:**

- **Enhanced insulation**
- **High performance doors and windows**
- **Windows with mechanical elements that can adapt to heating and cooling needs**
- **Double skin façade systems**

**Development should commit to the use of energy efficient appliances, such as Energy Star rated appliances, to reduce demand for electricity.**

Increasing the surface area to volume ratio of buildings also reduces energy efficiency, as building corners contribute to greater heat loss. While articulation limits should be discouraged from an energy efficiency perspective, buildings can create interesting urban design through varied materials and art pieces.

**Development should be designed to reduce the number of corners a building has to reduce the surface area to volume ratio.**

### Net-Zero Buildings

To meet the City of Calgary's net-zero emissions goals, all buildings in Calgary must be net zero by 2050. Net zero homes are highly energy-efficient buildings that produce or procure renewable no carbon energy that offset both the total annual operational energy use and the embodied emissions produced throughout the lifecycle of the building. There are several principles that are key to net-zero buildings and unique designs can employ a combination of efforts to reach net-zero:

1. Airtight and thermally-resistant building enclosures that significantly lower the thermal energy demand intensity (TEDI) of the building.
2. Highly-efficient, interactive and adaptive electrical and mechanical building systems that lower the total energy use intensity (TEUI) of the building.
3. On-site renewable energy generation from solar photovoltaic, solar thermal, and geothermal sources.
4. Off-site renewable energy purchase to supplement or take place of on-site renewable energy generation.

Not only are net-zero buildings critical for meeting climate goals, but they also provide long term cost savings to residents by reducing energy bills. Net zero homes can be marketable for households looking to reduce their carbon footprint. All buildings that are not built to net-zero standards will need to be retrofitted before 2050, often at significantly greater expense to the residents. Developments should be aware that not including net-zero features will require residents to perform costly retrofits in the future and may be asked to conduct an assessment on the actions, and associated costs, that would be needed to achieve net zero.

**Developments are strongly encouraged to achieve net-zero or net zero ready status. For more information about achieving net zero certification, please see the** *Canadian Home Builders' Association Net Zero Home Labelling Program*.

**Developments that are not built to net zero or net zero ready standards should complete an assessment of the actions and associated costs that will be required to achieve net zero compliance. These assessments can help developers understand the actions needed to achieve net zero, highlight that the costs of retrofits exceed upfront costs to reach net-zero, and provide a plan of action for future building owners.** Planners should consider requesting a study when Applicants are unsure about the feasibility or benefits of net zero buildings.

**To support the development of high performing buildings, The City offers a** *Green Buildings Priority Stream* **that apply to net-zero homes. Priority stream participants receive dedicated support, accelerated permit reviews, and project promotion. The priority stream can be entered through several pathways, including net zero and net zero ready home labels and Passive House certification. Applicants should consider applying for the Green Buildings Priority Stream.**

To create more efficient heating in buildings, heat pumps should also be encouraged. Please see 3.3 Heat Pumps.

## 3.2 Renewable Generation

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: Low<br>City: None<br>Owner/Occupant: Owner/occupant: Return on investment over time from costs savings and revenue generation |
| **IMPACT** | High - Can be paired with measures like EV charging and electric heating/cooling for additional GHG emissions reduction |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Clean energy supply |

Renewable energy reduces dependence on energy from the electricity grid in Alberta, which is currently produced using mostly fossil fuels. With renewable sources producing no carbon, renewable energy reduces GHG emissions from energy, while also bringing additional benefits from offsetting energy costs and generating revenue by selling excess power back to the grid. The Government of Alberta allows, under microgeneration regulations, enables buildings to include renewable energy generation equivalent to the power usage of the building up to 5 MW.

One of the best sources of renewable energy in Calgary is solar photovoltaic (PV) which uses light from the sun to produce power, capitalising on the high solar irradiation Calgary gets. Solar PV is a proven technology that often results in a quick return on the initial investment. To support solar PV installations, planners should require developments optimise solar feasibility by maximising the southern exposure of the roof and ensuring developments are solar-ready, or ready to accommodate solar PV.

Developments are encouraged to integrate other types of renewable energy is they are willing, including geothermal and wind, though these technologies are either less feasible or less proven. Planners should prioritise renewable technologies with the greatest emissions reduction profile and the inclusion of more novel or innovative renewable technologies should not prevent the development of solar PV unless it can be demonstrated the alternative technology produces greater emissions offset.

**Development should include a solar PV system.**

**Where solar PV systems are not provided at the time of development but are still feasible, rooftops should be designed to maximise south-facing exposure and have steeper slopes to maximise solar feasibility.**

**Developments should be solar ready, through the inclusion of the following features:**

- **Rooftops provide an unobstructed area (clear of chimneys, vents, skylights, gables and other protrusions) large enough to accommodate the maximum size of a PV system the building could achieve; and**
- **Ensure a solar PV conduit is continuous from an accessible attic or roof location to a designated wall space for PV electrical hardware**

## 3.3 Heat Pumps

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: High<br>City: None<br>Owner/Occupant: Owner/occupant: Return on investment over due to efficiency |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | Extreme heat |
| **CLIMATE MITIGATION THEMES** | Energy efficiency |

Most homes in Calgary are heated using natural gas, which produces emissions in combustion. Unlike conventional gas furnaces, heat pumps use electricity to heat buildings by transferring heat from outside the building to the inside. Heat pumps can also move heat from inside the building to the outside, cooling a building and providing climate resilience to extreme heat events.

Heat pumps can achieve efficiencies significantly higher than traditional furnaces and electric resistance heating, resulting in reduced emissions. Additionally, as heat pumps are powered by electricity, as the grid decarbonises, the emissions reduction value of heat pumps will rise. Pairing heat pumps with on-site renewable generation results in the lowest emissions to provide heating and cooling.

Air source heat pumps transfer heat between the air inside and outside of a building. While air source heat pumps are the cheapest type, they can also struggle to generate enough heat in extreme cold and therefore may require a back-up system, such as a gas furnace or electric resistance heating. Ground-source heat pumps transfer heat between the building and the ground, which takes advantage of the relatively constant temperature of the ground for greater efficiency and reliability. However, ground-source heat pumps are more expensive to install.

While heat pumps may require back-up gas and/or electric heating during extreme temperature periods, the benefits in efficiency they create for the majority of the year offset the need for redundancy. Heat pump minimums can vary from -15 to -25 degrees Celsius[5]. Historical data shows that only an average 11 nights per year drop below -25, while climate changes will reduce that number to a projected median of 4 days a year by the 2050s and 1 day a year by the 2080s. Heat pumps provide additional value by replacing the need to provide a separate air conditioning unit.

**Developments should include heat pumps to reduce emissions required to heat indoor spaces and to reduce climate risk by providing cooling.**

**Developments with greater energy requirements, including large multi-unit residential, commercial, industrial, and institutional uses are strongly encouraged to consider a ground-source heat pump for heating and cooling.**

[5] Heating and Cooling With a Heat Pump (*canada.ca*)

## 3.4 Climate Resilient Building Designs and Materials

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: Varies<br>City: None<br>Owner/Occupant: Reduces liability to climate change damage |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | Extreme heat, heavy rainfall, severe storms, river flooding, wildfire |
| **CLIMATE MITIGATION THEMES** | None |

**Developments are strongly encouraged to complete a *Climate Risk Screening Assessment* to identify climate risks, identify adaptation measures, and prioritize actions based on risks identified.**

### Roofing

#### Roof Design

Climate resilient design reduces the likelihood of climate change hazards damaging a structure and/or reduces the severity of damage. Climate resilient design can also reduce the risk that climate hazards pose to building occupants.

Storms (wind, snow, and hail): According to climate projections, hail and wind events may become more frequent, occur throughout more of the year, and become more intense. These events can significantly damage roofs, walls, and exterior building components.

- Simpler designs, such as hip roofs where all sides slope downward, are less susceptible to complex roofs. Fewer corners, edges, and projections experience less wind pressure.
- Fewer obstructions on the roof, such as chimneys, skylights, and dormers, reduce the risks of high wind damage.
- Steeper roof angles reduce the likelihood of wind, snow, and hail damage.

Drought:
Downspouts should be connected to rainwater harvesting systems, which can reduce water demand during periods of drought.

Extreme Heat:
- Shading overhangs, especially on the south side of buildings can lower indoor temperatures.

Heavy rainfall:
- Downspouts not connected to rainfall harvesting systems should direct water into a landscaped area at least 2 metres from the building.

#### Roof Materials

Roofing materials should be chosen to reduce the risk of wind, hail, and heat damage. Table 2: Roofing Materials shows the comparative resilience and costs impacts of different roofing materials. Roofs should:

- Use resilient materials (e.g. class 4 impact resistant shingles) that provide increased resistance to tears, splits, and water damage;

- Use hurricane clips to secure the roof to the walls;
- Consider two layers of underlayment that are cemented together, or an ice-and-water shield underlayment to reduce the risk of damage of snow and ice buildup;
- Install solar panels that are built to withstand weather and impact (see Renewable Generation)
- Consider heat trace cables that can melt snow on the roof;
- Consider roofing materials with a class A fire rating, especially where adjacent to natural areas like parks, forests, and grassland; and,
- Consider installing a green roof, which reduces cooling and heating needs through better insulation (see Green Roofs and Walls)

**Roof design should be climate resilient, including shade overhangs, Developments specify the use of climate resilient roofing materials.**

## Siding

Exterior siding materials have a role in reducing the risk of damage from hail, high winds, and heavy rain. Siding materials can contribute greatly to resilient to climate damage. Vinyl siding provides limited resilience to climate change impacts. Table 3: Siding Materials shows the comparative resilience value of different siding materials and estimates of cost implications. Wall should be sheathed completely.

**Developments should specify the use of climate resilient siding materials.**

## Windows

In addition to including high performance doors and windows to reduce heat loss or gain (see section 3.1), windows designed to be impact resistant to withstand shattering during hail or wind storms. However, the high cost of impact resilient glass can be prohibitive; alternatively, window films can be applied to glass to improve the resilience for a far lower cost. To ensure window warranty coverage, manufacturer's instructions must be carefully followed, as well as applicable building code requirements.

High performing windows, such as triple pane windows, have high insulative ability, retaining heat in winter and cooling in summer. These high efficiency windows are recommended for both climate mitigation and adaptation benefits. See Energy Efficient Buildings.

**Development is encouraged to include impact resilient windows or apply a safety film for windows. Windows should be well-integrated into the wall assembly.**

**Table 2: Roofing Materials**

| Roofing Material | Description | Installed costs |
|---|---|---|
| Asphalt shingles | • Resilient to moderate wind and hailstorms<br>• Excellent fire resistance<br>• 20 year lifespan | - |
| Laminated architectural asphalt shingles | • Resilient to strong wind and hail events<br>• Class 4 impact resistant (IR) shingles have increased resistance to water damage<br>• 30 year lifespan | +25% [arch. shingles]<br>+45% [Class 4 IR] |
| Rubber | • High resistant to impact and temperature damage<br>• Lower fire resistant, can be increased when treated with fire retardant<br>• Can be made from recycled materials<br>• 30-50 year lifespan | +80% |
| Metal roofs (aluminum and steel) | • Fire resistant<br>• Can be dented by hail, but generally dents will not affect building<br>• High water and ice resistance<br>• High reflectivity reduces summer heat gain<br>• Can be made from recycled materials<br>• High lifespan | +185% (steel)<br>+215% (aluminum) |
| Wood shingles (Class B fire resistant) | • Hail resistant<br>• High insulative value<br>• Should seek minimum class A or B fire resistance | +245% |
| Concrete tiles | • Reduce heat gain<br>• High fire resistance<br>• High hail and wind resistance<br>• Lower water resistance | +265% |
| Slate shingles | • High hail and wildfire resistance<br>• Shed snow<br>• High insulative value<br>• Very high lifespan (70-200 years) | +355% |
| Clay tiles | • Can be damaged in hailstorms<br>• Crack from freezing and thawing<br>• High wind resistance<br>• Fire and water resistance<br>• Reduced heat gain | +370% |

Table 3: Siding Materials

| Siding Material | Description | Installed costs |
|---|---|---|
| Vinyl siding (standard) | • No fire resistance<br>• Can be damaged by extreme heat<br>• Can be damaged by hail, high winds, and weather fluctuations | - |
| Aluminum siding | • High resistance to extreme heat and wildfire<br>• Hail and high wind debris can dent siding but will not damage building integrity<br>• Resistant to temperature fluctuations<br>• Can be made from recycled materials. | +35% |
| Engineered wood siding (wood composite) | • Moderate fire resistance<br>• High impact resistance<br>• Resilient to temperature fluctuation damage | +45% |
| Insulated vinyl siding | • Moderate impact resistance to hail and high winds<br>• High insulative ability, reduces heating needs in winter and cooling needs in summer | +60% |
| Fibre cement board | • High hail and wind resistance<br>• Fire resistant<br>• Low water resilience, can be improved with maintenance and features like water resistant paint<br>• Low insulative value | +65% |
| Cementitious stucco | • Fire resistant<br>• Hail and high wind resistant<br>• Low water resistance<br>• Low insulative ability, unless using a three coat finish | +70% |
| Steel | • High wind, water, hail, and fire resistance<br>• Insulated steel siding had increased R-Value | +100% |
| Natural wood | • Low fire, wind, and water resistance<br>• Can be improved with flame-retardant sprays and water resistant paint. | +160% |
| Brick | • High fire, hail, and wind resistance<br>• Reduces heat gain<br>• Must ensure mortar is in good condition | +195% |
| Stone | • Fire and wind resistant<br>• Can crack due to temperature fluctuations<br>• Low insulative ability | +455% |

## 3.5 On-site Stormwater Management

| | |
|---|---|
| **APPLICABILITY** | Areas with high permeability, communities with older stormwater systems or stormwater systems with low stormwater capacity, low-lying communities |
| **COSTS** | Applicant: Very to low<br>City: Reduced risk of stormwater systems being overwhelmed or damaged<br>Owner/Occupant: Low due to maintenance requirements |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | Heavy rainfall |
| **CLIMATE MITIGATION THEMES** | None |

Stormwater flooding risk will increase significantly as heavy rainfall events become more intense and frequent. To limit the risk of stormwater systems becoming overwhelmed, on-site stormwater management systems can collect and hold rainwater on site, reducing the amount and rate of water entering the stormwater system and therefore reducing the risk of heavy rainfall events overwhelming the stormwater system and flooding buildings and areas.

The options to do so can be very low cost, like installing rain barrels that are fed by eavestroughs. Cisterns can also be used to collect rainfall, though are typically more costly.

**Development is encouraged to include measures to collect stormwater on site, such as rain barrels or cisterns.**

Low impact development features such as rain gardens, vegetated swales, as well as green roofs and permeable pavements (see Green roofs and walls and Permeability) can also be used to reduce the risk of stormwater flooding. These natural features mimic natural hydrological features to capture, treat, and slow the release of stormwater into stormwater systems, reducing the risk of them being overwhelmed and improve the quality of water in waterways.

Bioswales are ideal for linear spaces, such as road right of ways, pathway systems, and along building edges. Rain gardens are very low cost and ideal as parts of greenspaces. While low impact development provides critical value for stormwater reduction, they can also require specialised maintenance and care from a responsible entity. For more information about low impact development, please see: Low Impact Development (*calgary.ca*).

**Development should include low impact development features. Low impact development features should particularly be encouraged in underutilised greenspaces, such as in road right of ways, medians, and small vegetated areas.**

## 3.6 Green Roofs and Walls

| | |
|---|---|
| **APPLICABILITY** | High density communities, highly paved communities, low-lying communities |
| **COSTS** | Applicant: High<br>City: None<br>Owner/Occupant: High, due to maintenance costs |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | Extreme heat, heavy rainfall, higher average temperatures |
| **CLIMATE MITIGATION THEMES** | Energy efficiency |

Green roofs provide vegetation on top of the building, which provides numerous environmental benefits, including the filtering air and water, absorbing rainfall that would otherwise enter the stormwater management system, reducing the urban heat island effect, hail protection, and absorbing carbon. Increasing plant space can also support biodiversity through design measures that can support local species, provide habitat to pollinators, and grow food, contributing to food resilience. Green roofs also result in greater energy efficiency due to the high insulative ability of vegetation. In some buildings, publicly accessible green roofs function as park space.

While green roofs provide numerous benefits, they also have high initial costs to establish and require maintenance from the building owner.

Green walls, also called living walls, involve planting vegetation on vertical surfaces. While these structures also provide air filtration and enhanced insulation, they do not provide the same stormwater retention benefits. Living walls must be appropriately installed and maintained to ensure they operate most effectively.

Green roofs have also been used successfully alongside rooftop solar PV; solar panels produce no carbon energy at higher efficiencies due to the lower temperature of green roofs. The panels also provide shelter from direct sunlight, wind, and precipitation for the underlying plants, which can enhance plant growth and encourage species variety.

**Developments are strongly encouraged to include a green roof.**

- **Developers are encouraged to pair green roofs with solar PV infrastructure for maximum efficiency**

**Where green roofs are not possible or feasible, aspects of green infrastructure should be included on the roof, such as planter boxes.**

## 3.7 Cooling Requirements

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: Moderate<br>City: None<br>Owner/Occupant: Reduced costs from adding cooling systems in the future |
| **IMPACT** | High |
| **HAZARDS ADDRESSED** | Extreme heat |
| **CLIMATE MITIGATION THEMES** | None |

While the majority of indoor spaces in Calgary are heated, the amount of space with cooling is significantly lower. As climate change drives both higher average temperatures and extreme heat, the physiological risk of heat related illnesses is increasing, including morbidity and mortality Of the 595 people that died in a recent Canadian heat event (2021) 97% died indoors and most did not have adequate air cooling systems in their home. To protect Calgarians from heat impacts, all residential buildings should provide cooling for residents. Both heating and cooling can be provided using a heat pump as a high efficiency system that also provides heating and can achieve reduced GHG emissions through combination with a renewable energy system (See Section 3.2 Renewable Generation). If central cooling is not feasible, ceiling fans can also be used to provide cooling.

Passive cooling systems, like windows, can also reduce internal temperatures but have limited ability to provide adequate cooling and cannot be used if high pollution (e.g. wildfire smoke) coincides with extreme heat.

Research also demonstrates uncomfortable heats have a significant impact on reducing labour productivity, affecting the output and survival of businesses in Calgary. Non-residential development should be strongly encouraged to include cooling for indoor spaces to ensure the safety and productivity of staff.

**All residential units should include cooling, provided by heat pumps where possible. Non-residential development is strongly encouraged to include cooling for indoor space.**

**All residential units are encouraged to consider passive cooling design measures, including:**

- **Have operable windows with cross-ventilation;**
- **Lower window to wall ratios;**
- **Include shade trees around buildings, particularly along south-facing walls; and,**
- **Include exterior window shades (louvres, awnings, overhangs)**

## 3.8 Passive Solar

| | |
|---|---|
| **APPLICABILITY** | Residential and residential mixed-use |
| **COSTS** | Applicant: Moderate<br>City: None<br>Owner/Occupant: None |
| **IMPACT** | Moderate |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Energy demand reduction |

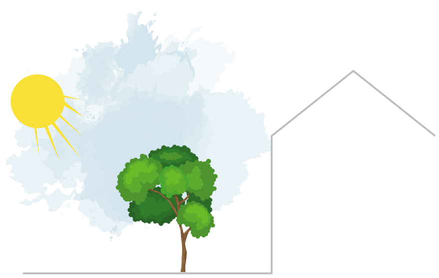
Site level passive solar design can reduce energy demand through capitalising on the heat and light of the sun to replace mechanical heating and lighting. Passive solar design uses energy from the sun without the use of mechanical systems by creating opportunities for sunlight to enter the building and designing around circulating solar heat. Passive houses have extremely low operational costs, reducing long-term costs for building owners.

Passive House Canada offers a certification for buildings that achieve a certain level of energy use through passive solar design. Certifiers can be engaged at the start of the project to help design the project. Certifications are available for both new developments and for retrofits.

**Planners should encourage developments to achieve Passive House Certification through adherence to established design standards.**

**Where developments are not pursuing Passive House Certification, they should be encouraged to adhere to passive design features.** These features include:

- Maximising south facing transparency to allow solar light and heat penetration;
- Using overhangs, shades, blinds, and/or trellis on windows designed to block solar heat and light in summer, when the sun is higher in the sky, to reduce cooling requirements. Overhangs are encouraged to be adjustable, to allow them to be raised in summer and lowered in winter;
- Continuous insulation with no thermal bridging (elements that allows heat or cooling to transfer from the outside of a building to within);
- Using landscaping to optimise heat gain/loss;
- High performance windows and doors that are well tied into the surrounding wall assembly; and
- Creating a trombe wall, where a thermal mass (a material that collects, stores, and emits heat) with exterior glazing with an air gap is exposed to the sun, creating a greenhouse effect that the wall material transfers into the home. The wall should be shaded such that it reduces summer heat gain and maximises winter heat gain.


Deciduous vegetation should be used to block the high summer sun and reduce the chance of overheating. In the winter the low sun will be able to penetrate through the branches and increase solar gain.

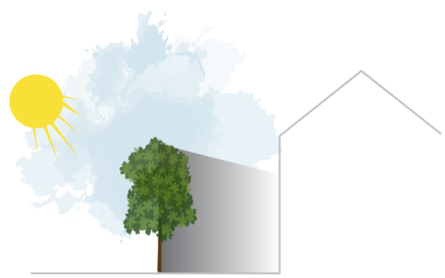

Taller buildings should be located to the north of a site to maximise solar access.

**Figure 2: Using landscaping to reduce heat gain in Summer and maximizing it in Winter**

**Additional resources:**

*Active for more comfort: Passive House* – Provides detailed information for developers on features that achieving passive house standards.

*Passive Design Toolkit – City of Vancouver* – Provides technical details on developing for passive solar gain for larger buildings

*Passive Design Toolkit Homes* – City of Vancouver – Provides technical details on developing for passive solar gain for smaller and detached homes

## 3.9 Climate Resilient Landscaping

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: Low<br>City: None<br>Owner/Occupant: Reduces likelihood of needing to replace dying vegetation |
| **IMPACT** | Moderate |
| **HAZARDS ADDRESSED** | Extreme heat, heavy rainfall, higher average temperatures, drought, river flooding, |
| **CLIMATE MITIGATION THEMES** | Carbon capture |

Some vegetation species in Calgary will be negatively impacted by changing climate patterns, including changing temperatures and precipitation patterns. Not all plant species in Calgary will be able to survive the changing climate, creating the risk of vegetation dying and associated costs and loss of ecosystem services. Landscaped areas need to be designed to be resilient to future climate change conditions. Plants chosen should also be native species, varieties developed for local conditions, and not known to host or vector diseases or pests.

Landscaping can also achieve a number of additional benefits through design, such as:

- Edible landscaping, community gardens, and residential gardening can help achieve food security objectives. However, edible landscaping programs need to be adequately managed and located. Edible landscaping can attract wildlife, and therefore should not be located near high traffic streets or where wildlife can negatively interact with people. Including a management program or responsible entity can ensure that edible elements are harvested on time.
- Native Pollinator friendly landscaping can support species that play a key role in maintaining the well-being of the environment. Landscaping should support a variety of pollinators, including bee colonies, native bees, birds, insects, and animals.
- Low-impact development reduces the risk of stormwater flooding
- No or low maintenance landscaping reduces the emissions produced in maintaining a landscaped area, such as mowing.

All species chosen in a landscaping plan should be climate resilient. Planners can consult this tool from Natural Resources Canada to determine which species are appropriate by entering Calgary as the municipality and selecting 2041-2070 as the time period to generate a list of modelled species for Calgary: *http://www.planthardiness.gc.ca/?m=23*. Planners should also ensure that that vegetation is not an invasive species by consulting the following tool: *https://yjccc8.a2cdn1.secureserver.net/wp-content/uploads/2021/05/AISC-GMI-PlantWise-Brochure-web.pdf.*

**Development should be strongly encouraged to include edible landscaping, where appropriate and accompanied by management.**

**Natural spaces should be designed to provide pollinator friendly landscapes.**

**Development should be encouraged to establish low to no maintenance landscaped areas, including areas that do not require or require minimal irrigation and mowing.**

**Due to their carbon intensive creation, contribution to the heat island effect, and impermeability to stormwater, synthetic turfs should not be allowed.**

**Landscaping near forested areas should consider distances, designs, and species to limit the spread of wildfire.**

## 3.10 Refuge Spaces

| | |
|---|---|
| **APPLICABILITY** | Multi-unit residential, commercial, and mixed-use buildings |
| **COSTS** | Applicant: None<br>City: None<br>Owner/Occupant: Moderate |
| **IMPACT** | Moderate |
| **HAZARDS ADDRESSED** | Extreme heat, heavy rainfall, severe storms, river flooding, wildfire |
| **CLIMATE MITIGATION THEMES** | Energy demand reduction, energy efficiency, clean energy supply, low carbon transportation |

As extreme hazard events become more common, having refuge spaces where Calgarians can go to provide relief can reduce the risk of climate change harming residents. Having refuge spaces that residents can go to in emergencies, such as severe storms, heat waves, and heavy precipitation, can reduce the health impacts of these climate change amplified events.

Refuge spaces can be indoor or outdoor but should be universally accessible. Outdoor spaces should seek to provide heat relief through providing access to shade, cooling, and drinking water to provide relief during extreme heat events. Indoor spaces provide resilience to other hazards. These spaces should provide shelter to precipitation and wind, air filtration, cooling and heating ability, drinking water, bathrooms, and back-up power than can function during times of blackouts.

Refuge spaces, when publicly and universally accessible, should be considered amenity space and/or community amenities for the purposes of planning allocations, including density bonusing.

**Commercial, residential, and mixed-use developments are encouraged allocate an indoor refuge space intended to provide relief during extreme weather events. Refuge spaces should be designed to be universally accessible. Publicly accessible spaces should be considered community amenities for any density bonusing or amenity space requirements.**

**Proposed community amenity spaces should be designed to include features that provide resilience, including cooling, heating, drinking water, and air filtration.**

**Outdoor spaces should be designed to include features that provide climate resilience, including access to shaded spaces, drinking water, and shelter from wind and precipitation.**

## 3.11 Buildings Oriented to the Street

| | |
|---|---|
| **APPLICABILITY** | Commercial, including big-box and other retail |
| **COSTS** | Applicant: None<br>City: None<br>Owner/Occupant: None |
| **IMPACT** | Low to moderate, depending on land use composition |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Low carbon transportation |

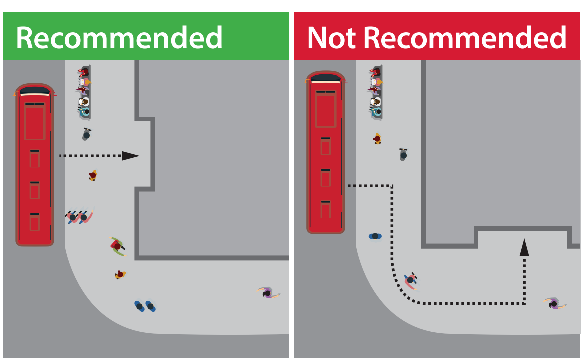
Designing developments to support active transportation creates a more favourable experience for pedestrians, cyclists, and transit users and encourages these uses. This not only reduces the emissions produced to travel, but also supports more equitable travel modes and create more lively and vibrant streets. One way to support sustainable travel patterns is through designing buildings to front streets, instead of internal parking areas. This reduces the need for pedestrians and cyclists to travel through parking areas, which adds travel time and can be dangerous due to interactions with vehicles. Buildings oriented to internal parking lots can also require pedestrians and cyclists to walk around buildings, adding travel time and distance.

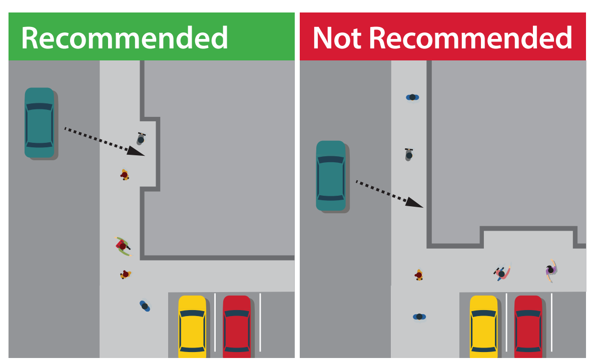
**Developments should provide an accessible front entrance along a public street or public right-of-way for pedestrians. Developments are encouraged to provide a secondary entrance oriented to internal parking areas.**

**Entrances should be closest to bus stops on a public street, where applicable. Where buildings are not built to the property line, a direct pathway should be provided from the public right-of-way.**

**Pedestrian and cyclist paths should not cross loading zones.**

**Developments near transit stations, including bus stations and LRT stations, should front to the station or as close to the station as possible.**



## 3.12 Energy and Emissions Benchmarking

| | |
|---|---|
| **APPLICABILITY** | Multiunit Residential, Commercial, Industrial, Institutional Developments |
| **COSTS** | Applicant: None<br>City: Very Low<br>Owner/Occupant: Very Low |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Energy demand reduction, energy efficiencd |

Energy and emissions benchmarking is the process of measuring and tracking the year-over-year energy and emissions performance of a building. This data can help building owners understand how building performance changes over time and allows for comparisons to similar type buildings. The benefits of energy and emissions benchmarking include standardised and reliable information on energy use, identifying best practices that can be replicated in other buildings, and identifying priority buildings for deep retrofit and adaptive reuse.

Benchmarking requires minimal time and costs. Benchmarking does require the building owner to register, and therefore is an appropriate comment for Applicants that will be the long-term owner of the development.

**The development is strongly encouraged to participate in energy and emissions benchmarking through BenchmarkYYC.**

## 3.13 Permeability

| | |
|---|---|
| **APPLICABILITY** | Areas with high amounts of impervious spacesa |
| **COSTS** | Applicant: Low<br>City: None<br>Owner/Occupant: Low, as permeable pavements may require maintenance |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | Heavy rainfall, river flooding |
| **CLIMATE MITIGATION THEMES** | None |

Stormwater risk is amplified in areas with high amounts of impervious (hard) surfaces. Water cannot be absorbed into the ground and instead makes its way into the stormwater system. When a significant amount of rain falls in a short period of time, the stormwater system can be overwhelmed and result in stormwater flooding. As climate change accelerates the rate of heavy rainfall, the likelihood of stormwater flooding rises. One way to reduce flooding risk is by increase the permeability of an area, allowing more water to be absorbed into the ground instead of entering the stormwater system.

Site designs should seek to increase the amount of permeability by increasing the amount of landscaped land on a site.

Developments can also use semi-permeable pavements, materials that provide small gaps that allow water to penetrate the pavement and onto the ground underneath. Semi-permeable pavement can include porous bricks, open joint bricks, and grass concrete pavers. Semi-permeable pavement can be created using a laying brick pattern that creates space between bricks. Semi-permeable pavements are appropriate for lightly trafficked areas, such as pathways, plazas, and storage areas. For more information about design considerations for permeable pavements, please see: *https://www.calgary.ca/content/dam/www/uep/water/documents/water-documents/development-approvals-documents/2019/module-six-permeable-pavement.pdf*.

**Developments should minimise their hardscaping as much as possible. Specific factors to consider are the presence of urban plazas, which can benefit from being replaced with a greenspace or including vegetation wherever possible.**

**Developments should consider including semi-permeable pavements where possible.**

## 3.14 Low Carbon Building Materials

| | |
|---|---|
| **APPLICABILITY** | All |
| **COSTS** | Applicant: High<br>City: None<br>Owner/Occupant: None |
| **IMPACT** | Very low, as embodied carbon is a small portion of lifecycle emissions |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Embodied Emissions |

Construction materials and processes require carbon, contributing to greenhouse gas emissions. Developments should seek to reduce these embodied emissions as much as possible by using recycled materials, incorporating existing site features, and using low carbon materials and locally produced materials. Recycling materials also brings emissions reduction from eliminated the emissions produced from the disposal of the material. Locally produced materials require reduced transportation emissions to bring the materials to the site, which can be a significant contributor to the total emissions of the development. Renovation and reuse can play a key role in reducing emissions, especially the foundation and structure can be salvaged and/or reused.

Not all building materials have the same emissions profile. High emission materials include concrete, plastics, foam, and metals. These materials should be used sparingly and only when necessary, such as for structural stability or to maintain high energy efficiency. These materials should not be used for aesthetic purposes. Where these materials are used, they should be recycled materials where possible.

One critical material in many developments is concrete, which has a high GHG emissions profile. The emissions profile of concrete can be offset using low-carbon concrete mixes and approaches.

**Development is encouraged to:**

- **repurpose or reuse parts of any existing structures on site;**
- **calculate the lifecycle emissions produced by the development**
  - **This can help developers understand how the carbon impacts of their material choices and demonstrate commitment to reducing embodied emissions.**
- **Limit the inclusion of high emission materials, including metals, cement, and plastics.**
  - **High emission materials should not be allowed when used for purely aesthetic purposes.**
- **Encourage the use of locally-sourced materials or recycled materials.**
- **Reference their building materials' *Environmental Product Declaration* climate declaration for more information about their carbon footprint.**

## 3.15 Gas Appliances

| | |
|---|---|
| **APPLICABILITY** | Residential, Commercial |
| **COSTS** | Applicant: None<br>City: None<br>Owner/Occupant: None |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | None |
| **CLIMATE MITIGATION THEMES** | Clean energy supply |

Gas appliances produce carbon dioxide in combustion and leak methane, a highly potent greenhouse gas. Not only does this have a high climate impact, gas appliances will also leak gases that have highly detrimental health impacts, such as worsening lung and heart conditions. In most cases, replacing natural gas appliances, including stoves and fireplaces, with electric appliances is most cost-effective, performs better, and is safer.

**Developments should specify the use of electrical appliances instead of gas appliances where possible.**

## 3.16 Cool roofs

| | |
|---|---|
| **APPLICABILITY** | Development with the highest heights in the area |
| **COSTS** | Applicant: Very low<br>City: None<br>Owner/Occupant: Reduced |
| **IMPACT** | Very low, as embodied carbon is a small portion of lifecycle emissions |
| **HAZARDS ADDRESSED** | Extreme heat, higher average temperatures |
| **CLIMATE MITIGATION THEMES** | Energy demand reduction |

Reflective materials used for roofing reduce the thermal gain of a building by absorbing less solar energy. In summer, roofs with reflective material, called cool roofs, lower building temperatures that threaten the health of residents and/or increase the greater energy demand for cooling. Cool roofs can be inexpensive to install, in most cases simply by choosing a lighter coloured and/or glazed roofing materials. Cool roof products can be applied to low slope or high slope roofs, and can include membranes, coatings, aggregates (e.g. light coloured gravel), shingles, shakes, tiles, and more.

Using reflective materials for pavements or buildings shorter than nearby buildings can adversely reflect light and thermal energy into adjacent buildings. Cool roofs are most appropriate for the tallest buildings in an area.

**Developments should include lighter, more reflective materials for roofing.**

## 3.17 Water Efficient Appliances

| | |
|---|---|
| **APPLICABILITY** | Residential, |
| **COSTS** | Applicant: Moderate<br>City: None<br>Owner/Occupant: Reduced water costs |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | Drought |
| **CLIMATE MITIGATION THEMES** | Energy efficiency |

Climate change will increase the frequency, duration, and intensity of droughts in Calgary. To reduce the risk of drought in Calgary, the use of low flow and water efficient features should be encouraged as much as possible. Low flow appliances include:

- Low flow faucets and showerheads, which reduce the rate at which water is released
- Low flow toilets, which use significantly less water. Duel flush systems allow the use of less water in a flush for liquids, reducing water requirements
- High-Efficiency washers use both less water and energy per load

While low flow appliances can be more costly than conventional appliances, they present a long-term cost savings their lower water demand.

**New developments should specify the use of low flow faucets and showerheads, low flow toilets, and high efficiency washers.**

## 3.18 HVAC and Mechanical Systems

| | |
|---|---|
| **APPLICABILITY** | Residential, |
| **COSTS** | Applicant: Moderate<br>City: None<br>Owner/Occupant: Reduced water costs |
| **IMPACT** | Low |
| **HAZARDS ADDRESSED** | Wildfire |
| **CLIMATE MITIGATION THEMES** | None |

Wildfires produce several air pollutants that threaten human health and well-being, including particulate matter that can cause respiratory symptoms, heart problems, and others. Health risks are amplified for pregnant women, infants and children, and the elderly As climate change causes an increase in wildfire frequency and growth, smoke exposure is a high and growing threat. To protect Calgarians, buildings should be equipped with air filtration.

HVAC (Heating, ventilation, and air conditioning) systems should be:

- Properly sealed, to ensure all air is directed through air filters
- Switched to recirculation mode during times of poor outdoor air quality
- Include higher quality filters. A MERV filter of 13 or higher is recommended to reduce particulate matter. Filters should be changed annually.

**Developments are encouraged to include air filters over MERV 13 and to maintain and operate HVAC systems appropriately to reduce air quality health risks.**

# Monitoring and Compliance

Because the building permit stage of the Planning Continuum focuses on adherence to building code, The City has limited opportunities for ensuring comments provided at other stages are reflected in the final development. In order to ensure compliance with certain comments, such as energy performance, The City can request a certification of compliance signed by a professional expert, such as an energy engineer, to be included at with the building permit circulation.

The City can also request adherence to an external certification, such as LEED certification, Passive House Standards, etc. These certifications often include measurement of compliance with required features that The City cannot measure. These certifications programs can also provide more specific and dedicated building advice through specific direction and support from energy advisors and are often highly marketable to funders and owners/occupants.

For comments related to the use of certain appliances and internal elements, such as 3.15 Gas Appliances, 3.17 Water Efficient Appliances, and 3.18 HVAC and Mechanical Systems, that may be unverifiable by City staff or an external body, the Development Authority should consider the provision of these comments as advisory, with no requirements. Advisory comments provide information to Applicants to improve their capacity and understanding of effective climate action, but do not require adherence and therefore do not require confirmation at building permit stages.

In cases where climate actions are encouraged in responses to files but challenged by Applicants, file planners should request information about the reason climate measures are not included in design and forward this information onto the Climate Planning and Policy team. Similarly, where actions are required in comments but not followed, The City should request information from the Applicant as to why the action was not completed through a Lessons Learned report. Completed Lessons Learned reports should be forwarded to Sonak Patel, Climate Planning and Policy to support the ongoing development of PACT through evidence from implementation.

# Incentivizing Action

Many incentives for climate action exist to support developers and homeowners with adopting climate mitigation and adaptation features, that may come with increased costs. These can vary from financial incentives, procedural benefits, and access to offset increased costs, procedural benefits, and access to financing. financing.

## City Incentives

The City offers a procedural incentive for projects that can achieve certain performance standards, such as net-zero or net-zero ready or passive house standards, The Green Buildings Priority Stream Program (*calgary.ca*) Green Buildings Priority Stream provides accelerated permit reviews, preliminary building code compliance at the development permit stage, project promotion, and support from senior leadership.  Developments are encouraged to consider the Green Buildings Priority Stream Program.

Residential property owners can also access the Clean Energy Improvement Program (CEIP) (*calgary.ca*), which provides flexible financing for energy efficiency and renewable energy upgrading (retrofitting) at long repayment terms via property tax and competitive interest rates. CEIP is administered by Alberta Municipalities.

## External Incentives

Other orders of government and private institutions, such as banks, are seeking to support climate action to achieve their own climate goals. These incentives may include achieving a certain specification, such as net zero, or including a certain building component, such as EV parking or heat pumps.

Development authorities may encourageare encouraged to direct Applicants to seek external funding sources, including the federal government, provincial government, and other non-governmental institution. The City maintains a list of financial opportunities under **financial support programs tab** on the Calgary Climate Change Program page: *Calgary's Climate Program page.*

# Additional Resources

Recommendations for Climate Adaptation Planning (2023).
*https://www.calgary.ca/content/dam/www/uep/esm/documents/esm-documents/recommendations-for-climate-adaptation-planning.pdf*

Climate Projections for Calgary (2022):
*https://calgary.ca/content/dam/www/uep/esm/documents/esm-documents/climate-projections.pdf*

Climate Ready Home Guide (2021):
*https://www.calgary.ca/uep/esm/documents/calgary-climate-resilient-home-handbook.pdf*