OUR CLIMATE FUTURE
climate change action plan

City of Spruce Grove

Climate Change Action Plan

Climate Change Adaptation & Greenhouse Gas Mitigation Actions: Review & Prioritization

Technical Report #3

26 April 2022

All One Sky FOUNDATION

The City of SPRUCE GROVE

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City of Spruce Grove

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1. INTRODUCTION

The City of Spruce Grove (the City) is taking steps to proactively address climate change by developing a comprehensive Climate Change Action Plan (CCAP). The CCAP is a 12-year guiding document that will outline feasible, effective and equitable actions to both reduce greenhouse gas (GHG) emissions and enhance community resilience. The long-term goal is to ensure Spruce Grove remains a resilient, safe and attractive City to live, work and play, and that the City does its part to address global climate change.

Two earlier technical reports examined the direct risks facing Spruce Grove as a result of projected local climate changes, and an assessment of two potential pathways for future GHG emissions reductions for the city. Additional details are shown in Table 1 below.

Table 1: Summary of Previous Technical Reports

Report	Description
Technical Report #1 – Climate Change Vulnerability and Risk Assessment (Zukiwsky et al 2021)	▪ Presented climate modelling results for Spruce Grove in the 2060's under a scenario where overall GHG emissions continue to rise at historical trajectories ▪ Described the results of a climate change risk assessment process that examined the likelihood and consequence of climate impact scenarios on Spruce Grove ▪ Identified high and moderate priority risks for actions planning
Technical Report #2 – GHG Emission Projections and Reduction Scenarios (Boyd et al 2021)	▪ Detailed modelling to estimate future GHG emissions in Spruce Grove if no additional actions are taken to reduce them, assuming likely rates of population growth and historical levels of technology efficiency improvements ▪ Identification of two science based GHG emission reduction targets: a steep decline pathway and a Canadian path pathway ▪ Identification of the GHG emission reductions needed in every GHG category to meet the two different pathways

For GHG mitigation actions, this report presents further details of GHG modelling for what is described as the 'Canada Path' in Technical Report #2, and which has been chosen for adoption by Spruce Grove. For both adaptation and GHG mitigation actions, this report describes how potential actions were identified and ranked, as well as the results of that ranking. These results, if taken by the city, will reduce the city's GHG emissions and increase the resiliency of the city to anticipated changes in the local climate.

2. ACTION IDENTIFICATION AND EVALUATION PROCESS

2.1 Action Identification

Three sources of information were used to identify a wide range of actions that could be taken by the City. The goal of using these three information sources was to identify actions that were both grounded in the cultural and policy environment of the city and that also clearly addressed the climate change risks and GHG mitigation goals of the City. These three information sources were:

- Consultation with city staff
- Engagement with residents of Spruce Grove
- Recent climate change adaptation and mitigation plans from other small and large communities across the prairies

City staff were consulted in three phases.

- Related to climate change adaptation, City staff from various departments were engaged in climate adaptation action brainstorming sessions.
- Related to GHG mitigation, engagement began with individual department interviews, to identify sources of GHGs and to identify potential GHG mitigation actions. A GHG mitigation action planning workshop was also participated in by staff from departments across the city
- In the final project stages, city staff from departments that had participated in previous meetings and workshops were invited to review all initially identified adaptation and GHG mitigation actions, providing feedback on the feasibility and framing of identified actions. Staff were also invited to conduct a review of the preliminary budget ranges that have been identified for each action.

Residents of Spruce Grove were consulted about their preferences for GHG mitigation and climate change adaptation actions at a number of times over the course of 2021. These engagement opportunities consisted of:

- An online public webinar in May, 2021
- An online public survey in May and June, 2021
- An online public survey in September and October, 2021
- A booth at an in-person Farmer's Market on September 25, 2021
- A classroom presentation to a high school science classroom in September, 2021

Residents also had the opportunity to comment on the results of the CCAP process in webinars held on January 18 and 19, 2022.

Finally, climate change mitigation and adaptation action plans from the following cities were reviewed to provide additional depth and breadth to the set of actions considered for Spruce Grove, including Leduc[1], Calgary[2], Edmonton[3], Saskatoon[4], Canmore[5], and Red Deer[6].

A large number of potential GHG mitigation and climate change adaptation actions for the City were identified through this process. These actions were then evaluated on a number of criteria to determine if they should be recommended for inclusion in the CCAP. The process used for this evaluation is described below.

2.2 Evaluating the Actions

Given the reality of limited staff time and financial resources, and competing priorities for Council, it is unlikely that all identified climate mitigation and adaptation actions can be implemented within the lifetime of the current CCAP. It is necessary to evaluate and screen potential actions to identify those actions that perform best with respect to key criteria typically used by decision-makers in a climate change context. Screening potential actions allow us to sort relatively promising actions from less promising ones, so that time and effort invested in taking actions forward to implementation or in performing more detailed, quantitative cost-benefit analyses, is focused on the top performing actions. To these ends, we employ a semi-quantitative procedure to screen candidate climate mitigation and adaptation actions, which is described below.

Multi-Criteria Framework for Screening Actions

The evaluation and prioritization of climate mitigation and adaptation actions should be based on all relevant anticipated benefits of investing in climate actions as well as all relevant costs needed to deliver those outputs (Boyd and Markandya, 2021). Other important considerations are the uncertainty that surrounds these benefits and the ease to which an action can be successfully implemented. Finally, the City was also interested in how its actions related to climate change would link to principles of energy and climate justice, and the resulting implications of the transition to a low carbon, climate resilient future for social equity in the community. These considerations resulted in the inclusion of a variety of cost and benefit criteria (financial and otherwise) to screen the identified climate mitigation and adaptation actions. Each of these decision criteria is described in Table 2.

[1] City of Leduc Greenhouse Gas Reduction Action Plan: 2020-2030 (2019)
[2] The Economics of Low Carbon Development: Calgary (2018)
[3] Edmonton Energy Transition Strategy (2019)
[4] Saskatoon's Actions for Climate Change Mitigation: The Low Emissions Community Plan (2019)
[5] Town of Canmore Climate Action Plan (2018)
[6] The City of Red Deer 2010 Corporate Greenhouse Gas Inventory (2012)

Table 2: Description of decision criteria used to evaluate and screen climate mitigation and adaptation actions

	Decision criteria	Description
Action Benefits	**Effectiveness**	The degree to which the climate action achieves the goal(s) of the Climate Change Action Plan—i.e., reduces anticipated adverse consequences of a climate risk, enables anticipated beneficial consequences of a climate opportunity to be realized, avoids or reduces GHG emissions, or enhances activities that remove these gases from the atmosphere. *Prioritize*: Prioritize actions that provide the largest reduction in either risk (adaptation actions) or, for GHG mitigation actions, provide the largest reduction GHG emissions or capture and store the most GHGs.
	Co-benefits (climate)	Intentional or unintentional positive side-effects of climate mitigation actions for climate adaptation goals, or vice versa. For example, the use of green space and urban trees to remove GHGs from the atmosphere also reduces urban heat island effects and helps to manage stormwater. As well, installing shades on windows to reduce heat stress on occupants will reduce demand for space cooling and reduce GHG emissions. *Prioritize*: For mitigation actions, prioritize actions with high climate adaptation co-benefits climate mitigation. For adaptation actions, prioritize actions with high GHG mitigation co-benefits.
	Co-benefits (non-climate)	Intentional or unintentional positive side-effects of the climate action for other City economic, social or environmental objectives. Examples include actions that provide recreation opportunities and ecosystem services, support employment opportunities, improve the physical and mental health of individuals, support social interactions and build social capital. *Prioritize*: climate actions the contribute positively to multiple other City economic, social or environmental objectives.
	Equity	The fair and equitable distribution of the net benefits and climate action (and residual impacts in the case of adaptation) between population groups in Spruce Grove, today and in the future. Ideally, climate actions should benefit the broadest possible range and number of people. Equity also encapsulates the degree to which climate actions reduce existing inequalities and disparities—e.g., the degree to which underserved and marginalized groups or neighborhoods accrue benefits. *Prioritize*: climate actions that benefit disadvantaged and underserved segments of the population, and that reduce existing inequalities in the community.
	Flexibility	Adjustable actions that can be implemented incrementally and readily adapted (i.e., scaled up or down, or brought forward or delated at minimal additional costs) if future climate and socioeconomic conditions changed or turned out to be different from those expected today. This criterion is most relevant to long-lived climate adaptation decisions that must be taken in the near-term. *Prioritize*: climate actions that are readily adjustable to changing climate and socioeconomic conditions and City priorities, with minimal transition costs.

Action Costs	**Capital Costs**	The upfront investment (capital) costs of the action to the City ***Prioritize***: climate actions will low total capital costs
	Operating (ongoing) costs	The annual recurring (operation and maintenance) costs of the action to the City ***Prioritize***: climate actions will low total operating costs
	Negative side-effects	Unintentional negative impacts for other City economic, social or environmental objectives. Examples include actions that increase GHG emissions, increase risks to other groups or sectors that are not the target of the action, or that limit future climate action. ***Prioritize***: climate actions that produce no or few negative side-effects.
	Feasibility	The capacity of the City to successfully implement the climate action, including access to necessary knowledge, technologies, human resources, budgets etc., all of which could act as barriers to action. Feasibility is also influenced by local and regional political preferences and priorities, as well as the presence of entry points or windows of opportunity to adopt the action, like upcoming revisions to strategic plans or the construction of a new civic building. ***Prioritize***: the most feasible climate actions.
	Acceptability	The degree of support for the climate action from the public generally. ***Prioritize***: climate actions will the broadest support across the community.

Source: Adapted from Boyd and Markandya (2021)

The performance of each climate action was scored on a 5-point scale. A visual representation of this assessment is shown in Figure 1. The scoring criteria used for each criterion is described in . For the benefit criteria, actions with lower benefits scored closer to 1 and actions with higher benefits scored closer to 5. For the cost criteria, more 'expensive' actions scored closer to 1 and more 'affordable' actions scored closer to 5.

Figure 1: Criteria and framework for evaluating and screening climate actions

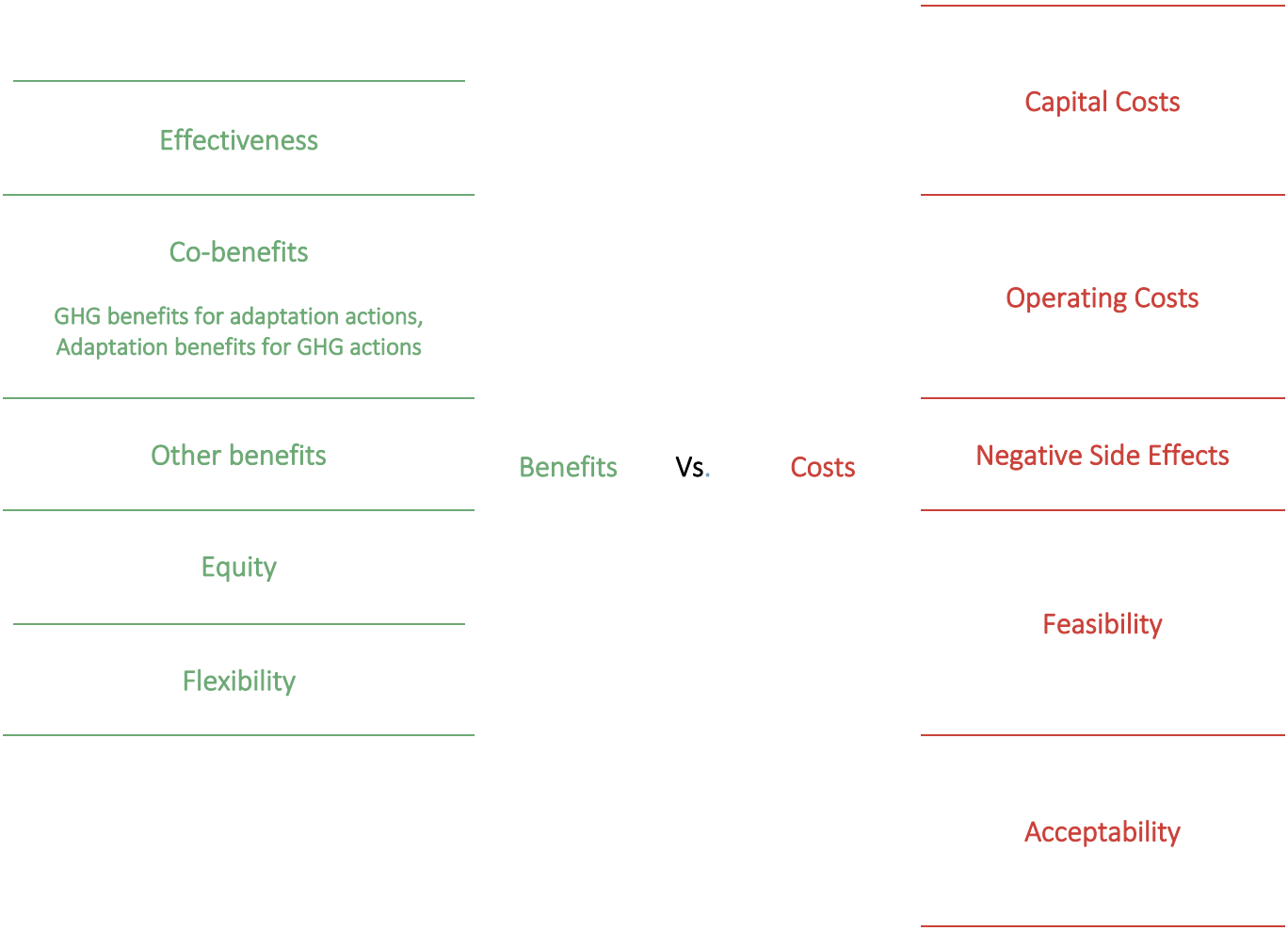


Table 3: Scale for scoring the performance of the identified candidate climate actions

	Decision criteria	Score = 1	Score = 3	Score = 5
Action Benefits	**Effectiveness**	Minor reduction in priority climate risk or GHG emissions from targeted source, or minor realization of climate opportunities or removal of GHGs from atmosphere	Moderate reduction in priority climate risk or GHG emissions from targeted source, or moderate realization of climate opportunities or removal of GHGs from atmosphere	Significant reduction in priority climate risk or GHG emissions from targeted source, or significant realization of climate opportunities or removal of GHGs from atmosphere
	Co-benefits *Adaptation* Benefits for GHG Actions; *GHG Mitigation* Benefits for Adaptation Actions	No or minor contribution to the complementary climate goal	Modest contribution to the complementary climate goal	Significant contribution to the complementary climate goal
	Co-benefits (non-climate)	No or minor cross-over and positive contribution to the other City economic, social or environmental objectives	Modest cross-over and positive contribution to the other City economic, social or environmental objectives	Significant cross-over and positive contribution to the other City economic, social or environmental objectives
	Equity	Benefits of action accrue to a narrow segment of the population or business community, but do not help disadvantaged and underserved segments of the population, and provide benefits at a very specific site	Benefits of action accrue to multiple segments of the population and business community, but only slightly benefit disadvantaged and underserved segments of the population, and provides benefits across multiple areas of the City	Action deliberately targets disadvantaged and underserved segments of the population and reduces existing inequalities in the community, and most residents and businesses see benefits, and provides benefits across the City
	Flexibility	Action has no to limited scope to be modified	Action can be partially modified, but at moderate additional costs	Action can be fully adjusted at minimal additional costs
Action Costs	**Capital costs**	Annualized total cost of action <$25,000	Annualized total cost of action $100,000 - $200,000	Annualized total cost of action > $500,000
	Operating (ongoing) Costs	Annual costs of <10,000	Annual costs $25,000-$50,000	Annual costs >$100,000
	Negative side-effects	No or minor unintentional negative impacts and consequences for the City	Unintentional negative impacts with moderate consequences for the City	Unintentional negative impacts with significant consequences for the City
	Feasibility	No or minor technological, knowledge, staff, political, or financial barriers to action	Moderate technological, knowledge, staff, political, or financial barriers to action	Significant technological, knowledge, staff, political, or financial barriers to action
	Acceptability	Majority of community members support the action	Modest community support for the action	No or limited community support for the action

For the benefit criteria, lower benefit actions scored closer to 1, and higher benefit actions scored closer to 5. The overall performance of an action was based on its benefit-cost ratio.

The maximum benefit-cost ratio (BCR) is 5:

$$Maximum\ benefit-cost\ ratio\ = \frac{Benefit\ score}{Cost\ score} = \frac{5}{1} = 5$$

The minimum output-input ratio is 1/5 or 0.2:

$$Maximum\ benefit-cost\ ratio = \frac{Benefit\ score}{Cost\ score} = \frac{1}{5} = 0.2$$

Similar to the benefit-cost ratio used in economic project appraisal, a benefit-cost ratio greater than one indicated that the climate action would generate positive outcomes that would exceed the resources and effort invested to realize those outcomes. The higher the benefit-cost ratio was above one, the more positive outcomes should be created by the option for the resources and effort invested. Consequently, actions with higher ratios were preferred to options with lower ratios, other things being equal. More formally, this results in the following two decision rules for screening the identified climate actions.

1. Screening Rule 1: Climate actions with a ratio *equal to or greater than one* pass the screening test, as they generate positive outcomes that exceed the resources and effort invested to realize those outcomes.
2. Screening Rule 2: Climate actions passing Screening Rule 1 may be ranked in order of ascending benefit-cost ratio; *actions with higher ratios are preferred* to those with lower ratios.

The screening analysis was initially performed by the project team, with the outcomes shared with the City's project team and other interested stakeholders for feedback.

Relative Priority Assessment

The 'relative priority' of adaptation actions was assessed as a function of the Benefit Cost Ratio score. Actions were ranked as low-very high priority based on the following procedure:

Lower Priority Actions: Actions with a BCR score of <1 were ranked 'lower priority'

Moderate to Very High Priority Actions:

- The average value and the standard deviation of all adaptation and mitigation actions with a BCR score of 1 or more was measured ('recommended BCR').

- Half of the value of the standard deviation of the 'recommended BCR' average was calculated ('distribution calculation')
- 'Moderate' priority actions had a BCR score between 1.0 and the 'recommended BCR average' less the 'distribution calculation'. This mapped to values between 1.0 and 1.33 for this plan.
- 'High' priority actions ranged between the 'moderate' and 'very high' priority actions (as defined below). This mapped to BCR values between 1.34 and 1.87 for this plan.
- 'Very high' priority actions had a BCR score above the 'recommended BCR average' plus the 'distribution calculation'. This mapped to values greater than 1.87 for this plan.

Complementary Action Assessment

A number of the identified mitigation and adaptation actions are complementary to each other. This could refer to an education program that could accomplish both a mitigation or adaptation action together, or an incentive program that addresses both mitigation and adaptation actions. Actions that passed both screening rules and that could be complementary to each other are identified in Section 5.2.

A Just and Equitable Transition

It is clear that responding appropriately to the need for climate change mitigation and adaptation will require extensive changes to our society and to our whole way of life over the upcoming decades. While it is predicted that the benefits of this change will be greater than the costs, there will still be costs to this change. As with all changes to society, some people tend to bear a disproportionate share of these costs. However, this is not an inevitable situation. Our society can make the choice to adjust the way that we respond to climate crisis to reduce or eliminate these negative effects. The choice to do something to address the potentially negative effects of action on climate change is often referred to using the concept of 'a just and equitable transition' (Boyd, 2019).

As it refers to the Spruce Grove CCAP, there are two groupings of people that could be negatively affected by the city's climate actions, and by climate actions being taken in the province and the economy more generally:

- Directly Affected Workers: Individuals who work directly in the industry that is most likely to be negatively affected by action on climate change: that is, work that directly relates to the extraction, processing, transportation or use of coal, oil, or natural gas.
- Vulnerable and Disadvantaged People: Individuals who are vulnerable to the effects of stress and change in society, whether due to their income, educational background, gender, and/or their ethnicity or cultural background or another factor.

There are three components of equity to consider as it relates to a just and equitable transition. These components of equity mutually reinforce each other, and are all important to consider:

1. Distributional equity: What does the distribution of the costs and benefits of a low carbon transition look like? Are any groups of people more negatively affected than others? Are traditionally marginalized groups given opportunities to reduce levels of historic inequalities?
2. Recognitional equity: What underlying social structures, such as historical disparities, cultural differences, linguistic differences, or other identities, could influence a person's ability to access the goods and services, infrastructure and economic opportunities of a low carbon economy
3. Procedural equity: Who gets to participate in decision making relating to this transition – is it those who have traditionally held decision making power in society, or does it also include historically vulnerable and marginalized groups? Are decisions made using a 'top-down' or a 'bottom-up' process?

There are a number of ways that Spruce Grove can address the concept of a Just and Equitable Transition in its climate actions. The first way is in its *choice of what climate change mitigation pathway it chooses to follow*. Climate change research tells us that in order to avoid the worst effects of climate change, societies across the world must find a way to reduce global net GHG emissions to zero by 2050, which is a vast undertaking in and of itself. In addition to this, international climate negotiations since at least 1992 have advanced the idea that communities which have a) benefited as a society from high historical levels of GHG emissions and that b) have a current capacity to pay for emissions reductions and should take the lead in quickly and ambitiously reducing their GHG emissions now. Because carbon emissions created 'now' can contribute to climate change for decades or more to come, one tonne of carbon that is avoided 'now' has a larger relative contribution to reducing climate change than one tonne of carbon that is avoided ten years from now. Committing the city to an ambitious greenhouse gas mitigation strategy now will have positive impacts on vulnerable populations both now and into the future.

In addition to this, there are a number of discrete ways to incorporate a consideration of justice and equity principles into CCAP planning. As noted above in Section 0, all potential GHG mitigation and adaptation actions were scored on their relative equity impact. Actions with potential benefits to disadvantaged and underserved segments of the population were given a higher equity score than actions that benefited a small group of relatively advantaged individuals. The majority of our equity analysis for Spruce Grove relates to potential impacts and opportunities for vulnerable and disadvantaged people.

In addition to this, our team conducted analysis of geographic and socio-economic factors that relate to social vulnerability in Spruce Grove. Ways to incorporate general principles of justice and equity are described in the sections below.

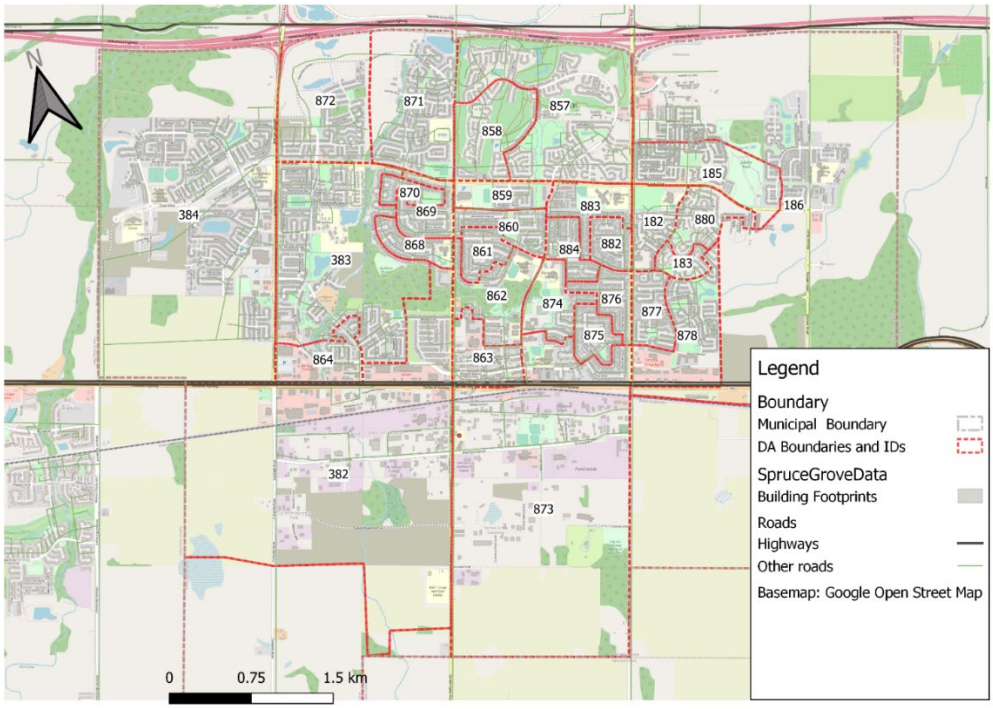
2.3 Census and Geographic Analysis

Statistics Canada divides the country into many types of geographic 'blocks', at both large and small levels of detail. A dissemination area (DA) is the smallest standard geographic area that Census Data is provided to the general public (Statistics Canada, 2021). Spruce Grove is covered by 30 DAs of various geographic sizes. Information was analyzed from the 2016 census in each of these DAs (Statistics Canada, 2017). DAs are

designed to contain population groups that are roughly similar to each other. As a result, more densely populated areas have smaller DAs, and less densely populated areas have larger DAs. A map of DAs in Spruce Grove, including ID numbers for reference, is shown in Figure 2. Areas within the Spruce Grove Boundary, including several areas of recently annexed land that are not currently developed, are highlighted in Figure 3 through

Figure 5. DAs are shown in a dashed red line, with the reference ID inside each DA polygon.

Figure 2: Spruce Grove Dissemination Areas



Vulnerable and Disadvantaged People

For our analysis, we have grouped potential negative effects to vulnerable and disadvantaged people into three metrics: exposure, sensitivity, and low coping capacity.

- *Exposure* refers to the density of the built environment in an area, represented by both the density of households and people in an area and the amount of greenspace in an area.
- *Sensitivity* refers to how likely you or your household is to be negatively affected by climatic or economic stressors. For example, if you live in an older home, you are more likely to have poorer quality home insulation, and as a result have higher energy bills in winter. If you work in an outdoor labour job, you will also be more exposed to climate risks such as heat waves or hailstorm than someone who works inside.
- *Response Capacity* refers to the ability of a person or household to easily adjust to climatic or economic stressors. For example, individuals with no certificate, diploma or degree may have a harder time finding a new job if their old job becomes redundant. In another way, individuals who rent their home have less power to improve the energy efficiency and climate resilience of their home than individuals who own their own home.

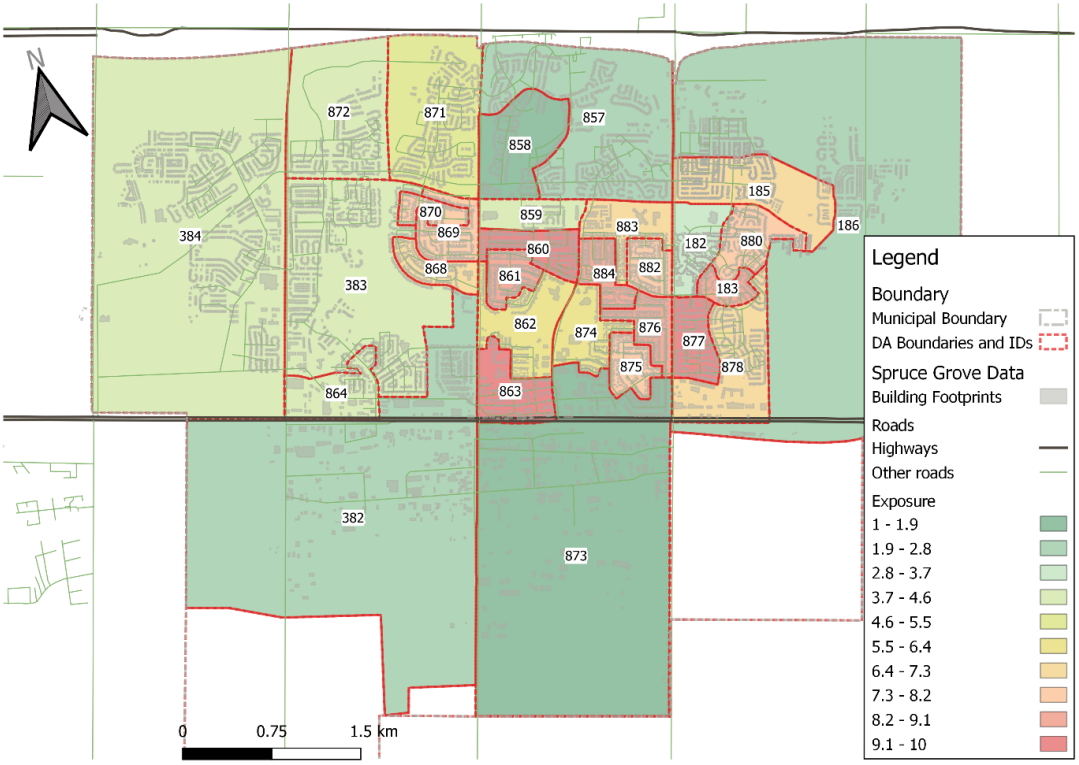
A summary of the factors included in these metrics, the relative scores of Spruce Grove DAs, and resulting justice and equity implications for climate actions are described below.

Exposure

The factors included within the Exposure metric are:

- Population density
- Dwelling Density
- Total 'open green space' (excluding urban reserves) as a percentage of total land area within the DA

Figure 3: 'Exposure' Vulnerability Metric in Spruce Grove Dissemination Areas



As might be expected, population and dwelling density in Spruce Grove are highest in the central parts of town. These areas also have the least access to immediately adjacent open green space.

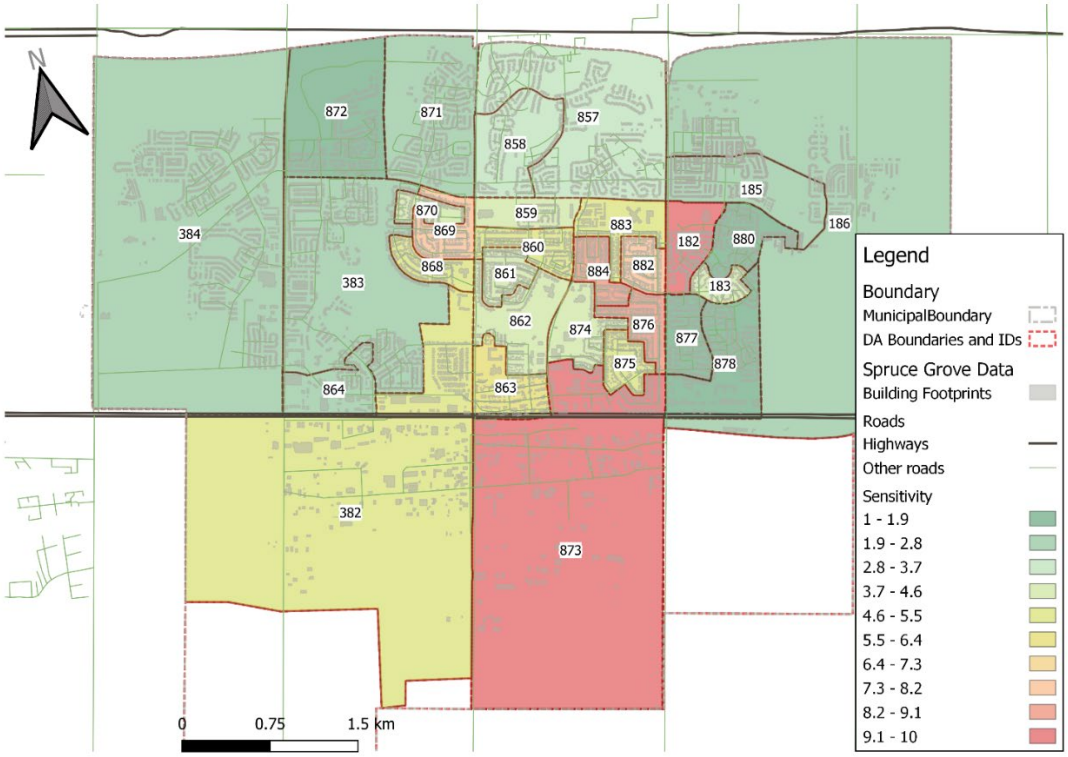
From a climate mitigation and adaptation lens, areas that have more people living in a smaller area, and a denser built environment, can often experience hotter temperatures than other areas in town. Actions that address heat waves and the anticipated increased demand for space cooling (such as air conditioning) would be best targeted in these geographic areas.

Sensitivity

The factors included within the Sensitivity metric are:

- Mean (self-reported) value of private dwellings
- Prevalence of dwellings constructed prior to 1990
- Prevalence of dwellings requiring major repairs
- Prevalence of person 65 and older
- Demographic dependency ratio
- Percentage of workers with commute to work of less than 15 minutes
- Diversity of household income sources
- Prevalence of outdoor jobs in labour force
- Proportion of economic output from outdoor jobs
- Proportion of labour income from outdoor jobs
- Employment diversity
- Employment income diversity
- Economic output diversity
- Diversity of commute to work

Figure 4: 'Sensitivity' Vulnerability Metric in Spruce Grove Dissemination Areas



One aspect of Figure 4 that needs to be interpreted with caution is that some DAs contain a relatively smaller proportion of the population than other areas. So, for example, while DA 873 in the southeast corner and DA 182 in the center east area have high sensitivity scores, they each contain only 1% of the city's population. The average DA in Spruce Grove contains 3% of the population. However, taken together, DAs with scores above 5.5 (colors ranging from yellow to red) contain 9% of the city's population. These areas contain 89-100% of dwellings constructed prior to 1990. These areas also contain a relatively higher percent of a household's labour income coming from individuals who work in outdoor jobs, with average values of 46%, compared to the city average of 38%. Households in these areas are likely to be more directly affected by poor weather of all types: heat, cold, storms, or snow and ice.

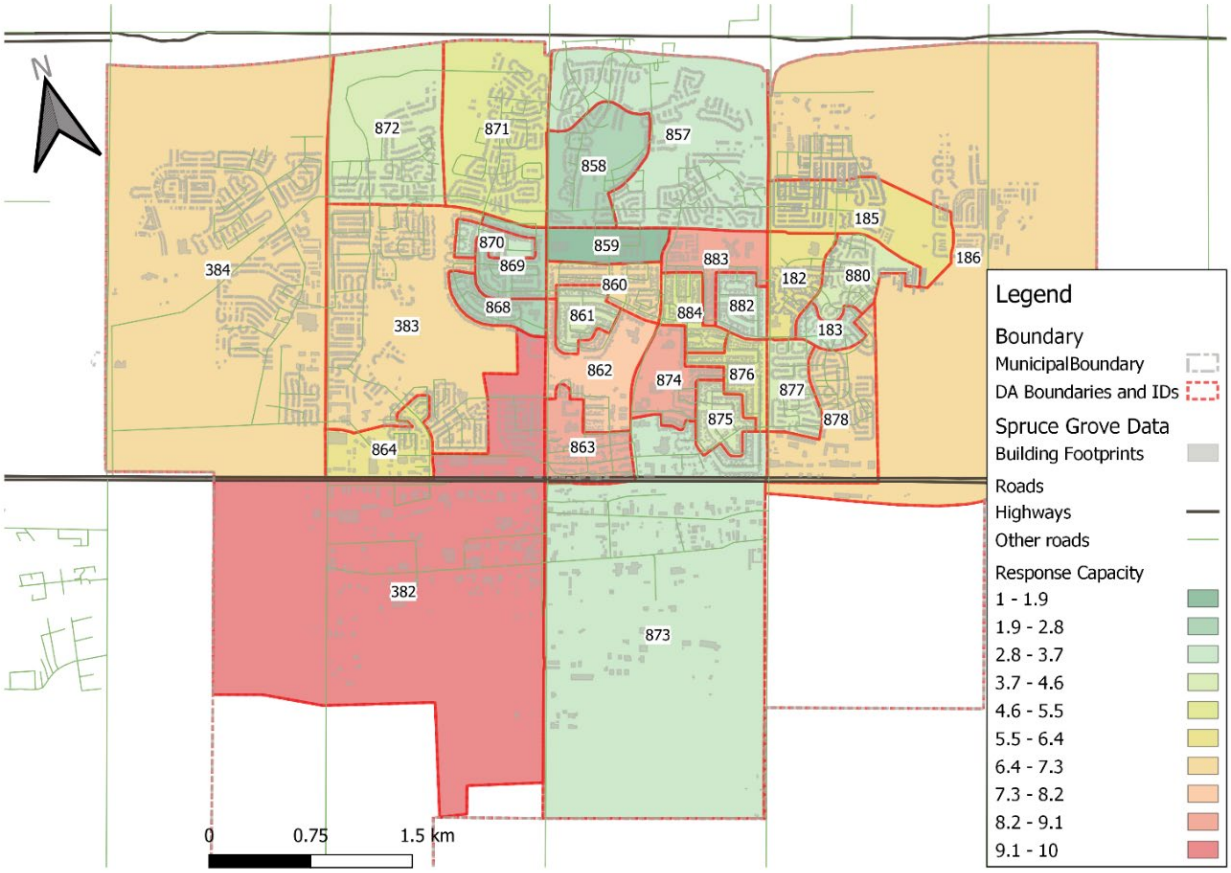
Response Capacity

The factors included within the Sensitivity metric are:

- Percentage of total private dwellings rented
- Prevalence of persons with no knowledge of official languages
- Prevalence of new immigrants
- Ethnic diversity
- Gini coefficient
- Percentage of population aged 25-64 with no certificate, diploma or degree
- Unemployment rate
- Prevalence of all households spending 30% or more on income shelter costs
- Median after tax income of households
- Prevalence of poverty

This metric relates more directly than the previous two to economic indicators. Half (53%) of the population living in areas with a response capacity ranking of 5.5 or higher (colored yellow, orange and red), with 30% of that in DAs 383 and 384. Residents living in these communities are more likely to have relatively low after-tax household incomes. As well, in these DAs, an average of 34% of households spend 30% or more of their income on shelter costs, compared to a city average of 15%. Households in these areas, if not provided with directed assistance, are less likely to take advantage of grant and incentive programs than more affluent households. Research has shown that in Alberta, participation rates in government energy efficiency programs is three times higher in the richest 20% of households than in the poorest 20% of households (Boyd, 2019).

Figure 5: 'Response Capacity' Vulnerability Metric in Spruce Grove Dissemination Areas



3. RANKED ADAPTATION ACTIONS

3.1 Section Overview

The sections below present descriptions and rankings for a number of climate adaptation actions for Spruce Grove. Any given adaptation action can help to address multiple risks and priorities. To organize recommended actions, the recommended actions have been described below using the following sector groupings:

- City Buildings and Infrastructure
  - City buildings used for offices or to offer city services
  - Infrastructure such as roads, trails, water and sewage infrastructure, and public parks

- City Programs and Outreach
  - Referring to ways that the City can educate or provide support to residents
  - Includes health and safety programs as well as education and recreation-based services

- Homes and Businesses
  - Relating to direct interactions between the City and homes or businesses
  - Includes bylaws, policies, procedures, and interaction with other levels of government

- Water Management and Natural Infrastructure
  - Includes water and stormwater management, which can be managed through either traditional engineering methods or through incorporation of 'natural infrastructure' into local policies

The four sections below each include two tables. The first table describes in both a 'short' and 'detailed' form actions that were ranked using the multi-criteria framework. The second table shows a) which climate risks and/or opportunities a given action could help to address and b) the ranking score for each aspect of the multi-criteria framework, as well as the resulting BCR score and relative priority assessment.

The high and moderate priority risks and opportunities these actions will address are described in . Table 4.

Table 4: High and Moderate Climate Change Risks and Opportunities in Spruce Grove

High Priority Risks & Opportunities	Moderate Priority Risks & Opportunities
▪ Freezing Rain ▪ Longer Construction Season ▪ Hail ▪ Freezing Rain	▪ Increased Summer Space Cooling Demand, ▪ Decreased Winter Space Heating Demand ▪ Increased Summer Recreation Season, ▪ Reduced Winter Recreation ▪ Drought ▪ Water Supply Shortage ▪ Increased Water Demand ▪ Urban Flooding ▪ Lightning ▪ Wind Storm ▪ Freeze Thaw Cycles (Fewer) ▪ Heavy Snowfall (Less) ▪ Wildfire Smoke ▪ Ground Level Ozone ▪ Increased Agricultural Productivity ▪ Increased Invasive Species

The following 'short form' headings (using the multi-criteria framework described previously in Section 2.2) were used in the action tables:

- Benefits (high score = high benefit)
  - Effect: Expected effectiveness towards the related adaptation risk or opportunity
  - GHG: Any GHG mitigation co-benefits
  - Co-Ben: Any non-climate co-benefits
  - Equity: Equity score
  - Flex: Flexibility

- Costs (high score = high cost)
  - CAPEX: Capital Costs
  - OPEX: Operating costs
  - Side Effects: Negative side effects
  - Feasible: Feasibility
  - Public: Acceptability

- BCR: Benefit Cost Ratio
- Priority: Relative Priority

The relative priority of actions is described using the following short form descriptions:

- Low = lower priority
- Mod = moderate priority
- H = high priority
- VH = very high priority

3.2 City Buildings and Infrastructure

Detailed descriptions of city owned building and infrastructure adaptation actions, organized from high to low relative priority, are shown in Table 5.

Table 5: Detailed Description of City Building and Infrastructure Adaptation Actions

ID	Short form action	Detailed action
1	Consider increasing freezing rain risk in snow and ice management policies	Consider incorporating considerations of freezing rain into the existing snow and ice control (SNIC) policy for City roads and walkways, considering options for improved materials and technologies to manage ice, including asphalt, sanding and salting strategies, and public communications. Include consideration of areas such as transit stops (both permanent and 'virtual' stops)
2	Incorporate climate risk assessment in building inspections	Include analysis of climate risks such as extreme heat, smoke, and extreme weather events into the scope of building inspectors when they assess new developments.

ID	Short form action	Detailed action
3	Install and distribute information from a local weather and climate monitoring station	Install a permanent weather and climate monitoring station in Spruce Grove. Capture real-time data and monitor over the long-term for air quality, smoke, precipitation (sub-hourly), wind, hail, etc. This station and other existing stations (e.g., city hall station and/or city building air quality monitors) would be linked to the City website for public access in a comprehensive and easy to understand way. Also work with the Capital Airshed to address gaps in Spruce Grove air quality monitoring coverage.
4	Ensure appropriate budget and staff for inspections, maintenance and repair of public infrastructure exposed to climate risks	Review and ensure, where appropriate, staff and budget for inspections, maintenance and repair of infrastructure. This could include road clearing and maintenance; maintenance of storm drains; freezing rain management such as sand and calcium chloride; the installation of heated sidewalks at critical public works access locations; and post-storm and post heat wave inspections of roadways and pedestrian pathways for debris, trees, or buckled sidewalks and roads.
5	Ensure appropriate budget and staff for inspections, maintenance and repair of public buildings and facilities exposed to climate risks	Review and ensure, where appropriate, staff and budget for inspections, maintenance and repair of public building and facilities, taking into account risks of extreme heat, smoke, and extreme weather events
6	Install shade and extreme weather shelters in public areas	Install shelters in local parks and other public locations around the City, to be used primarily for shade protection and secondarily for protection during extreme weather events. Increase the resiliency of these shelters by designing them to be resilient to hail, lightning, and high winds. Implement through a submission to the corporate plan.
7	Develop climate resilience design standards for city buildings and infrastructure	As needed, create or enhance City corporate design standards for climate resilience. Consider signage design relating to wind resilience; road and sidewalk resilience for extreme heat, ice and water absorption; and resilience of mechanical systems, electrical systems and building envelopes to extreme heat.
8	Construct additional outdoor cooling stations and water fountains	Construct additional outdoor cooling station(s) such as a splash park, splash pad, and/or misting station that uses recycled water and can be used during watering restrictions and drought. Ideally, integrate elements of universal design to increase its accessibility to all residents. Also consider additional locations for the installation of public water fountains.
9	Continue lightning protection installation on city buildings	This will increase protection from power outages and potential data loss or disruption during storms
10	Develop a covered storage area for corporate vehicles	This will help ensure that, similar to public works vehicles, these vehicles are protected from adverse weather such as hail, wind and extreme heat.
11	Increased the size and connectivity of the active transportation network	Increase investment in the active transportation network to take advantage of a longer summer season, including more multi-use pathways, bike lanes, and continued investment in the in-progress and planned pathways to Spruce Grove to Stony Plain.
12	Install back-up power at critical city buildings and facilities	Install back-up power supplies at all critical facilities in the City if they are not already installed, in sectors such as emergency services, operations/public works, Information technology (IT) locations, etc. Consider the need for transfer switches, mobile generators, fueling stations, and permanent back-up power supplies, and consider including renewable energy options such as wind and solar. Reduces the risk of both city service response limitations and data loss (re IT server locations)

ID	Short form action	Detailed action
13	Pilot Climate Resilience Retrofits on City Buildings	Retrofit one or more City buildings with enhanced climate resilience measures, through incorporation into the corporate business plan planning process. Possibly a pilot project and educational tool. Include measures such as: replacement of old air conditioners with newer more efficient options, increased insulation, ventilation, reflective surfaces (roof), shading, and efficient doors and windows to protect from extreme heat; hail resistant roofing and siding materials; and/or permeable pavement and other stormwater management upgrades. Enact by incorporating into the Corporate Business Planning process.
14	Purchase an additional sanding truck	Consider purchasing an additional sanding truck, possibly a narrow one suitable for new residential areas, to increase response times for ice storms and freezing rain
15	Bury all power lines	Partner with Fortis Alberta to encourage and work towards installation of all power lines underground in the City. This would increase the resiliency of the city to intense weather events as will as increase the aesthetic appeal of the city. Ensure potential flooding risks from powerline burial are taken into account.
16	Increase the amount of available public facilities to act as smoke and extreme weather shelters	Expand existing public facilities, or build a new public recreation facility/complex to handle increased capacity during smoke and extreme weather events.

The scoring and ranking of city owned building and infrastructure adaptation actions, as well as which adaptation risks and/or opportunities the action can help to address, are shown in Table 6. Actions with a BCR score of less than 1 are not recommended at this time.

Table 6: City Buildings and Infrastructure Adaptation Actions with Rankings

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Consider increasing freezing rain risk in snow and ice management policies	Freezing rain	n/a	5	1	2	3	4	2	1	1	1	2	2.14	VH
2	Incorporate climate risk assessment in building inspections	Heat wave, hailstorms	High winds, lightning, wildfire smoke	2	1	3	3	4	1	1	1	2	2	1.90	VH
3	Install and distribute information from a local weather and climate monitoring station	n/a	Wildfire smoke, ozone	3	1	3	3	2	2	2	1	2	1	1.77	H
4	Ensure appropriate budget and staff for inspections, maintenance and repair of public infrastructure exposed to climate risks	Freezing rain, hailstorm, longer construction season	High winds, urban flooding, heavy snowfall,	5	1	3	3	4	1	4	1	2	2	1.58	H
5	Ensure appropriate budget and staff for inspections, maintenance and repair of public buildings and	Heat wave, hailstorms	High winds, lightning, wildfire smoke	3	1	3	3	4	1	4	1	2	2	1.42	H

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
	facilities exposed to climate risks														
6	Install shade and extreme weather shelters in public areas	Heat wave	Increased space cooling demand	4	1	3	4	3	4	2	1	2	2	1.36	H
7	Develop climate resilience design standards for city buildings and infrastructure	Hailstorm, heat wave	High wind, lightning, increased space cooling demand, wildfire smoke	3	3	2	2	4	2	1	1	4	2	1.33	H
8	Construct additional outdoor cooling stations and water fountains	Drought, heat wave	Water supply shortage, increased water demand	4	1	3	3	4	3	3	2	2	2	1.32	Mod
9	Continue lightning protection installation on city buildings	n/a	Lightning	3	1	3	2	2	3	2	1	1	2	1.30	Mod
10	Develop a covered storage area for corporate vehicles	Hailstorms, heat wave	n/a	4	1	3	2	3	3	2	1	1	3	1.25	Mod
11	Increased the size and connectivity of the active transportation network	n/a	Increased summer recreation season,	3	5	5	4	3	5	4	2	3	1	1.22	Mod
12	Install back-up power at critical city buildings and facilities	Freezing rain, hailstorm	High winds, lightning, increased space cooling demand, urban flooding	5	2	3	3	3	5	3	1	2	2	1.15	Mod

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
13	Pilot Climate Resilience Retrofits on City Buildings	Heat wave, hailstorm	High wind, lightning, increased space cooling demand, wildfire smoke	3	3	3	2	2	4	2	1	4	2	1.03	Mod
14	Purchase an additional sanding truck	freezing rain	n/a	3	1	1	3	1	4	3	1	1	2	0.91	Low
15	Bury all power lines	Freezing rain	High Wind	3	1	3	3	2	2	5	3	3	2	0.83	Low
16	Increase the amount of available public facilities to act as smoke and extreme weather shelters	Heat Wave	Wildfire Smoke	3	1	3	3	1	5	5	2	2	3	0.69	Low

3.3 City Programs and Outreach

Detailed descriptions of city program and outreach adaptation actions, organized from relatively high to low priority, are shown in Table 7.

Table 7: City Programs and Outreach Actions

ID	Short form action	Detailed action
1	Encourage residents to create climate resilient home gardens	Educate residents on how to design climate resilient home gardens, considering factors such as drought, water supply shortage, and extreme heat, as well as how to manage pests and invasive species. Similar to the Edmonton in Bloom program, create an Edible Yard award in coordination with the award to create front yards with native species (a separate action)
2	Enhance existing neighbourhood social resilience programs	Support and empower neighbourhood social resilience programs including the Spruce Grove Neighbour Network and Block Party Program which help residents create connections with their neighbours and within their neighbourhood, and help neighbours to work together more effectively during extreme weather events. Make sure to include programs targeting more vulnerable neighbourhoods and populations such as the elderly, isolated and low income.
3	Create an Urban Agriculture Plan	Create an Urban Agriculture Plan to provide guidance on local urban agriculture development and resiliency in Spruce Grove. The plan could consider how to increase local food production at both a local and commercial idea. This could include ideas such as more or better supported community gardens, urban bee and chicken keeping, greenhouses, indoor gardens, irrigation, etc. The Plan would consider future climate changes and identify how the City can support the growing, processing, and distribution of food and food products in and around the City, by residents, private entities, and potentially by the City itself. This plan should also consider the risk of increased invasive species in the future.
4	Investigate how to effectively increase opportunities for indoor recreation activities and programming during times of extreme heat and poor air quality	This would include increased hours and availability of services during these times
5	Develop a City Climate Policy for requiring consideration of climate adaptation and mitigation in all budget decisions, procurements and projects	Potentially implement alongside a social procurement policy.
6	Increase monitoring of outdoor rinks and ice conditions and provide real-time updates to residents.	This will help to improve ice conditions and improve access conditions in winters with more variable and overall warmer temperatures.
7	Increased shoulder season outdoor recreation programs and opportunities	Take advantage of a warmer frost-free period by increasing spring and fall outdoor recreation programs and opportunities for residents. For example, re-purpose outdoor rinks for other recreational activities such as tennis, soccer, basketball, etc.
8	Educate and award residents for increasing use of native ground cover	Educate citizens about the benefits of native ground cover (pollination, biodiversity, carbon sequestration, etc.). Create an awards program, similar to the Edmonton in Bloom award, celebrating residents who use native ground covers

ID	Short form action	Detailed action
9	Improve the climate resilience of locations used for refuge during states of local emergency by assisting with the installation of climate resilience features	Help to improve the climate resilience of locations used for refuge during states of local emergency (public facilities, malls, churches, schools, etc.) by assisting with the installation of climate resilience features such as air filtration systems, air conditioning, and electricity backups, etc.
10	Update the Winter Emergency Response Program to assist unsheltered people during extreme weather events	This would include heat waves, extreme forest fire smoke events, etc. Ideally, the facility should be outfitted with air filters, a cooling system, back up power supply, and emergency provisions such as food, water, clothing and beds.
11	Education program on public climate resilience measures	Develop a climate resilience education program for residents to build awareness and improve communications about local climate change impacts and climate resilience measures. This includes measures such as resilient roofing and siding, painting flat roofs white, better lot grading, shading, insulation, snow and ice removal, stormwater management, air filters, flood risks, back-water valve installation, water conservation measures, water-aware gardening, xeriscaping, air filter installation, etc. This should include reference to existing federal and provincial climate resilience grants. Use multiple channels and tools including the website, print materials, community events, and social media. This likely requires an additional staff person.

The scoring and ranking of city program and outreach actions, as well as which adaptation risks and/or opportunities the action can help to address, are shown in Table 8 . Actions with a BCR score of less than 1 are not recommended at this time.

Table 8: City Programs and Outreach Action Rankings

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Encourage residents to create climate resilient home gardens	Drought, heat waves	Increased agricultural productivity, increased water demand, invasive species	3	2	5	3	5	2	1	1	1	1	2.78	VH
2	Enhance existing neighbourhood social resilience programs	Freezing rain, hailstorm	Increased space cooling demand, wildfire smoke, urban flooding	3	1	5	5	5	1	3	1	1	1	2.74	VH
3	Create an Urban Agriculture Plan	Drought, heat waves	Increased agricultural productivity, increased water demand, invasive species	4	2	5	3	5	3	1	1	1	1	2.62	VH
4	Investigate how to effectively increase opportunities for indoor recreation activities and programming during times of extreme heat and poor air quality	Heat wave	Wildfire smoke	2	1	4	3	4	1	3	1	1	1	2.02	VH

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
5	Develop a City Climate Policy for requiring consideration of climate adaptation and mitigation in all budget decisions, procurements and projects	All	All	5	3	1	3	4	1	1	1	3	2	2.00	VH
6	Increase monitoring of outdoor rinks and ice conditions and provide real-time updates to residents.	n/a	Reduced winter recreation	2	1	2	3	4	1	3	1	1	1	1.79	H
7	Increased shoulder season outdoor recreation programs and opportunities	n/a	Increased summer recreation season	2	1	4	4	3	1	4	1	1	1	1.75	H
8	Educate and award residents for increasing use of native ground cover	drought, heat wave,	increased water demand, invasive species, urban flooding	3	2	3	3	5	2	1	2	3	2	1.58	H
9	Improve the climate resilience of locations used for refuge during states of local emergency by assisting with the installation of climate resilience features	Heat wave	Wildfire smoke, urban flooding	5	1	3	5	5	3	5	1	2	2	1.47	H

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
10	Update the Winter Emergency Response Program to assist unsheltered people during extreme weather events	Heat wave	Wildfire smoke, urban flooding	5	1	3	5	3	3	2	1	3	2	1.44	H
11	Education program on public climate resilience measures	Drought, freezing rain, heat wave, hailstorm	high wind, increased water demand, invasive species, lightning, increased space cooling demand, wildfire smoke, urban flooding, heavy snowfall	4	2	1	3	5	2	4	1	1	3	1.36	H

3.4 Homes, Businesses and Local Economy

Detailed descriptions of home, business and local economy actions, organized from high to low relative priority, are shown in Table 9.

Table 9: Detailed Description of Home, Business and Local Economy Actions

ID	Short form action	Detailed action
1	Allow watering of privately owned trees during water restrictions	in order to avoid untimely death/damage to trees
2	Encourage construction companies to build to better than code regarding climate resilience	Encourage construction companies to construct local homes that use 'better than code' levels of construction. This would include better lot grading, climate resilient building materials, backflow preventions valves, lightning rods and grounding controls, passive solar, etc.
3	Provide climate resilience grants	Provide grants or other incentives to residents, businesses and non-profits to implement climate resilience measures at the home and property level. For example, the installation of climate resilient building features, such as hail resistant roofing and siding, heat pumps, backflow prevention valves, air filters, increased insulation, window glazing, shading, etc. Implement through the City of Spruce Grove Community Grant Program. Incorporate social equity considerations during incentive design (e.g., lower income housing, people living in apartments and mobile homes in addition to single family homes, etc.)
4	Regional Lobbying for more climate resilient building codes	Work with e.g., other local communities through organizations such as the EMRB to advocate for improved design standards for new home construction, to go beyond the Building Code requirements. This would include better lot grading, climate resilient building materials, backflow preventions valves, lightning rods and grounding controls, passive solar, etc.

Table 10 shows the scoring and ranking of home, business and local economy actions, as well as which adaptation risks and/or opportunities the action can help to address.

Table 10: Recommended Homes and Businesses Adaptation Actions with Rankings

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Allow watering of privately owned trees during water restrictions	Drought, heat wave	Water supply shortage, increased water demand, invasive species	3	4	3	3	3	1	1	2	2	1	2.26	VH
2	Encourage construction companies to build to better than code regarding climate resilience	Heat wave, hailstorm,	Urban flooding, high wind, increased water demand, increased space cooling demand	4	2	3	3	4	1	1	1	4	2	1.67	H
3	Provide climate resilience grants	Drought, freezing rain, heat wave, hailstorm	High wind, increased water demand, invasive species, lightning, increased space cooling demand, wildfire smoke, urban flooding, heavy snowfall	5	2	3	4	4	2	5	1	3	1	1.46	H
4	Regional Lobbying for more climate resilient building codes	Heat wave, hailstorm	Urban flooding, high wind, increased water demand, increased space cooling demand	4	2	3	3	4	1	1	3	4	2	1.44	H

3.1 Water Management and Natural Infrastructure

Detailed descriptions of water management and natural infrastructure adaptation actions, organized from relatively high to low priority, are shown in Table 11.

Table 11: Detailed Description of Recommended Water Management and Natural Infrastructure Adaptation Actions

ID	Short form action	Detailed action
1	Plant climate resilient tree species	Update recommendations on what type of trees the City should plant. Plant more climate resilient tree species (pest resistant, drought tolerant, wind resistant). Consider 'shading' as a key element of planting.
2	Incorporate climate change consideration into the Water Network Master Plan	make a plan to determine future requirements for water storage, including the need to understand and plan for changes to water supply and demand. Results should be used to inform future planning and development, and long-term growth of the City, including the need for increased reservoir capacity and pumping.
3	Enhance management of plant diseases as well as both invasive and desirable insect and plant species	Reduce the risk of tree death or damage and the risk of increased pests and invasive species by increasing increase staff and budget for management of plant diseases as well as invasive and desirable insect and plant species management. Regarding invasive species management, plan for and deal with pests, conduct community and staff education, and control invasives. Regarding desirable species, include a strategy for sustaining local bee populations, for example by planting flower populations that help bees, locating and protecting hives, and using appropriate pesticides.
4	Increase City participation in watershed protection planning	Increase City participation in watershed protection planning (staff time and funding). Work with regional partners, communities, Provincial Government and non-profits such as the North Saskatchewan Watershed Alliance to develop and implement source water quantity and quality protection actions.
5	Increase funds for tree planting and management:	Focus on climate resilient trees and the provision of co-benefits (e.g., shade).
6	Update the Parks and Open Space Master Plan	Update this 2007 plan by completing the natural areas inventory, and considering actions to manage climate risks by appropriately managing natural infrastructure and ecosystem services. For example, incorporate drought management techniques such as allowing turf grass to grow longer to increase its survival/health during these times; consider the ability of natural areas to provide shade, recreation, improved air quality, and stormwater management

ID	Short form action	Detailed action
7	Update flood mapping and develop a stormwater management plan	In addition to the storm capacity study that is currently underway, conduct/ update local flood mapping and a stormwater management plan that considers projected changes in extreme rainfall. Provide public access to these maps for increased transparency. Build policy guidance and regulations around the plan and update the Land Use Bylaw based on the results to require development restrictions in high-risk areas. The plan should also identify needs and options for increasing storm pond capacity, including methods such as the protection of wetlands and natural water bodies.
8	Increase inspections, maintenance and management of the stormwater system and asset management program	Increase staff and budget for inspections, maintenance and management of the City's stormwater system, and overall asset management program. Include funding and resources for asset management software to record and analyze storm infrastructure condition and performance.
9	Expand natural drought and flood reduction measures:	Increase City budget for xeriscaping, the use of bio-swales and mulches, and the use of native and drought resistant species in place of turf grass, as both a drought management and flood reduction measure.
10	Replace paved ground coverings with permeable ground coverings	Update the Municipal Development Standards and design guidelines to reduce the amount of run-off from paved surfaces by increasing on-site water retention requirements, for example through more permeable ground coverings. This will help to reduce local flood risk and also reduce extreme heat buildup in paved areas
11	Drought aware waste water treatment system maintenance	Increase funding for maintenance and repair of waste water system infrastructure in response to low water levels and drought conditions. Higher maintenance of the sewer system is needed during water shortages
12	Widespread smart water meter installation	Install smart meters on all water meters in the City as well as storm water facilities. Use data from smart metering to determine required changes to the water pricing mechanism to encourage water conservation during times of reduced water supply, for example, high consumptive water users pay an increased rate, mandatory odd-even watering, or time of day water use pricing (e.g., create incentives to water at night), etc.
13	Increased use of non-potable water	Develop and implement a strategy to increase the use of non-potable water (reclaimed/recycled water) across the City. For example, increase use of recycled water at splash parks, for tree watering, truck filling, and street sweeping.

The scoring and ranking of water management and natural infrastructure actions, as well as which adaptation risks and/or opportunities the action can help to address, are shown in Table 12. Actions with a BCR score of less than 1 are not recommended at this time.

Table 12: Water Management and Natural Infrastructure Adaptation Actions with Rankings

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Plant climate resilient tree species	Drought, heat wave,	Water supply shortage, increased water demand, invasive tree species, urban flooding	4	2	3	3	4	2	1	1	1	1	2.64	VH
2	Incorporate climate change consideration into the Water Network Master Plan	Drought,	Water supply shortage, increased water demand, urban flooding, heavy snowfall	4	1	4	3	4	2	1	1	1	2	2.26	VH
3	Enhance management of plant diseases as well as both invasive and desirable insect and plant species	Drought, heat wave,	Water supply shortage, increased water demand, invasive tree species	5	2	3	3	3	1	4	1	1	1	1.98	VH
4	Increase City participation in watershed protection planning	n/a	Water supply shortage	2	1	2	3	5	1	2	1	2	2	1.77	H
5	Increase funds for tree	Drought, heat wave	Increased space cooling demand,	4	2	5	4	4	2	4	1	3	1	1.67	H

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
	planting and management:		urban flooding, increased summer recreation season, increased agricultural productivity												
6	Update the Parks and Open Space Master Plan	Drought, heat wave	Water supply shortage, increased water demand, invasive species, urban flooding, increased summer recreation season	3	2	3	3	4	3	1	1	2	2	1.67	H
7	Update flood mapping and develop a stormwater management plan	n/a	Water supply shortage, urban flooding	3	1	2	3	4	3	1	1	2	2	1.39	H
8	Increase inspections, maintenance and management of the stormwater system and	Drought	Water supply shortage, increased water demand	4	1	1	3	4	1	4	1	2	1	1.30	Mod

ID	Short Form Action	High Priority Risk	Medium Priority Risks	Benefits; 1= low benefits, 5 = high benefits					Costs; 1= low costs, 5 = high costs					BCR	Priority
				Effect	GHG	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
	asset management program														
9	Expand natural drought and flood reduction measures:	Drought, heat wave,	Water supply shortage, increased water demand, invasive tree species, urban flooding	3	2	3	3	4	2	5	2	2	2	1.15	Mod
10	Replace paved ground coverings with permeable ground coverings	Heat wave	Urban flooding, Hailstorm	3	1	1	3	4	3	1	1	4	3	1.00	Mod
11	Drought aware waste water treatment system maintenance	Drought	Water supply shortage	2	1	3	3	4	5	5	1	2	2	0.87	Low
12	Widespread smart water meter installation	Drought	Urban flooding, water supply shortage, increased water demand	3	1	3	3	2	4	3	1	3	3	0.86	Low
13	Increased use of non-potable water	Drought, heat wave,	water supply shortage, increased water demand	3	1	1	3	4	2	5	2	3	3	0.80	Low

4. RANKED GHG MITIGATION ACTIONS

4.1 Section Overview

Spruce Grove's Path to Net Zero Emissions

Two possible GHG emission reduction targets were identified in the CCAP GHG modelling technical report (Boyd et al 2021). Based on the results of a meeting with Spruce Grove City Council's Committee of the Whole on February 22, 2022, as well as a follow-up meeting with Spruce Grove's Corporate Leadership Team, Spruce Grove will aspire towards achieving the emission reduction target identified as the Canada Pathway. In this pathway, herein referred to as "Spruce Grove's Path to Net Zero Emissions", the city's net annual emissions will be limited to 382.1 $ktCO_2eq$ by 2030, compared to the 489.5 $ktCO_2eq$ that would be expected in 'Reference Case' GHG emissions modelling. By the end of the CCAP time period in 2033, city wide GHG emissions will be capped at 287.8 $ktCO_2eq$/year, in comparison to predicted Reference Case GHG emissions in 2033 of 480.7 $ktCO_2eq$/year.

The GHG modelling conducted split achievement of these goals into three different 'carbon budgets' of four years each:

- Budget 1, from 2022-2026
- Budget 2, from 2027-2030
- Budget 3, from 2031-2033

In section 4.2, actions are identified under the heading of 'energy supply and carbon sinks' that could help to achieve GHG modelling objectives across multiple GHG emissions sources. For each of the eight distinct GHG emission sources within Spruce Grove (sections 4.3 to 1.1), each section describes in more detail the results of a) modelling of how particular objectives could help to meet these goals and b) describing particular actions the city could take towards meeting those goals. This description is split into the following sub-sections:

- GHG Modelling: Describes GHG modelling objectives and desired GHG emissions reductions both per carbon budget and over the entire time period of the CCAP
    - Note: Some of the GHG modelling results interact with each other. For example, one recommendation for local homes is to accelerate energy retrofits to homes, in order to reduce the amount of energy those homes consume. Another recommendation is to increase the proportion of consumed energy that comes from renewable sources. Individually, each of these actions will reduce GHG emissions by a certain quantity. However, if local homes are retrofitted to use 20% less energy than previously, and then 50% of that 20% of homes power their homes using renewable energy, then the sum of the impact of the individual effects may add up to more than the true sum when they are added together.

- GHG Mitigation Actions: Describes and shows the evaluated results and relative priorities of mitigation actions relevant to this sector
    - The recommended hierarchy of GHG mitigation actions is, from high to low:

  - #1 Avoid GHG emissions altogether (reduce the frequency of the activity)
  - #2 Improve the activity (e.g., increase energy efficiency)
  - #3 Switch the way of doing an activity (e.g., replace gasoline powered vehicles with electric vehicles)
  - Not modelled: removing GHG emissions directly from the atmosphere

- GHG Modelling and GHG Action Links: Shows the links between the GHG modelling objectives and the list of ranked GHG mitigation actions that could be taken in order to achieve the GHG modelling objectives.

The following 'short form' headings (using the multi-criteria framework described in more detail in Section 2.2) were used in the action tables:

- Benefits (high score = high benefit)
  - GHG: Expected effectiveness in reducing GHG emissions
  - Adapt: Any GHG mitigation co-benefits
  - Co-Ben: Any non-climate co-benefits
  - Equity: Equity score
  - Flex: Flexibility

- Costs (high score = high cost)
  - CAPEX: Capital Costs
  - OPEX: Operating costs
  - Side Effects: Negative side effects
  - Feasible: Feasibility
  - Public: Acceptability

- BCR: Benefit Cost Ratio

The relative priority of actions is described using the following short form descriptions:

- Low = lower priority
- Mod = moderate priority
- H = high priority
- VH = very high priority

Finally, action 'types' are described in the GHG Modelling and Action Links table. While more detailed information is described in the public-facing CCAP document, actions are organized within the categories of:

- Governance (assessments, plans or policies)
- Ventures (specific projects, programs, or procedures)
- Outreach (engagement with the community or partnerships with external stakeholders)

Table 13 below shows the different GHG emission and offset sectors within Spruce Grove, as well as their estimated percentage contribution towards Spruce Grove's GHG emissions in 2020. The subsections below are described in the same order as in this table.

Table 13: GHG Emission and Offset Sectors, and Relative Contribution to Estimated 2020 GHG Emissions

Applicable to Municipality or Community GHG emissions	Sector Name	Description	Estimated percent of city's GHG emissions in 2020
Both	Energy Supply	**Future additional production of renewable energy by the community and the municipality:** -current and past energy supply from city renewable energy installations and home solar panels is not currently explicitly included in city GHG inventories	N/A
	Carbon Sinks	**Future additional 'natural' carbon:** storage from trees and natural areas -not currently explicitly included in city GHG inventories	N/A
Community	Community Transportation & Land Use	**Vehicles:** -vehicle fuel, vehicle electricity	44.6%
	Homes	**Energy use in homes:** -space heating, water heating, appliances, lighting, space cooling	29.4%
	Businesses	**Energy use in businesses:** -space heating, water heating, equipment and motors, lighting, space cooling	12.9%
	Solid Waste	**From organic matter sent to landfill instead of being composted:** -food, garden & plant debris, paper & carboard, wood products, clothing/textiles	2.4%
Municipality	City Buildings	**Energy use in buildings:** -space heating, water heating, equipment and motors, lighting, space cooling	1.2%
	City Fleet	**Vehicles and Equipment:** -vehicle fuel, vehicle electricity	0.2%
	Lights & Signs	**Lights and signs:** -electricity use	0.2%
	Water & Sewage	**Electricity and fuel use:** - for pumping infrastructure	0.2%
	Carbon Sinks	**Future additional 'natural' carbon:** storage from trees and natural areas -not currently explicitly included in city GHG inventories	N/A

4.2 City Wide Actions: Energy Supply and Carbon Sink

GHG Actions

Table 14: Detailed Description of Energy Supply GHG Mitigation Actions

Action ID No.	Action	Detailed Action
1	Public-private partnerships for community energy generation	Investigate partnerships with local educational facilities and/or businesses to create renewable energy pilot projects that would benefit Spruce Grove
2	Privately funded community renewable energy	Explore ways to increase private renewable energy production at a community or city level, through methods such as geothermal energy, private local solar farms, wind turbines, etc.
3	Renewable power generation at city facilities	Continue to install renewable energy sources such as solar panels, at City facilities
4	Public-private partnerships for community generation	Investigate methods to improve the long-term financial maintenance viability of renewable energy infrastructure such as the Greenbury wind spires that are installed by developers and then maintained by the city
5	Develop a Green Industrial Area	Create local policies and incentives to create a 'green industrial area', composed of renewable energy production companies and/or companies that are part of the transition towards energy efficiency, energy use electrification, and renewable energy
6	Provincial and federal advocacy to reduce GHG intensity of grid	Advocate for the federal and provincial governments to pursue low-GHG forms of electricity generation while ensuring sufficient electricity supply
7	Community energy systems	Explore ways to increase energy efficiency at a community level, through methods such as district energy systems.
8	City owned renewable energy/ energy systems	Investigate (feasibility study) the possibility for city owned alternative energy systems and city owned renewable energy production, included co-gen and district energy. When technologically and financially appropriate, obtain battery storage to support city renewable energy production and improve city resilience to power outages

Table 15: Detailed Description of Carbon Sink GHG Mitigation Actions

Action No	Action	Detailed Action
1	Citizen tree planting	Create opportunities for citizens to plant trees in publicly owned spaces
2	Increased city tree planting	Increase the number of trees planted by the city along boulevards and in green spaces

Table 16: Energy Supply GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Public-private partnerships for community energy generation	4	3	2	2	5	3	2	1	1	1	2.00	VH
2	Privately funded community renewable energy	4	5	2	5	1	2	1	2	3	2	1.70	H
3	Renewable power generation at city facilities	4	2	2	2	3	4	1	1	1	1	1.63	H
4	Public-private partnerships for community generation	4	5	2	4	1	2	2	2	2	2	1.60	H
5	Develop a Green Industrial Area	3	3	3	3	3	3	2	1	2	3	1.36	H
6	Provincial and federal advocacy to reduce GHG intensity of gird	5	1	2	4	3	1	1	2	5	4	1.15	Mod
7	Community energy systems	4	5	1	4	1	5	2	2	4	1	1.07	Mod
8	City owned renewable energy/ energy systems	4	5	2	4	1	5	2	2	5	2	1.00	Mod

Table 17: Carbon Sink GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Citizen tree planting	2	4	3	2	4	2	1	3	1	1	1.88	VH
2	Increased city tree planting	2	4	3	4	4	3	3	3	1	1	1.55	H

4.3 Road Transportation

This section includes emissions related to transportation and overall land use planning within the city. These two components of the city are inextricably linked, because land use - the structure and design of the built and natural environment in the city - impacts and directs the ways that people move around within the city.

GHG Modelling

We recommend a shift towards 'full electric' vehicles for passenger vehicles, SUVs, and light trucks. We suggest a move towards hybrid vehicles for medium trucks due to current technological barriers.

Table 18: Community Transportation GHG Mitigation Modelling Results, 'Spruce Grove Path'

GHG ID	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions				By 2029 Desired Goal / Modelled Actions				By 2033 Desired Goal / Modelled Actions				GHG reduction % Sector/ tC02eq
R-T1	Annual reduction in average distances travelled	Vehicle type[2]	PV, SUV, LT	MT	MC	Bus	PV, SUV, LT	MT	MC	Bus	PV, SUV, LT	MT	MC	Bus	9%/ 52,573
		Percent reduction in driving distance	1%	0.25%	0%	0.2%	5%	1%	0%	1%	12%	2.5%	0%	2%	

GHG ID	Objective	**Desired Goal 'Type'** Modelled Action 'Type'	**By 2025 Desired Goal** Modelled Actions				**By 2029 Desired Goal** Modelled Actions				**By 2033 Desired Goal** Modelled Actions				**GHG reduction % Sector**/ tC02eq
		X% of drivers reduce their driving distances by Y% 1% reduction for	12%/ 10%	14%/ 2%	0%	n/a	26%/ 20%	32%/ 3%	0%	n/a	40%/ 30%	50% / 5%	0%	n/a	
R-T2	Overall reduction in vehicle ownership	Vehicle Type	PV, SUV, LT, MT		MC, Bus		PV, SUV, LT, MT		MC, Bus		PV, SUV, LT, MT		MC, Bus		**20%**/ 124,032
		Percent reduction in ownership by type from 2021 stock	3%		0%		7%		0%		11%		0%		
R-T3	Shift towards hybrid vehicles (by medium trucks)	Type of vehicle[2]	**PV**	**SUV**		**LT**	**PV**	**SUV**		**LT**	**PV**	**SUV**		**LT**	**9%**/ 54,871
		Proportion of vehicle stock in 2021	0.8%	0.5%		0%	0.8%	0.5%		0%	0.8%	0.5%		0%	
		Future proportion of vehicle stock	0.8%	0.5%		0%	0.8%	0.5%		0%	0.8%	0.5%		0%	
		Type of vehicle[2]	**MT**	**MC**		**Bus**	**MT**	**MC**		**Bus**	**MT**	**MC**		**Bus**	
		Proportion of vehicle stock in 2021	0%				0%				0%				
		Future proportion of vehicle stock	4%	0%			18%	0%			42%	0%			
R-T4	Shift towards electric vehicles (by all other vehicle types)	Type of vehicle[2]	**PV**	**SUV**		**LT**	**PV**	**SUV**		**LT**	**PV**	**SUV**		**LT**	**17%**/ 107,077
		Proportion of vehicle stock in 2021	0.1%	0%			0.1%	0%			0.1%	0%			
		Future proportion of vehicle stock	3.7%	4.3%		2.8%	15%	17%		14%	34%	38%		34%	
		Type of vehicle[2]	**MT**	**MC**		**Bus**	**MT**	**MC**		**Bus**	**MT**	**MC**		**Bus**	
		Proportion of vehicle stock in 2021	0%				0%				0%				

GHG ID	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions			By 2029 Desired Goal / Modelled Actions			By 2033 Desired Goal / Modelled Actions			GHG reduction % Sector/ tC02eq
		Future proportion of vehicle stock	0%	3.3%	2.6%	0%	16%	13%	0%	39%	32%	
R-T5	Electricity used in electric vehicles comes from renewable sources	Proportion of electricity for hybrid and electric vehicles coming from renewable sources	12%			27%			42%			**7%**/ 42,467
Total												**101%**/ 622,255

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package
[2] PV = passenger vehicle, SUV = sport utility vehicle, LT = light truck (half ton or less), MT = medium truck (1 tonne), MC = motorcycle, Bus = Private buses

GHG Mitigation Actions

Table 19: Detailed Description of Transportation Actions

Action ID No	Short Form Action	Detailed Action
1	Car dealership EV partnerships	Help educate residents about electric vehicles by encouraging local car dealerships to offer more floor space, salesman time, etc. to electric vehicles
2	Promote existing programs to purchase EV	Advertise provincial and federal grants, and offer targeted city incentives, to replace personal and commercial ICE vehicles (older or less efficient) with electric vehicles (preferred) or hybrid vehicles (also beneficial); run local advertising campaigns encouraging people to make the switch
3	Encourage businesses to promote working from home	Reduce the amount of time spent commuting to a job: Encourage businesses to offer work from home options or private workshare space
4	Improve active transportation infrastructure and culture	Create and implement a cohesive plan to significantly increase walking, biking, e-biking, and e-scooter use within the next 10 years, e.g. encourage citizens to try out new forms of local transportation, install sidewalk 'missing links',

Action ID No	Short Form Action	Detailed Action
		improve accessibility of sidewalks (ramps etc.), include active transportation networks in snow and ice removal/treatment plans, install more bike lanes and bike racks, install bike racks on buses and at bus route hubs, continue to incorporate identification and construction of paved bus stops that are connected to the active transportation network,
5	Increase local transit hours and area covered	Create a strategy to increase the amount of within-Spruce Grove transit use through: increased hours of transit, expanded service area of transit; advertising of on-demand service more; reduce local transit fees
6	EV Education	Use city resources to educate the public about the relative benefits of electric vehicles over 'internal combustion engine' vehicles
7	Encourage carpooling for commuting	Reduce the number of vehicles needed to transport people to work: run advertising campaigns to promote carpooling
8	Increase EV infrastructure through policy	Improve local electric vehicle infrastructure: research how to improve local EV infrastructure, increase the number of public electric vehicle charging stations, including at all City facilities for staff and public use; create designated parking spots for hybrid and electric vehicles; create a bylaw requiring EV charging stations in new multi family buildings, mixed use buildings, commercial buildigns, and parking lots. Continue to take advantage of available grants to facilitate charging station installation
9	Encourage EV carshare	Encourage the creation of, and reduce barriers to, and EV car sharing program/ business
10	Lobby for policies and programs to increase replacement older ICI vehicles	Incentivize the replacement of older vehicles with newer vehicles: work with regional groups to lobby for the provincial government to incentivize the purchase of fuel-efficient vehicles and to retire inefficient older vehicles;
11	Encourage EV taxis	Increase the visibility and acceptance of electric vehicles by encouraging or mandating that all local taxis/ rideshare vehicles be electric vehicles only
12	Reduce idling through policies and improved traffic flow design	Create a plan to reduce local vehicle 'idling' time: advertise efficient driving techniques; improve traffic light timing; reduce the number of traffic lights to reduce total time driving, investigate creation of a local anti-idling bylaw
13	Renewable energy EV charging	Use renewable energy to power electric vehicle recharging stations: install solar panel canopies above parking stalls in public parking lots such as at the Civic Centre, and use that energy to help power the charging station
14	Encourage infill development	Focus on increasing the city population through infill development and other developments within existing city limits instead of through geographic expansion
15	Design city to reduce travel distances to important services	Consider city design and planning guidelines to reduce necessary travel distances to private and public services: e.g., ensure necessities are available in walking distance; develop car free areas; encourage central hubs over spread out business areas; increase city density; provide city services in all city quadrants
16	Incentivize low carbon private buses	When within the city's jurisdiction, offer incentives to encourage private 'bus' owners to replace their diesel buses with natural gas or electric buses

Action ID No	Short Form Action	Detailed Action
17	Regulatory and policies to increase cost of ICI vehicle use	Increase the relative expense of owning an 'internal combustion engine' vehicle: Use local regulatory abilities to increase the relative cost of owning an ICE vehicle. Advocate for higher provincial and federal fees to own and operate in ICE vehicle. EG: taxes on ICE vehicle purchases, registrations and licenses when compared to hybrid + electric vehicles; increase fuel taxes at gas pumps; vehicle pollution pricing program in high traffic areas
18	Targeted charging for parking	Start to charge for parking in locations where it could help residents to switch out single-family-vehicle trips in favor of other forms of transportation

Table 20: Transportation GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Car dealership EV partnerships	1	1	2	1	5	1	1	1	2	1	1.67	H
2	Promote existing programs to purchase EV	2	1	1	2	5	1	2	1	2	1	1.57	H
3	Encourage businesses to promote working from home	3	1	2	2	3	1	1	2	2	2	1.38	H
4	Improve active transportation infrastructure and culture	3	5	5	4	3	5	4	2	3	2	1.25	Mod
5	Increase local transit hours and area covered	3	1	4	5	2	3	4	1	1	3	1.25	Mod
6	EV Education	3	1	1	2	5	2	3	1	1	3	1.20	Mod
7	Encourage carpooling for commuting	2	1	2	3	5	2	2	1	3	3	1.18	Mod
8	Increase EV infrastructure through policy	2	1	1	3	3	2	1	2	1	3	1.11	Mod
9	Encourage EV carshare	2	1	2	3	3	1	2	1	3	3	1.10	Mod
10	Lobby for policies and programs to increase	3	1	2	3	3	1	1	1	5	3	1.09	Mod

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
	replacement older ICI vehicles												
11	Encourage EV taxis	2	1	1	1	4	1	1	1	3	3	1.00	Mod
12	Reduce idling through policies and improved traffic flow design	1	1	2	3	5	3	3	3	2	1	1.00	Mod
13	Renewable energy EV charging	3	3	1	3	4	5	2	1	5	1	1.00	Mod
14	Encourage infill development	3	1	3	2	3	2	1	4	5	4	0.75	Low
15	Design city to reduce travel distances to important services	3	1	3	4	1	3	2	3	4	4	0.75	Low
16	Incentivize low carbon private buses	2	1	2	1	5	2	5	1	3	4	0.73	Low
17	Regulatory and policies to increase cost of ICI vehicle use	3	1	2	1	3	2	2	2	5	5	0.63	Low
18	Targeted charging for parking	2	1	2	1	3	3	1	1	5	5	0.60	Low

GHG Modelling and GHG Action Links

Table 21: Transportation GHG Modelling and Action Links

Action Type	Action No	Action	BCR	RT-1	RT-2	RT-3	RT-4	RT-5
				Annual reduction in average distances travelled	Overall reduction in vehicle ownership	Shift towards hybrid vehicles	Shift towards electric vehicles	Electricity used in electric vehicles comes from renewable sources
Governance	8	Increase EV infrastructure through policy	1.1				X	X
	9	Encourage EV carshare	1.1				X	X
	11	Encourage EV taxis	1.0				X	X
	12	Reduce idling through policies and improved traffic flow design	1.0	X				
	14	Encourage infill development	0.8	X	X			
	15	Design city to reduce travel distances to important services	0.8	X	X			
	17	Regulations and policies to increase cost of vehicle use	0.6	X	X			
	18	Targeted charging for parking	0.6	X				

Action Type	Action No	Action	BCR	RT-1	RT-2	RT-3	RT-4	RT-5
				Annual reduction in average distances travelled	Overall reduction in vehicle ownership	Shift towards hybrid vehicles	Shift towards electric vehicles	Electricity used in electric vehicles comes from renewable sources
Ventures	2	Promote existing programs to purchase EV	1.6				X	X
	4	Improve active transportation infrastructure and culture	1.3	X	X			
	5	Increase local transit hours and area covered	1.3	X	X			
	6	EV Education	1.2				X	X
	7	Encourage carpooling for commuting	1.2	X				
	13	Renewable energy EV charging	1.0			X	X	X
	16	Incentivize low carbon private buses	0.7				X	
Collaboration	1	Car dealership EV partnerships	1.7				X	X
	3	Encourage businesses to promote working from home	1.4	X	X			
	10	Lobby for policies and programs to increase	1.1			X	X	

Action Type	Actio n No	Action	BCR	RT-1	RT-2	RT-3	RT-4	RT-5
				Annual reduction in average distances travelled	Overall reduction in vehicle ownership	Shift towards hybrid vehicles	Shift towards electric vehicles	Electricity used in electric vehicles comes from renewable sources
		replacement older business vehicles						

4.4 Homes

This section includes emissions related to both existing homes and homes that may be built in the future.

GHG Modelling

Table 22: Residential GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

GHG ID	**Objective**	**Desired Goal 'Type'** / Modelled Action 'Type'	**By 2025 Desired Goal** / Modelled Actions	**By 2029 Desired Goal** / Modelled Actions	**By 2033 Desired Goal** / Modelled Actions	**GHG reduction % Sector**/ tC02eq
R-H1A	Accelerate energy retrofits to existing	**Percent reduction in 'reference case' home *energy consumption***	**3%**	**11%**	**23%**	**51%** 174,701

GHG ID	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions				By 2029 Desired Goal / Modelled Actions				By 2033 Desired Goal / Modelled Actions				GHG reduction % Sector/ tC02eq
	homes (built before 2022)	Retrofit X% of homes built by 2022; install upgrades to achieve average home energy savings of Y%	12% / 25%				27%/ 36%				45%/ 50%				
R-H1B	Accelerate energy efficiency building design in homes built after 2022	**Percent reduction in 'reference case' home *energy consumption***	**6%**				**11%**				**70%**				**48% /** 165,725
		Build or retrofit X% of new homes to achieve average home energy savings of Y%	20%/ 30%				60%/ 50%				100%/ 70%				
R-H2A	Increased amount of heating from renewable energy sources for existing homes (built before 2022)	Home Type[2]	SFD	SFA	APT	M	SFD	SFA	APT	M	SFD	SFA	APT	M	**5.5% /** 18,870
		Percent reduction in 'reference case' *GHG emissions* from home heating	1%	2%	2%	1%	3%	5%	5%	3%	7%	10%	9%	6%	
		Retrofit X% of existing homes to achieve average home heating *GHG reductions* of Y%	7%/ 14%	8%/ 21%	8%/ 19%	8%/ 12%	21%/ 14%	24%/ 21%	24%/ 19%	24%/ 12%	45%/ 14%	50%/ 21%	50%/ 19%	50%/ 12%	

GHG ID	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions				By 2029 Desired Goal / Modelled Actions				By 2033 Desired Goal / Modelled Actions				GHG reduction % Sector/ tC02eq
R-H2B	Increased heating from renewable energy sources for homes built after 2022	Home Type[2]	SFD	SFA	APT	M	SFD	SFA	APT	M	SFD	SFA	APT	M	**1.6% /** 5,686
		Percent reduction in 'reference case' *GHG emissions* from home heating	1%	2%	2%	1%	4%	6%	6%	4%	7%	10%	9%	6%	
		Build or retrofit X% of new homes to achieve average home heating *GHG reductions* of Y%	10%/ 14%	10%/ 21%	10%/ 19%	10%/ 12%	30%/ 14%	30%/ 21%	30%/ 19%	30%/ 12%	48%/ 14%	50%/ 21%	50%/ 19%	50%/ 12%	
R-H3A	Increased energy from appliances, lighting, and space cooling from renewable energy sources for existing homes	Home Type[2]	SFD	SFA; APT; M			SFD	SFA	APT	M	SFD	SFA	APT	M	**18% /** 62,512
		Percent reduction in 'reference case' *GHG emissions* from appliances, lighting and space cooling	7%	8%			21%	24%			45%	50%			
		Retrofit X% of existing homes to achieve average home GHG reductions from	12%/ 60%	13%/ 60%			27%/ 80%	30%/ 80%			45%/ 100%	50%/ 100%			

GHG ID	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions	By 2029 Desired Goal / Modelled Actions	By 2033 Desired Goal / Modelled Actions	GHG reduction % Sector/ tC02eq
		appliances, lighting and space cooling of Y%				
R-H3B	Increased energy from appliances, lighting, and space cooling from renewable energy sources for homes built after 2022	Home Type[2]	All home types	All home types	SFD SFA APT M	**9% /** 29,842
		Percent reduction in 'reference case' *GHG emissions* from appliances, lighting and space cooling	12%	48%	95% 100%	
		Build or retrofit X% of new homes to achieve average home GHG reductions from appliances, lighting and space cooling of Y%	20%/ 60%	60%/ 80%	95%/ 100% 100%/ 100%	
R-H4	Shift towards multi-family	Home Type[2]	SFD / SFA / APT / M	SFD / SFA / APT / M	SFD / SFA / APT / M	**1% /** 4,694

GHG ID	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions				By 2029 Desired Goal / Modelled Actions				By 2033 Desired Goal / Modelled Actions				GHG reduction % Sector/ tC02eq
	buildings in new construction	Change as a percent of total stock in 2022	0%				-3.9%	-15%	+36%	0%	-7.9%	-30%	+72%	0%	
		Percent of total building stock	63%	17%	14%	6%	61%	14%	19%	6%	58%	12%	23.8%	6.3%	
Sum															**100%** 345,121

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package
[2]SFD = Single Family Detached; SFA = Single Family Attached (e.g., townhouse); Apt = Apartment; M = mobile home

GHG Mitigation Actions

Table 23: Detailed Description of Community Residential Actions

Action ID No	Short Form Action	Detailed Action
1	New development sustainability checklist	Enable and encourage city staff to provide a voluntary sustainability checklist for new developments to increase awareness of actions that could be taken to reduce GHG emissions and increase climate resiliency. Actions could be aligned to meet LEED or other standards.
2	Lobby for prompt adoption of updates to energy building codes	Encourage the provincial government to promptly adopt the regular updates to the National Building Code, and to adopt other appropriate energy efficiency requirements to the provincial building code

Action ID No	Short Form Action	Detailed Action
3	Amend permissions for non standard heating technologies	Amend development permissions to allow for non-standard heat sources such as ground source heat pumps to be used on multiple sizes of building
4	Energy conservation education	Continue existing program to educate residents about ways to use energy and water more efficiently in their homes
5	Above-code new construction program	Encourage construction companies to construct local homes that use 'better than code' levels of energy efficiency in local buildings. Explore the relative cost and benefit of offering various forms of grants or tax breaks to home residents to either reduce their overall energy use through improved energy efficiency, or to install renewable energy such as solar panels. Include affordability and other equity considerations in the design of these grants.
6	Lobby for higher energy efficiency standards in building code	Work with other local communities through organizations such as the EMRB to agree on a set of new 'regional' energy efficiency related building energy efficiency standards to lobby the provincial government to adopt
7	Encourage builders & developers to make solar-ready homes	Encourage construction companies to construct homes that are either solar PV 'ready' or that include pre-installed solar panel, at both a local level and through regional groups such as the EMRB
8	Home retrofit grant program	Provide targeted incentives to residents to conduct energy retrofits, targeting older or 'known inefficient' residential buildings. Explore the relative cost and benefit of offering various forms of grants or tax breaks to home residents to either reduce their overall energy use through improved energy efficiency, or to install renewable energy such as solar panels. Include affordability and other equity considerations in the design of these grants.
9	Lobby for solar-ready homes in building code	Work with other local communities through organizations such as the EMRB to agree on a set of building codes to lobby the provincial government to adopt that would require new homes to either be solar PV 'ready' or to include pre-installed solar panels
10	Home Energy Audit Assistance	Advertise and potentially provide grants to homeowners to allow them to have an energy audit of their home, helping them to identify the most cost-effective and most energy-saving ways to retrofit their homes
11	Home retrofit CEIP program	Help residents finance deep energy retrofits, ideally to a net zero level, by approving the Clean Energy Improvement Program (CEIP) at a city level
12	CEIP implementation for home renewable energy	Help residents finance the installation of their own renewable energy, such as solar panels, by approving the Clean Energy Improvement Program (CEIP) at a city level
13	Voluntary home labelling	Adopt or make use of existing programs and procedures such as the Edmonton EnerGuide home rating system and the related Home Energy online Map rating program to a) provide prospective homeowners with historical home energy use and b) tell existing homeowners how their energy use compares to their neighbours
14	Design homes for larger household sizes	Encourage builders to build homes that are suitable for more than a single nuclear family: multi-generational homes, secondary suites, laneway homes, etc.
15	Encourage construction of smaller homes	Encourage builders to construct smaller homes: smaller single-family dwellings, townhouses, infill suites, etc. at both a local level and through regional groups such as the EMRB

Table 24: Community Residential GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	New development sustainability checklist	2	3	1	3	5	1	1	1	2	1	2.33	VH
2	Lobby for prompt adoption of updates to energy building codes	3	4	1	3	3	1	1	1	1	2	2.33	VH
3	Amend permissions for non standard heating technologies	3	5	1	3	3	1	1	1	1	3	2.14	VH
4	Energy conservation education	2	3	2	3	5	1	3	1	1	1	2.14	VH
5	Above-code new construction program	4	4	3	3	3	1	1	1	4	1	2.13	VH
6	Lobby for higher energy efficiency standards in building code	4	4	3	3	3	1	1	2	3	3	1.70	H
7	Encourage builders & developers to make solar-ready homes	4	4	1	3	3	1	1	1	4	2	1.67	H
8	Home retrofit grant program	4	4	1	5	5	3	5	1	2	1	1.58	H
9	Lobby for solar-ready homes in building code	4	4	1	3	3	1	1	2	3	3	1.50	H
10	Home Energy Audit Assistance	2	4	1	4	5	3	2	2	3	1	1.45	H
11	Home retrofit CEIP program	4	4	1	5	1	3	3	1	3	1	1.36	H
12	CEIP implementation for home renewable energy	4	4	1	5	1	3	3	1	3	1	1.36	H
13	Voluntary home labelling	2	2	2	3	4	2	2	1	2	3	1.30	Mod
14	Design homes for larger household sizes	3	1	3	4	3	1	1	2	5	4	1.08	Mod
15	Encourage construction of smaller homes	3	1	3	4	3	1	1	3	5	4	1.00	Mod

GHG Modelling and GHG Action Links

Table 25: Community Homes GHG Modelling and Action Links

Type	No	Short Form Action	BCR	R-H1	R-H2	R-H3	R-H4
				Accelerate energy retrofits and building design	Increased heating from renewable energy sources	Increased energy from appliances, lighting, and space cooling from renewable energy sources	Shift towards multi-family buildings in new construction
Governance	3	Amend permissions for non standard heating technologies	2.14	X	X		
	5	Above-code new construction program	2.13	X	X	X	
Ventures	1	New development sustainability checklist	2.33	X	X	X	
	4	Energy conservation education	2.14	X			
	8	Home retrofit grant program	1.58	X			
	10	Home Energy Audit Assistance	1.45	X			
	11	Home retrofit CEIP program	1.36	X	X	X	
	12	CEIP implementation for home renewable energy	1.36		X	X	
	13	Voluntary home labelling	1.30	X			

Type	No	Short Form Action	BCR	R-H1	R-H2	R-H3	R-H4
				Accelerate energy retrofits and building design	Increased heating from renewable energy sources	Increased energy from appliances, lighting, and space cooling from renewable energy sources	Shift towards multi-family buildings in new construction
Outreach	2	Lobby for prompt adoption of updates to energy building codes	2.33	X	X	X	
	6	Lobby for higher energy efficiency standards in building code	1.70	X			
	7	Encourage builders & developers to make solar-ready homes	1.67		X	X	
	9	Lobby for solar-ready homes in building code	1.50		X	X	
	14	Design homes for larger household sizes	1.08				X
	15	Encourage construction of smaller homes	1.00	X			

4.5 Local Business and Industry Actions

GHG Modelling

Industrial and Commercial Sectors:

Table 26: Local Business GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

Result No.	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions	By 2029 Desired Goal / Modelled Actions	By 2033 Desired Goal / Modelled Actions	GHG reduction % Sector/ tC02eq [1]
R-IC1A	Accelerate energy retrofits to existing commercial and institutional buildings (built before 2022)	**Percent reduction in 'reference case' business *energy consumption***	3%	9%	22%	**44%**/ 87,067
		Retrofit X% of businesses built by 2022; install upgrades to achieve average business energy savings of Y%	11%/ 26%	24%/ 39%	60%/ 53%	
R-IC1B	Accelerate energy retrofits to commercial and institutional buildings built after 2022	**Percent reduction in 'reference case' business *energy consumption***	6%	32%	60%	**68%**/ 133,897
		Built or retrofit X% of businesses built after 2022; install upgrades to achieve average business energy savings of Y%	20%/ 30%	60%/ 53%	80%/ 75%	

Result No.	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions	By 2029 Desired Goal / Modelled Actions	By 2033 Desired Goal / Modelled Actions	GHG reduction % Sector/ tC02eq [1]
R-IC2A	Increased amount of heating from renewable energy sources for existing businesses (built before 2022)	Percent reduction in 'reference case' *GHG emissions* from heating business buildings	0.4%	1%	2%	**0.9%**/ 1,782
		Retrofit X% of existing businesses to achieve average businesses heating *GHG reductions* of Y%	8%/ 5%	24%/5%	50%/5%	
R-IC2B	Increased amount of heating from renewable energy sources for businesses built after 2022	Percent reduction in 'reference case' *GHG emissions* from heating business buildings	0.5%	1.5%	2%	**0.4%**/ 828
		Build or retrofit X% of new businesses to achieve average businesses heating *GHG reductions* of Y%	10%/ 5%	30%/5%	50%/ 5%	
R-IC3A	Increased amount of renewable energy use to power **equipment, lighting and space cooling** for existing businesses (built before 2022)	Percent reduction in 'reference case' *GHG emissions* from business building equipment, lighting and space cooling use	8%	24%	50%	**21%**/ 40,622
		Retrofit X% of new businesses to achieve average businesses equipment, lighting and space cooling *GHG reductions* of Y%	13%/ 60%	30%/ 80%	50%/ 100%	

Result No.	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions	By 2029 Desired Goal / Modelled Actions	By 2033 Desired Goal / Modelled Actions	GHG reduction % Sector/ tC02eq [1]
R-IC3B	Increased amount of renewable energy use to power **equipment, lighting and space cooling** for businesses built after 2022	Percent reduction in 'reference case' *GHG emissions* from business building equipment, lighting and space cooling use	12%	48%	100%	**18**/ 34,636
		Build or retrofit X% of new businesses to achieve average businesses equipment, lighting and space cooling *GHG reductions* of Y%	20%/ 60%	60%/ 80%	100%/ 100%	
Total						**113%**/ 298,832

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

Light Industry

Table 27: Light Industrial GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

Result No.	Objective	Desired Goal 'Type' ——— Modelled Action 'Type'	By 2025 Desired Goal ——— Modelled Actions	By 2029 Desired Goal ——— Modelled Actions	By 2033 Desired Goal ——— Modelled Actions	GHG reduction % Sector/ tC02eq [1]
R-I1	Improvements in overall energy efficiency in the construction and manufacturing industries	Percent reduction in 'reference case' industrial *energy use intensity* (energy use per employee)	2%	4%	7%	**56%**/ 59,578
		Retrofit X% of construction and manufacturing facilities built by 2022; install upgrades to achieve average energy savings of Y%	10%/ 17%	19%/ 21%	28%/ 25%	
R-I2	Increased use of renewable energy for electricity the construction and manufacturing industries	Percent reduction in 'reference case' *GHG emissions* from light industry	8%	14%	20%	**41%**/ 44,219
		Build or retrofit X% of light industrial facilities to achieve *GHG reductions* of Y% through renewable energy use for electricity	8%/ 100%	14%/ 100%	20%/ 100%	
Total						**100%/** 103,797

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

GHG Mitigation Actions

Table 28: Detailed Description of GHG Mitigation Local Business & Industry Actions

Action ID No	Short Form Action	Detailed Action
1	Recognize Business Achievements	Develop a recognition and awards program for businesses that reduce their energy use and adopt lower GHG emission sources of energy production (e.g., transitioning from natural gas heating to forms of electricity powered heating), building on existing businesses recognition programs that are already sponsored by governments and industry associations
2	Energy literacy program for business sector	Provide tailored outreach education programs to businesses, potentially delivered by third parties with relevant expertise, to help them understand the benefits and opportunities relating to energy efficiency, energy use electrification, and renewable energy adoption. And actively support builders to take advantage of improved building codes and new, more energy efficient construction methods and technologies, to reduce the overall energy use of business.
3	Retrofit program for existing ICI buildings	Provide incentives for existing businesses to conduct and then act on the results of energy efficiency audits, e.g., grants to conduct energy audits, or tax breaks for meeting certain conditions of an energy audit
4	Business incentive program for renewable energy	Provide local incentives for local businesses to install renewable energy, such as solar panels or geothermal energy production
5	Commercial CEIP program	Implement CEIP program for local businesses and industry. Investigate the potential to access provincial or federal funding to help implement the program.
6	Regional collaborative to encourage business emission reductions	Work with local municipalities to create regional guidelines for local businesses to be increasingly electrified, energy efficient and renewable energy, to incentivize all businesses in the area to improve instead of having businesses move to the 'least cost' communities
7	Business Energy Benchmarking	Help existing business understand how their energy use compares to other comparable energy users, starting with a voluntary program and then expanding the program over time. Use existing CBSM design processes to reduce the likelihood of accidentally incentivizing more energy use in companies that are currently doing well.
8	Business requirements for renewable energy	If/when required, require new businesses to obtain a certain proportion of their total energy use from renewable energy sources

Table 29: Local Business & Industry GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Recognize Business Achievements	2	2	1	2	4	2	2	1	1	1	1.57	H
2	Energy literacy program for business sector	2	3	1	2	5	3	4	1	1	2	1.18	Mod
3	Retrofit program for existing ICI buildings	4	3	1	2	5	3	5	2	1	2	1.15	Mod
4	Business incentive program for renewable energy	4	3	1	2	5	5	5	2	1	2	1.00	Mod
5	Commercial CEIP program	5	3	1	2	1	3	3	3	3	1	0.92	Low
6	Regional collaborative to encourage business emission reductions	3	3	1	2	3	2	3	2	4	3	0.86	Low
7	Business Energy Benchmarking	2	1	1	2	3	3	3	1	2	3	0.75	Low
8	Business requirements for renewable energy	4	3	1	2	1	1	2	4	5	5	0.65	Low

GHG Modelling and GHG Action Links

Table 30: Local Business and Industry GHG Modelling and Action Links

Type	No	Short Form Action	BCR	R-IC1	R-IC2	R-IC3	R-I1	R-I2
				Accelerate energy retrofits and building design	Increased heating from renewable energy sources	Increased energy from appliances, lighting, and space cooling from renewable energy sources	Improvements in overall energy efficiency in the construction and manufacturing industries	Increased use of renewable energy for electricity the construction and manufacturing industries
Governance	8	Business requirements for renewable energy	0.65		X	X		X
Ventures	1	Recognize Business Achievements	1.57	X	X	X	X	X
	2	Energy literacy program for business sector	1.18	X	X	X	X	X
	3	Retrofit program for existing ICI buildings	1.15	X			X	
	4	Business incentive program for renewable energy	1		X	X		X
	5	Commercial CEIP program	0.92	X	X	X	X	X
	7	Business Energy Benchmarking	0.75	X			X	

Type	No	Short Form Action	BCR	R-IC1	R-IC2	R-IC3	R-I1	R-I2
				Accelerate energy retrofits and building design	Increased heating from renewable energy sources	Increased energy from appliances, lighting, and space cooling from renewable energy sources	Improvements in overall energy efficiency in the construction and manufacturing industries	Increased use of renewable energy for electricity the construction and manufacturing industries
Collaboration	6	Regional collaborative to encourage business emission reductions	0.86	X	X	X	X	X

4.6 Solid Waste

GHG Modelling

Table 31: Solid Waste GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

Result No.	Desired Goal 'Type'	By 2025 Desired Goal	By 2029 Desired Goal	By 2033 Desired Goal	GHG reduction % Sector/ tC02eq
R-SW1	Reduce waste generation annually from 0.36 tonnes/capita to:	0.36 tonnes/capita	0.35 tonnes/capita	0.34 tonnes/capita	**2%**/ 716
R-SW2	Increase waste diversion rate from 40% to:	45%	52%	61%	**56%**/ 20,103
R-SW3	Local landfill captures an increasing percentage of methane gas capture:	0%	0%	10% (starting in 2030)	**5%**/ 1,857
R-SW4	Annual reduction in organic composition of landfill waste	1.5% annual reduction between 2022-2033			**29%**/ 10,405
Total					**100%**

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

GHG Mitigation Actions

Table 32: Detailed Description of Community Solid Waste GHG Mitigation Actions

Action ID No	Short Form Action	Detailed Action
1	Continue existing waste education	Continue existing programs to educate residents about how to reduce, reuse, and recycle
2	Focus education on organic diversion	Increase support for existing education programs and pilot projects for residents and business owners that are specifically focused on improving diversion of organic materials to the organics waste container
3	Composting partner best practises	Work with the existing city composting partner to encourage them to adopt composting best practices and get facility back on line
4	Every other week garbage collection	Implement every other week waste collection to encourage appropriate recycling and organics diversion
5	Landfill partner best practises	Work with the city landfill partner to encourage them to use practises such as methane capture to reduce the total GHG emissions from Spruce Grove landfill waste
6	Waste volume and contamination penalties	Increase enforcement of existing fines for high waste volumes. Investigate the implementation of fines for contamination of recycling and organic waste streams with inappropriate material
7	New composting facility, if required	Work with regional partners to identify, if needed, a location and design for a future composting facility

Table 33: Community Solid Waste GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Continue existing waste education	2	1	4	4	5	1	1	1	1	1	3.20	VH
2	Focus education on organic diversion	2	1	4	3	5	1	2	1	1	1	2.50	VH
3	Composting partner best practises	1	1	1	3	3	1	1	1	4	2	1.00	Mod
4	Every other week garbage collection	2	1	5	3	3	2	1	3	4	4	1.00	Mod
5	Landfill partner best practises	4	1	2	3	2	5	1	1	4	2	0.92	Low

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
6	Waste volume and contamination penalties	2	1	4	2	5	2	3	2	4	5	0.88	Low
7	New composting facility, if required	3	1	3	3	2	5	4	1	4	2	0.75	Low

GHG Modelling and GHG Action Links

Table 34: Solid Waste GHG Modelling and Action Links

Type	No	Short Form Action	BCR	R-SW1	R-SW2	R-SW3	R-SW4
				Reduce total waste generation per person	Increase waste diversion rate	Reduce methane production at composting and landfill facilities	Reduction in organic composition of landfill waste
Governance	6	Waste volume and contamination penalties	0.88	X	X		X
Ventures	1	Continue existing waste education	3.2	X	X		X
	2	Focus education on organic diversion	2.5				X
	4	Every other week garbage collection	1		X		X

Type	No	Short Form Action	BCR	R-SW1	R-SW2	R-SW3	R-SW4
				Reduce total waste generation per person	Increase waste diversion rate	Reduce methane production at composting and landfill facilities	Reduction in organic composition of landfill waste
Collaboration	3	Composting partner best practises	1			X	
	5	Landfill partner best practises	0.92			X	
	7	New composting facility, if required	0.75			X	X

4.7 City Buildings

GHG Modelling

Table 35: City Building GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

Building Category	Building	Desired outcome and method	GHG reduction % Sector/ tC02eq [1]
Indoor Recreation	Agrena	Reduce energy use by 10% in 2026 In 2026+, meet 50% of energy demand with renewables	**36%**/ 5,823
	BPAC	In 2028+, reduce energy use by 10% In 2023+, meeting 20% of all energy demand using renewables	**4%**/ 678
	Fuhr Sports Park/ West District Park	In 2023+, reduce energy use by 10% In 2023+, meet 25% of all energy demand with renewables	**3%**/ 440
	Civic Centre (not yet constructed)	When the Civic Centre opens in 2025, construct it to use 30% lower energy use intensity than standard buildings of its type In 2025+, meet 15% of its total energy demand from renewable energy	**29%**/ 4,590
Public Works/ Eco Centre	PW Shop – Century Close	In 2025+, reduce energy use by 5% In 2025+, meet 15% of all energy demand with renewables	**11%**/ 1,749
	PW Shop – Schram St	In 2026+, reduce energy use by 10% In 2026+, meet 15% of all energy demand with renewables	**2%**/ 226
	PW Shop – Spruce Ridge Satellite	In 2026+, reduce energy use by 10% In 2026+, meet 15% of all energy demand with renewables	**<0.1%**/ 9

Building Category	Building	Desired outcome and method	GHG reduction % Sector/ tC02eq [1]
	Eco Centre	In 2027+, reduce energy use by 10% In 2027+, meet 20% of all energy demand with renewables	**<0.1%**/ 29
Protective Services	Protective Services	No reduction in energy use In 2030+, meet 10% of total energy demand with renewables	**2%**/ 262
	RCMP	In 2030+, reduce energy use by 10% In 2030+, meet 10% of all energy demand with renewables	**2%**/ 232
Parks and Outdoor Recreation	Brookwood Rink	In 2027+, reduce energy use by 10% In 2027+, meet 20% of total energy demand with renewables	**0.1%**/ 20
	Jubilee Spray Park	In 2026+, reduce energy use by 10% In 2026+, meet 15% of all energy demand with renewables	**1%**/ 149
	Aspenglen Rink	In 2026+, reduce energy use by 20% In 2026+, meet 20% of electricity demand using renewables	**<0.1%**/ 4
	Henry Singer Park	In 2026+, reduce energy use by 10% In 2026+, meet 20% of electricity demand using renewables	**<0.1%**/ 4
	Columbus Park	In 2026+, reduce energy use by 20% In 2026+, meet 20% of electricity demand using renewables	**<0.1%**/ 16
	Tunnel and Rink	In 2026+, reduce energy use by 20% In 2026+, meet 50% of electricity demand using renewables	**<0.16**/ 12
	City Hall	In 2025+, reduce energy use by 10% In 2025+, meet 10% of energy demand using renewables	**4%**/ 722

Building Category	Building	Desired outcome and method	GHG reduction % Sector/ tC02eq [1]
Other City Services	Elks Hall	In 2024+, reduce energy use by 10% In 2024+, meet 20% of all energy demand with renewables	**2%**/ 266
	FCSS	In 2026+, reduce energy use by 10% In 2026+, meet 20% of all energy demand with renewables	**<0.1%**/ 64
	Library	In 2028+, reduce energy use by 10% In 2028+, meet 15% of all energy demand with renewables	**1%**/ 192
	Log Cabin	In 2024+, reduce energy use by 20% In 2024+, meet 15% of all energy demand with renewables	**<0.1%**/ 76
	Transit Building	In 2028+, reduce energy use by 10% In 2028+, meet 15% of all energy demand with renewables	**<0.1%**/ 65
Total			104%/ 16,720

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

GHG Mitigation Actions

Table 36: Detailed Description of City Building Actions

Action ID No	Short Form Action	Detailed Action
1	Act on energy benchmark analysis of city buildings	Use and act on findings of energy conservation analyses of city buildings to identify ways to improve energy efficiency.
2	Incorporate long term energy costs into building design decisions	Incorporate consideration of lifetime building energy costs into design considerations for new city facilities
3	Purchase renewable electricity for city corporate use	Investigate the purchase of renewable electricity for corporate electricity use
4	Civic Centre energy efficiency	Incorporate high energy efficiency considerations into the design of the Civic Centre
5	Net Zero' existing city buildings	Update the green building policy to retrofit existing city buildings towards a 'net zero' standard
6	'Net Zero' new city buildings	Update the green building policy to require new city buildings to be built towards a 'net zero' standard
7	Reduce city office space	Reduce the need for corporate office space by continuing the work from home policy and by looking for staff consolidation opportunities

Table 37: City Buildings GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Act on energy benchmark analysis of city buildings	3	3	4	3	4	5	1	1	1	1	1.89	VH
2	Incorporate long term energy costs into building design decisions	3	3	4	3	3	3	1	1	3	3	1.45	H
3	Purchase renewable electricity for city corporate use	5	1	1	3	4	1	4	2	1	3	1.27	Mod
4	Civic Centre energy efficiency	3	3	4	3	2	4	1	1	5	1	1.25	Mod
5	Net Zero' existing city buildings	4	3	4	3	2	5	1	1	5	3	1.07	Mod
6	'Net Zero' new city buildings	4	3	4	3	2	5	1	1	5	3	1.07	Mod
7	Reduce city office space	1	3	2	1	3	1	1	2	5	2	0.91	Low

GHG Modelling and GHG Action Links

Table 38: City Buildings GHG Modelling and Action Links

Action Type	Action No	Action	BCR	R-CB1	R-CB2
				Reduce building energy use	Meet building energy demand using renewables
Governance	2	Incorporate long term energy costs into building design decisions	1.45	X	
	3	Purchase renewable electricity for city corporate use	1.27		X
	5	'Net Zero' existing city buildings	1.07	X	X
	6	'Net Zero' new city buildings	1.07	X	X
Ventures	4	Civic Centre energy efficiency	1.25	X	
	1	Act on energy benchmark analysis of city buildings	1.89	X	
	7	Reduce city office space	0.91	X	

4.8 City Fleet

GHG Modelling

Table 39: City Fleet GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

Result No.	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions			By 2029 Desired Goal / Modelled Actions			Desired outcome by 2033:			GHG reduction % Sector/ tC02eq [1]
R-F1	No increase in annual distance travelled	Annual distances travelled by city vehicles remain constant at 2020 levels										Baseline
R-F2	Improved fuel efficiency in tractors	Fuel efficiency improved by 0.5% per year from 2023 onwards	Achieve a 1.5% improvement in fuel efficiency compared to 2022			Achieve a 3.5% improvement in fuel efficiency compared to 2022			Achieve a 5.4% improvement in fuel efficiency compared to 2022			**2.6%**/ 58
R-F3	Shift from gasoline and diesel vehicles to plug-in hybrid and full electric vehicles	**Type of vehicle[2]**	**PV**	**LT**	**MT**	**PV**	**LT**	**MT**	**PV**	**LT**	**MT**	**18%**/ 386
		Change in the number of gasoline vehicles (G); Diesel vehicles (D); Hybrid vehicles (H); Electric vehicles (E)	G -1 H+1	G-3 H+3	G-3 H+3	D -1 E +1	G-2 D-1 E+3	G-2 D-1 E+3	G -1 H +1	G-2 D-1 E+3	G-2 D-1 E+3	
		Modelled number of total vehicles per category	4	39	16	4	39	16	4	39	16	
		Type of vehicle[2] **Note: no changes suggested to the number of SGFS vehicles**	**Bus**	**HT**	**OR/C**	**Bus**	**HT**	**OR/C**	**Bus**	**HT**	**OR/C**	**27%**/ 586
		Change in the number of gasoline vehicles (G); Diesel vehicles (D); Hybrid vehicles (H);	n/a	n/a	D-2 E+2	G-1 E+1	n/a	D-3 E+3	G-1 E+1	n/a	D-3 E+3	

Result No.	Objective	Desired Goal 'Type' / Modelled Action 'Type'	By 2025 Desired Goal / Modelled Actions			By 2029 Desired Goal / Modelled Actions			Desired outcome by 2033:			GHG reduction % Sector/ tC02eq [1]
		Electric vehicles (E)										
		Modelled number of total vehicles per category	6	8	20	6	8	20	6	8	20	
		Type of vehicle[2] **Note: no changes suggested to the number of SGFS vehicles**	**Tractors**									
		Change in the number of gasoline vehicles (G); Diesel vehicles (D); Hybrid vehicles (H); Electric vehicles (E)	D-6 E+6			D-12 E+12			G-1 D-14 E+15			**51%/** 1,118
		Modelled number of vehicles per category	48									
R-F3	Electricity for hybrid and electric vehicles is renewable	In 2023, shift to 50% renewable energy for hybrid and full-electric vehicles										**12%**/ 260
Total												100%/ 2,408

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

[2]PV = passenger vehicle/sedan; LT = light truck (half tonne or less); MT = medium truck (one tonne); HT = heavy truck (>1 tonne); Bus = transit; OR/C = Off road and Construction

GHG Actions

Table 40: Detailed Description of City Fleet GHG Mitigation Actions

Action ID No	Short Form Action	Detailed Action
1	Right-sized city vehicles	When replacing vehicles and fleet equipment, continue to select vehicles/equipment with appropriate energy (fuel or electricity) needs for the required task - downsizing or upsizing as necessary instead of replacing vehicles with the same type of vehicle/machine that was used most recently
2	Reduced city vehicle use	Continue to look for opportunities to reduce the use of city vehicles, as part of the Green Fleet Plan
3	Electric City fleet and supporting infrastructure	Continue to invest in electric vehicle infrastructure for city owned vehicles, taking advantage of grants from organizations such as the MCCAC. In the EV strategy being developed in 2022, create a plan to eventually transition city fleet to all electric vehicles, when electric options exist.

Table 41: City Fleet GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Right-sized city vehicles	2	1	3	1	5	1	1	1	1	1	2.40	VH
2	Reduced city vehicle use	1	1	3	1	5	1	1	1	1	1	2.20	VH
3	Electric City fleet and supporting infrastructure	4	1	4	1	3	4	1	2	3	3	1.00	Mod

GHG Modelling and GHG Action Links

Table 42: City Fleet GHG Modelling and Action Links

Action Type	Action No	Action	BCR	R-F1	R-F2	R-F3	R-F4
				No increase in annual distance travelled	Improved fuel efficiency in tractors	Shift from gasoline and diesel vehicles to plug-in hybrid and full electric vehicles	Electricity for hybrid and electric vehicles is renewable
Governance	2	Reduced city vehicle use	2.2	X			
	3	Electric City fleet and supporting infrastructure	1			X	X
Ventures	1	Right-sized city vehicles	2.4		X		

4.9 City Lights & Signs

GHG Modelling

Table 43: City Lights and Signs GHG Mitigation Reduction Modelling Results, 'Spruce Grove Path'

Result No.	Objective	By 2025 Desired Goal	By 2029 Desired Goal	By 2033 Desired Goal	GHG reduction % Sector/ tC02eq [1]
R-LS1A	Improve lighting energy efficiency of crosswalks and streetlights	Reduce energy use per light by 19% from 2021	Reduce energy use per light by 38% from 2021	Reduce energy use per light by 48% from 2021	**94%/** 1,752
R-LS1B	Improve lighting energy efficiency of streetlights and traffic signals	Reduce energy use per light by 15% from 2021	Reduce energy use per light by 30% from 2021	Reduce energy use per light by 37% from 2021	**21%**/ 369
Total					**122%/**2121

[1]Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

GHG Actions

Table 44: Detailed Description of City Lights & Signs GHG Mitigation Actions

Action ID No	Short Form Action	Detailed Action
1	Complete replacement of lights with high efficiency light bulbs	Replace all remaining city lighting with LED or similarly efficient lights (e.g., streetlights, parking lots, etc.)
2	Reduce unneeded City lighting	Adopt recommendations from Fortis about safely reducing or removing public lighting, where appropriate (e.g., through motion sensor lighting)
3	Power City lighting using renewable energy	Where possible, power city lights and signs using renewable energy (signage, walkway lighting, etc.)

Table 45: City Lights & Signs GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Complete replacement of lights with high efficiency light bulbs	2	1	1	3	4	1	1	1	2	1	1.83	H
2	Reduce unneeded City lighting	2	1	1	3	4	1	1	1	2	2	1.57	H
3	Power City lighting using renewable energy	4	3	2	3	2	4	2	1	3	1	1.27	Mod

GHG Modelling and GHG Action Links

The GHG modelling for lights and signs focused on improving lighting energy efficiency, which can be accomplished by continuing the replacement of lights and signs with high efficiency lightbulbs. Reducing unneeded lights and powering city lighting using renewable energy would also reduce the GHG emissions from city lights and signs.

4.10 Water & Sewage

GHG Modelling

Result No.	Objective	Desired outcome and timeline:	GHG reduction % Sector/ tC02eq [1]
R-W1	Decrease energy use at all filling/ pump stations	By 20% in 2024	**11%**/ 159
R-W2	Increase the percentage of electricity from renewables sources	By 30% in 2024 at the Zone 1 and 2 pump houses and the truck fill station By 30% in 2026 at the Zone 2 pump house	**96%**/ 1,407
Total			**109%**/ 1,566

GHG Actions

Table 46: Detailed Description of Water & Sewage GHG Mitigation Actions

Action ID No	Short Form Action	Detailed Action
1	Water conservation education programs	Maintain existing water use education programs
2	Efficient water and wastewater equipment	Continue to ensure that water and wastewater mechanical systems are designed and operated efficiently
3	Purchase renewable electricity	Investigate the purchase of renewable electricity for city water and sewage equipment
4	Water leak mitigation	Invest staff time in maintaining the quality of the water and wastewater system to reduce leaks

Table 47: Water & Sewage GHG Mitigation Actions with Rankings

Action ID	Short Form Action	Benefits 1 = low benefits; 5 = high benefits					Costs 1 = low costs; 5 = high costs					BCR	Priority
		GHG	Adapt	Co-Ben	Equity	Flex	CAPEX	OPEX	Side Effects	Feasible	Public		
1	Water conservation education programs	2	3	3	3	5	1	2	1	1	1	2.67	VH
2	Efficient water and wastewater equipment	3	3	3	4	4	2	2	1	1	1	2.43	VH
3	Purchase renewable electricity	5	1	1	3	4	1	4	2	1	3	1.27	Mod
4	Water leak mitigation	2	3	3	4	4	4	4	2	5	1	1.00	Mod

GHG Modelling and GHG Action Links

Table 48: Water and Sewage GHG Modelling and Action Links

Action Type	Action No	Action	BCR	R-W1	R-W2
				Decrease energy use at all filling/ pump stations	Increase the percentage of electricity from renewables sources
Ventures	1	Water conservation education programs	2.67	X	
	2	Efficient water and wastewater equipment	2.43	X	
	3	Purchase renewable electricity	1.27		X
	4	Water leak mitigation	1	X	

5. HIGHLIGHTED ACTIONS

5.1 Highest Equity Actions

While justice and equity components can be embedded into many of the actions recommended above, the GHG mitigation and adaptation actions with the highest equity scores are described in Table 49 and Table 50.

Table 49: Top Scoring GHG Mitigation Actions for Equity

Sector	Sector ID No.	Short form action	Equity considerations
Homes	8	Home retrofit grant program	There is the potential with this action to provide targeted assistance, including direct grants, to lower income households and/or to individuals living in older and less efficient homes.
Homes	11	Home retrofit CEIP program	The CEIP program can provide upfront financing for many home energy retrofits. Upfront financing can be a critical factor that enables vulnerable and disadvantaged groups to take advantage of assistance programs.
Homes	12	CEIP implementation for home renewable energy	Similar to the home retrofit CEIP action, the upfront financing component of a CEIP program for home renewable energy would increase accessibility to such a program.
Transportation and Land Use Planning	5	Increase local transit hours and area covered	This action would increase the ease of transportation around Spruce Grove, and would disproportionately benefit vulnerable and disadvantaged groups of people.

Table 50: Top Scoring Adaptation Actions for Equity

Sector	Sector ID No.	Short form action	Equity considerations
City Programs and Outreach	2	Enhance existing neighbourhood social resilience programs	This action could directly increase the number and quality of social connections of vulnerable and disadvantaged individuals.
City Programs and Outreach	10	Update the Winter Emergency Response Program to assist unsheltered people during extreme weather events	This action would provide direct assistance to unhoused people during extreme weather events.
City Programs and Outreach	9	Improve the climate resilience of locations used for refuge during states of local emergency by assisting with the installation of climate resilience features	This action would improve the climate resiliency of buildings used by all members of the general public, but disproportionately benefiting vulnerable and disadvantaged people, during extreme weather events.

5.2 Complementary Action Identification

Recommended adaptation and GHG mitigation actions with potential complementarity to each other are shown below in Table 51.

Table 51: Summary of complementary GHG Mitigation and Climate Adaptation Actions

Adaptation Sector and ID No.	Short form action	GHG Rank	Short form action	Complementarity
City Buildings & Infrastructure #7	Create Climate Resilience Standards for New City Buildings	City Buildings #1 Energy Supply #3	Act on energy benchmark analysis of city buildings Renewable power generation at city facilities	All relate to improvement of city buildings
City Buildings & Infrastructure #12	Back-up power installation at critical locations			
City Buildings & Infrastructure #9	Continue Lightning Protection Installation on City Buildings			
City Buildings & Infrastructure #11	Increased size and connectivity of active transportation network	Transportation and Land Use Planning #4	Improve active transportation infrastructure and culture	Increased active transportation infrastructure and connectivity was recommended for both its GHG mitigation and climate adaptation benefits
Homes, Businesses & Local Economy #3	Provide climate resilience grants	Homes #8	Home retrofit grant program	Links to grant programs, both city and external programs
Homes, Businesses & Local Economy #4	Regional Lobbying for more climate resilient building codes	Homes #2	Lobby for prompt adoption of updates to energy building codes	All relate to recommended regional lobbying efforts
		Homes #6	Lobby for higher energy efficiency standards in building code	
		Homes #9	Lobby for solar-ready homes in building code	
Water Management & Natural Infrastructure #5	Increase funds for tree planting and management:	Carbon Sinks #1	Citizen tree planting	Tree planting has been identified as both a mitigation and as an adaptation action
		Carbon Sinks #2	Increased city tree planting	
City Programs	Education program on public climate resilience measures	Homes #4	Energy conservation education	All relate to education programs and public awards programs

Adaptation Sector and ID No.	Short form action	GHG Rank	Short form action	Complementarity
and Outreach #11		Local Business and Industry #2	Energy literacy program for business sector	
City Programs and Outreach #1	Encourage residents to create climate resilient home gardens	Local Business and Industry #1	Recognize Business Achievements	
City Programs and Outreach #8	Educate and award residents for increasing use of native ground cover			

6. NEXT STEPS

To start implementation of this plan, specific departments will be identified to work on particular actions. Monitoring, evaluation and review of progress on this plan will occur every 4 years, in line with the city's carbon budgets.

7. REFERENCE LIST

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8. APPENDICES

Appendix A: Steep Decline GHG Modelling Results

For future reference, this Appendix compares the detailed modelling results for the two assessed GHG models. The 'Canada Path' described in Technical Report #2 was adopted as the 'Spruce Grove Path' for the CCAP.

NOTE the modelling ID/reference numbers noted in the tables below may or may not match the final modelling/ID numbers described in the main report above

Summary comparison of GHG Modelling Results

Minimum reductions required in GHG emissions per person from the Steep and Spruce Grove GHG Mitigation Pathways (from modelled 2020 baseline)

GHG Mitigation Pathway	*Year and Carbon Budget Phase, if applicable*			
	2025 (P1)	2030 (P2)	2033 (P3)	2050
Steep Decline[1]	36%	63%	74%	100%
Spruce Grove path[2]	19%	36%	55%	100%

[1]Table 1, Technical Report #2
[2]Table 2, Technical Report #2

Community GHG Modelling Results

	Steep Decline				Spruce Grove Path			
Summary table information	**B1**	**B2**	**B3**	**Total**	**B1**	**B2**	**B3**	**Total**
Emissions Reductions Required	387.7 ktC02eq	888.9 ktC02eq	1,300 ktC02eq	**2,576 ktC02eq**	155 ktC02eq	384 ktC02eq	757 ktC02eq	1,300 ktC02eq
Emissions Reductions Achieved	76.4 ktC02eq	432.5 ktC02eq	1,040 ktC02eq	**1,548 ktC02eq**	67.2 ktC02eq	369 ktC02eq	896 ktC02eq	1,330 ktC02eq
Percentage of required emissions achieved by 2033	20%	49%	80%	**60%**	43%	96%	118%	**102%**

Corporate GHG Modelling Results

	Steep Decline				Spruce Grove Path			
Summary table information	**B1**	**B2**	**B3**	**Total**	**B1**	**B2**	**B3**	**Total**
Emissions Reductions Required	6.6 ktC02eq	15.7 ktC02eq	20.7 ktC02eq	**43.0 ktC02eq**	22.6 ktC02eq	22.6 ktC02eq	22.6 ktC02eq	22.6 ktC02eq
Emissions Reductions Achieved	6.2 ktC02eq	17.0 ktC02eq	19.8 ktC02eq	**43.0 ktC02eq**	22.6 ktC02eq	22.6 ktC02eq	22.6 ktC02eq	22.6 ktC02eq
Percentage of required emissions achieved by 2033	94%	109%	96%	**100%**	74%	134%	96%	**105%**

Sector GHG Modelling Results

Transportation and Land Use

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome By 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome By 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-T1	Annual reduction in average distances travelled	15% reduction for passenger vehicles and light trucks 2.5% reduction for medium trucks	**29%**	13%	12% reduction for passenger vehicles and light trucks 2.5% reduction for medium trucks	**47%**	22%
R-T2	Overall reduction in vehicle ownership	2.5% reduction for passenger vehicles, SUVs, light trucks, medium trucks	**10%**	5%	2.5% reduction for passenger vehicles, SUVs, light trucks, medium trucks	**20%**	10%
R-T3	Electricity used in electric vehicles comes from renewable sources	42% of electricity for all hybrid & electric vehicles is renewable	**3%**	2%	42% for all hybrid & electric vehicles	**7%**	3%
R-T4	Shift towards hybrid vehicles	42% for medium trucks	**4%**	2%	42% for medium trucks	**9%**	4%
R-T5	Shift towards electric vehicles	32%-39% for all private vehicles	**9%**	4%	32%-39% for all private vehicles	**17%**	8%
Total			54%	25%		101%	47%

Homes

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-H1A	Energy retrofits to existing homes	Energy savings from reference case of: 3-4% by 2025 12% by 2029 30% by 2033	**18%**	5%	Energy savings from reference case of: 3% by 2025 11% by 2029 23-25% by 2033	**51%**	13%
R-H1B	Energy retrofits to homes built after 2022	Energy savings from reference case of: 6% by 2025 33% by 2029 80% by 2033	**50%**	13%	Energy savings from reference case of: 5-6%% by 2025 30% by 2029 70% by 2033	**48%**	13%
R-H2A	Increased heating from renewable energy sources for existing homes	Energy savings from reference case of: 1-2% by 2025 3-5% by 2029 6-9% by 2033	**3%**	0.7%	Energy savings from reference case of: 1-2% by 2025 3-5% by 2029 6-9% by 2033	**5%**	1.4%
R-H2B	Increased heating from renewable energy sources for homes built after 2022	Energy savings from reference case of: 1-2% by 2025 4-6% by 2029 6-10% by 2033	**1%**	0.2%	Energy savings from reference case of: 1-2% by 2025 4-6% by 2029 6-10% by 2033	**2%**	0.4%
R-H3A	Increased energy from appliances, lighting, and space cooling from renewable energy sources for existing homes	Energy savings from reference case of: 8% by 2025 24% by 2029 50% by 2033	**9%**	2.4%	Energy savings from reference case of: 8% by 2025 24% by 2029 50% by 2033	**18%**	4.7%

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-H3B	Increased energy from appliances, lighting, and space cooling from renewable energy sources for homes built after 2022	Energy savings from reference case of: 12% by 2025 48% by 2029 100% by 2033	**4%**	1%	Energy savings from reference case of: 12% by 2025 48% by 2029 100% by 2033	**9%**	2.3%
R-H4	Shift towards multi-family buildings in new construction	Between 2022 and 2033: -reduce the share of single-family homes from 63% to 58% of homes -increase the share of apartments from 14% to 24% of homes	**1%**	0.2%	Between 2022 and 2033: -reduce the share of single-family homes from 63% to 58% of homes -increase the share of apartments from 14% to 24% of homes	**1%**	0.4%
			55%	14.5%		**100%**	26%

Local Business and Industry

Industrial and Commercial Sectors:

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-IC1A	Improvements in overall **energy efficiency** in: -existing IC buildings	Energy savings from reference case of: 4% by 2025 12% by 2029 30% by 2033	**15%**	2.2%	Energy savings from reference case of: 3% by 2025 9% by 2029 22% by 2033	**44%**	6.6%
R-IC1B	Improvements in overall **energy efficiency** in: -post-2022 IC buildings	Energy savings from reference case of: 30% by 2025 55% by 2029 80% by 2033	**29%**	4.2%	Energy savings from reference case of: 6% by 2025 32% by 2029 60% by 2033	**68%**	10.1%
R-IC2A	Increased **heating** energy from renewable sources in -existing IC buildings	Energy savings from reference case of: 0.4% by 2025 1% by 2029 2% by 2033	**34%**	5%	Energy savings from reference case of: 0.4% by 2025 1% by 2029 2% by 2033	**66%**	9.9%
R-IC2B	Increased **heating** energy from renewable sources in -post-2022 IC buildings	Energy savings from reference case of: 0.5% by 2025 1.5% by 2029 2% by 2033	**0.2%**	<0.1%	Energy savings from reference case of: 0.5% by 2025 1.5% by 2029 2% by 2033	**0.4%**	<0.1%
R-IC3A	Increased renewable energy use to power **equipment, lighting and space cooling** -existing IC buildings	Energy savings from reference case of: 8% by 2025 24% by 2029 50% by 2033	**23%**	3%	Energy savings from reference case of: 8% by 2025 24% by 2029 50% by 2033	**45%**	6.7%

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-IC3B	Increased renewable energy use to power **equipment, lighting and space cooling** -post-2022 IC buildings	Energy savings from reference case of: 12% by 2025 48% by 2029 100% by 2033	**7%**	1%	Energy savings from reference case of: 12% by 2025 48% by 2029 100% by 2033	**14%**	2.0%
Total			**67%**	10%		**113%**	17%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

Light Industry

Comparison of Steep Decline Path & Spruce Grove Pathway

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-I1	Improvements in overall energy efficiency in the construction and manufacturing industries	Energy savings from reference case of: 2% by 2025 7% by 2029 13% by 2033	**44%**	3.6%	Energy savings from reference case of: 2% by 2025 4% by 2029 7% by 2033	**56%**	4.5%
R-I2	Increased use of renewable energy for electricity the construction and manufacturing industries	Energy savings from reference case of: 14% by 2025 32% by 2029 50% by 2033	**42%**	3.4%	Energy savings from reference case of: 8% by 2025 14% by 2029 20% by 2033	**41%**	3.3%
Total			**87%**	7%		**100%**	8%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

Solid Waste Actions

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-SW1	Reduce waste generation annually from 0.36 tonnes/capita to:	0.35 t/capita by 2029 0.34 t/capita by 2033	**1%**	<0.1%	0.35 t/capita by 2033	**2%**	<0.1%
R-SW2	Increase waste diversion rate from 40% to:	46% by 2025 53% by 2029 61% by 2033	**32%**	0.8%	46% by 2025 53% by 2029 61% by 2033	**62%**	1.7%
R-SW3	Local landfill captures an increasing percentage of methane gas capture:	30% capture in 2025 50% capture in 2029	**68%**	1.8%	10% capture in 203	**11%**	0.3%
R-SW4	Annual reduction in organic composition of landfill waste	1% annual reduction between 2023-2033	**13%**	0.3%	1% annual reduction between 2023-2033	**25%**	0.7%
Total			**100%**	2.7%		**100%**	2.5%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

City Building Actions

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
Agrena	In 2023+, reduce energy use by 20% In 2023+, meet 20% of natural gas energy demand with renewables In 2028+, meet 50% of electricity demand with renewables	**20%**	0.2%	Reduce energy use by 10% in 2026 In 2026+, meet 50% of energy demand with renewables	**36%**	0.4%
BPAC	In 2023+, reduce energy use by 20% In 2023+, meet 40% of natural gas demand with renewables In 2031+, meet 50% of electricity demand with renewables	**3%**	<0.1%	In 2028+, reduce energy use by 10% In 2023+, meeting 20% of all energy demand using renewables	**4%**	<0.1%
Brookwood Rink	In 2027+, reduce energy use by 20% In 2027+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand with renewables	**0.1%**	<0.1%	In 2027+, reduce energy use by 10% In 2027+, meet 20% of total energy demand with renewables	**0.1%**	<0.1%

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
City Hall	In 2023+, reduce energy use by 20% In 2023+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**3%**	<0.1%	In 2025+, reduce energy use by 10% In 2025+, meet 10% of energy demand using renewables	**4%**	<0.1%
Eco Centre	In 2027+, reduce energy use by 20% In 2027+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**0.1%**	<0.1%	In 2027+, reduce energy use by 10% In 2027+, meet 20% of all energy demand with renewables	**<0.1%**	<0.1%
Elks Hall	In 2024+, reduce energy use by 20% In 2024+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**1.4%**	<0.1%	In 2024+, reduce energy use by 10% In 2024+, meet 20% of all energy demand with renewables	**2%**	<0.1%
FCSS	In 2026+, reduce energy use by 20%	**0.3%**	<0.1%	In 2026+, reduce energy use by 10%	**<0.1%**	<0.1%

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
	In 2032+, meet 50% of all energy demand with renewables			In 2026+, meet 20% of all energy demand with renewables		
Fuhr Sports Park/ West District Park	In 2023+, reduce energy use by 20% In 2023+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**1.8%**	<0.1%	In 2023+, reduce energy use by 10% In 2023+, meet 25% of all energy demand with renewables	**3%**	<0.1%
Protective Services	In 2024+, reduce energy use by 10% In 2024+, meet 40% of natural gas demand with renewables In 2031+, meet 50% of electricity demand using renewables	**8%**	0.1%	No reduction in energy use In 2030+, meet 10% of total energy demand with renewables	**2%**	<0.1%
RCMP	In 2027+, reduce energy use by 20% In 2027+, meet 40% of natural gas demand with renewables In 2033+, meet 50% of electricity demand using renewables	**3%**	<0.1%	In 2030+, reduce energy use by 10% In 2030+, meet 10% of all energy demand with renewables	**2%**	<0.1%

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
Jubilee Spray Park	In 2026+, reduce energy use by 20% In 2026+, meet 40% of natural gas demand with renewables In 2033+, meet 50% of electricity demand using renewables	**0.7%**	<0.1%	In 2026+, reduce energy use by 10% In 2026+, meet 15% of all energy demand with renewables	**1%**	<0.1%
Library	In 2029+, reduce energy use by 20% In 2029+, meet 40% of natural gas demand with renewables In 2029+, meet 50% of electricity demand using renewables	**0.9%**	<0.1%	In 2028+, reduce energy use by 10% In 2028+, meet 15% of all energy demand with renewables	**1%**	<0.1%
Log Cabin	In 2024+, reduce energy use by 20% In 2024+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**0.4%**	<0.1%	In 2024+, reduce energy use by 20% In 2024+, meet 15% of all energy demand with renewables	**<0.1%**	<0.1%
PW Shop – Century Close	In 2024+, reduce energy use by 20%	**7%**	0.1%	In 2025+, reduce energy use by 5%	**11%**	0.1%

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
	In 2024+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables			In 2025+, meet 15% of all energy demand with renewables		
PW Shop – Schram St	In 2026+, reduce energy use by 20% In 2026+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**1.5%**	<0.1%	In 2026+, reduce energy use by 10% In 2026+, meet 15% of all energy demand with renewables	**2%**	<0.1%
PW Shop – Spruce Ridge Satellite	In 2026+, reduce energy use by 20% In 2026+, meet 40% of natural gas demand with renewables In 2032+, meet 50% of electricity demand using renewables	**0.1%**	<0.1%	In 2026+, reduce energy use by 10% In 2026+, meet 15% of all energy demand with renewables	**<0.1%**	<0.1%
Transit Building	In 2028+, reduce energy use by 20% In 2028+, meet 40% of natural gas demand with renewables	**0.5%**	<0.1%	In 2028+, reduce energy use by 10% In 2028+, meet 15% of all energy demand with renewables	**<0.1%**	<0.1%

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
	In 2082+, meet 50% of electricity demand using renewables					
Aspenglen Rink	In 2026+, reduce energy use by 20% In 2026+, meet 50% of electricity demand using renewables	**<0.1%**	<0.1%	In 2026+, reduce energy use by 20% In 2026+, meet 20% of electricity demand using renewables	**<0.1%**	<0.1%
Henry Singer Park	In 2026+, reduce energy use by 20% In 2026+, meet 50% of electricity demand using renewables	**<0.1%**	<0.1%	In 2026+, reduce energy use by 10% In 2026+, meet 20% of electricity demand using renewables	**<0.1%**	<0.1%
Columbus Park	In 2026+, reduce energy use by 20% In 2026+, meet 50% of electricity demand using renewables	**0.1%**	<0.1%	In 2026+, reduce energy use by 20% In 2026+, meet 20% of electricity demand using renewables	**<0.1%**	<0.1%
Tunnel and Rink	In 2026+, reduce energy use by 20% In 2026+, meet 50% of electricity demand using renewables	**0.1%**	<0.1%	In 2026+, reduce energy use by 20% In 2026+, meet 50% of electricity demand using renewables	**<0.1%**	<0.1%
Civic Centre (not yet constructed)	When the Civic Centre opens in 2025, construct it to use 70% lower EUI than standard buildings of its type	**48%**	0.6%	When the Civic Centre opens in 2025, construct it to use 30% lower EUI than standard buildings of its type	**29%**	0.3%

	Steep Decline Path			Spruce Grove Path		
Building	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
	In 2025+, meet 5% of natural gas demand and 50% of electricity demand using renewables			In 2025+, meet 15% of its total energy demand from renewable energy		
Total		**100%**	1.2%		104%	1.3%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

City Fleet Actions

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-F1	Reduction in average vehicle distance travelled	By 1-1.5% per year	**9%**	<0.1%	No reduction	**0**	0
R-F2	Improved fuel efficiency in tractors	Annual fuel efficiency improvement of 1.5%	**6.3%**	<0.1%	No reduction	**0**	0
R-F3	Incremental reduction of vehicle ownership	Reduction in 1-2 vehicles per vehicle type (passenger vehicle, light truck, medium truck, etc) per year	**17%**	<0.1%	No reduction	**0**	0
R-F4	Shift from gasoline and diesel vehicles to plug-in hybrid then full electric vehicles	Incremental shift in vehicle types towards electric vehicles (when available) and hybrid vehicles (when good electric options do not exist)	**10%**	<0.1%	Incremental shift in vehicle types towards electric vehicles (when available) and hybrid vehicles (when good electric options do not exist)	**17%**	<0.1%
R-F5	Shift from gasoline and diesel vehicles to full electric vehicles	Incremental shift in vehicles, including local transit buses, off-road construction and tractors/ equipment, towards full electric options	**40%**	<0.1%	Incremental shift in vehicles, including off-road construction and tractors/ equipment, towards full electric options	**77%**	0.1%
R-F6	Electricity for hybrid and electric vehicles is renewable	In 2033, shift to 100% renewable energy	**15%**	<0.1%	In 2033, shift to 50% renewable energy	**12%**	<0.1%

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
			97%	0.2%		100%	0.2%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

Lights & Signs

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-LS1A	Improve lighting energy efficiency of streetlights	Replace all remaining streetlight bulbs with LEDs by 2025	**47%**	<0.1%	Replace all remaining streetlight bulbs with LEDs by 2025	94%	**0.1%**
R-LS1B	Improve lighting energy efficiency of cross walks and road signs	Reaching 57% reduction by 2033	**3%**	<0.1%	Reaching 57% reduction by 2033	7%	**<0.1%**
R-LS1C	Improve lighting energy efficiency of traffic signals	Reaching 88% reduction by 2033	**11%**	<0.1%	Reaching 88% reduction by 2033	21%	**<0.1%**
R-LS2	Use renewable electricity for all lights and signs	Reaching 55% by 2033	**43%**	<0.1%	N/A	**0**	**0**
			104%	0.1%		**122%**	0.2%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

Water & Sewage

		Steep Decline Path			Spruce Grove Path		
Result No.	Objective	Desired outcome	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*	Desired outcome by 2033:	GHG Reductions (% of Required Sector Total)*	GHG Reductions (% of Required City Total)*
R-W1	Decrease energy use at all filling/ pump stations	By 55% in 2024	**16%**	<0.1%	By 20% in 2024	**11%**	<0.1%
R-W2	Increase the percentage of electricity from renewables sources	By 60% in 2025 at the Zone 1 and 2 pump houses and the truck fill station By 60% in 2023 at the Zone 2 pump house	**83%**	0.1%	By 30% in 2024 at the Zone 1 and 2 pump houses and the truck fill station By 30% in 2026 at the Zone 2 pump house	**96%**	0.1%
Total			**99%**	0.1%		**109%**	0.1%

*Due to interaction effects within the GHG emissions model, the sum of individual percentages may add up to more than the true sum of all actions modeled as a package

Appendix B: Public Engagement Results

Summary results from each of the two public surveys conducted in 2021 are shown below.

OUR CLIMATE FUTURE

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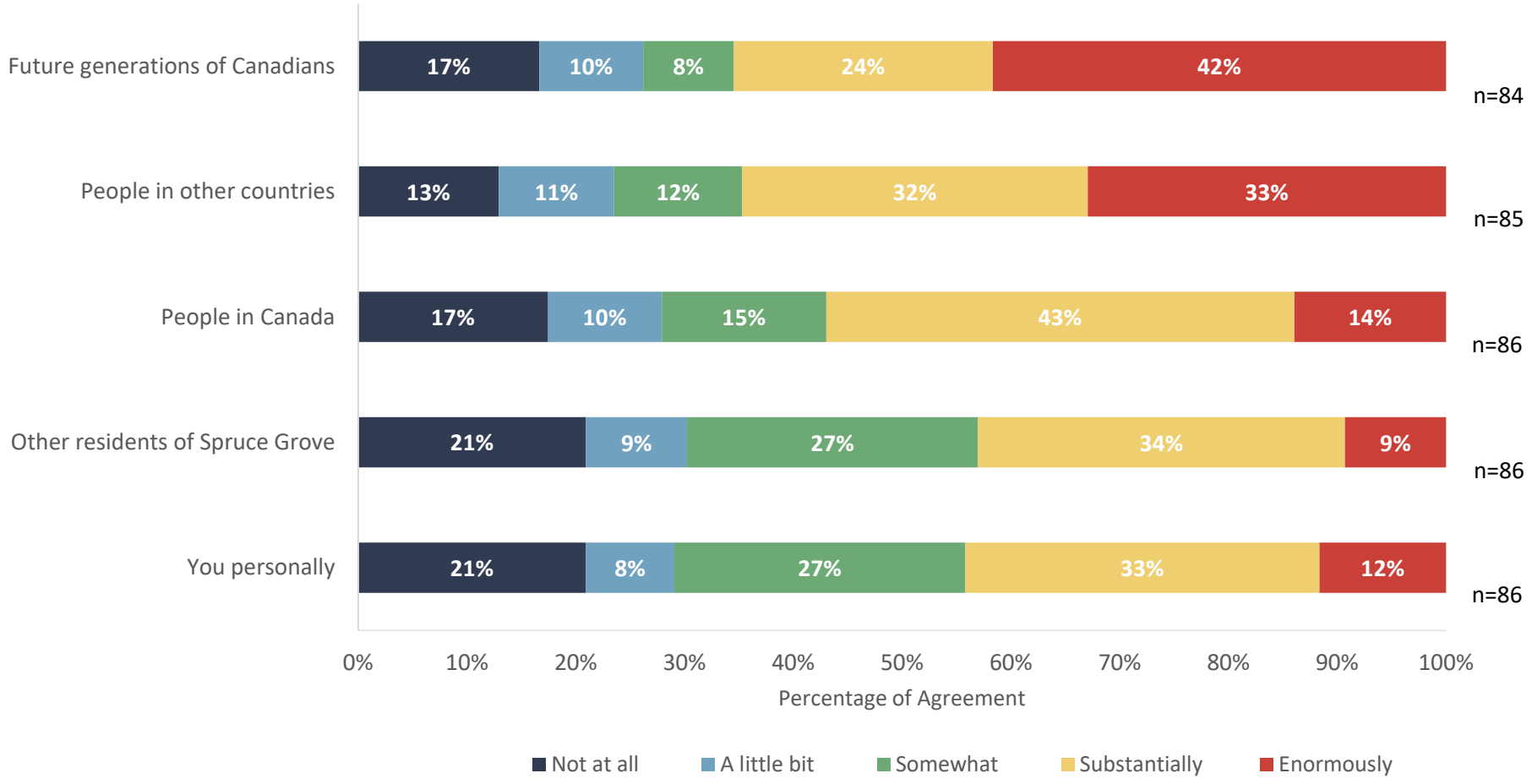
SPRING SURVEY RESULTS

Overall information

- A survey on the Climate Change Action Plan was open from May 18 to June 8, 2021
- This survey was published on the Spruce Grove ‘Connect’ website, and was advertised on the city’s social media channels, the Spruce Grove Examiner, and on driver message boards
- A total of 86 people responded to the survey
- Results to each survey question are shown in the following slides

1. How much do you think different groups will be affected by climate change?



Question 2 preamble:

According to recent climate predictions, Spruce Grove can expect to see some of the following changes in their local climate both now and into the future:

- more **heavy rainfall** events
- **hotter, drier** summers
- warmer temperatures in all seasons
- warmer winters with **fewer cold days**
- more **extreme weather** (hail, wind, etc.)

These changes could affect Spruce Grove in a variety of ways.

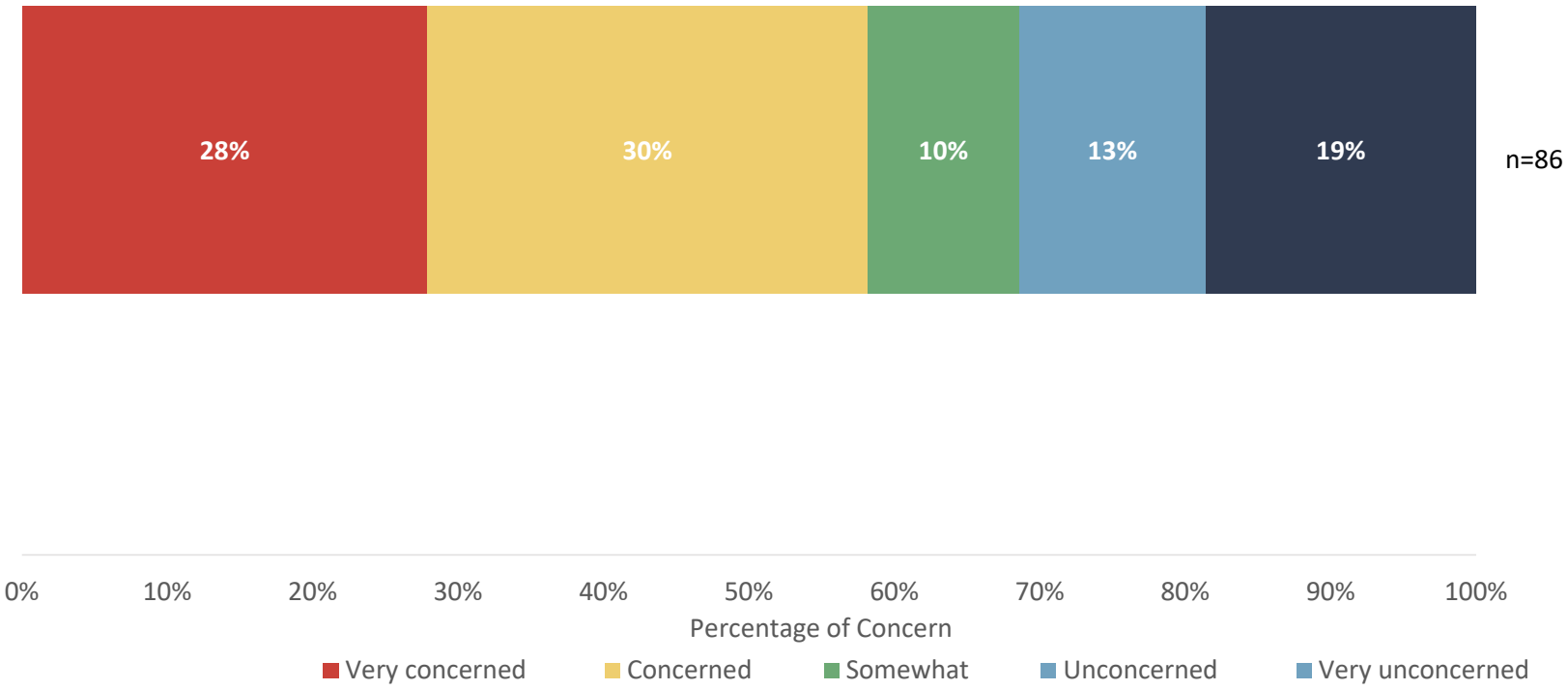
A few **negative examples** include:

- increased chance of **urban flooding in the spring**, due to more rainfall, especially rain that falls during intense storms
- increased chances of **water shortages in the summer**, due to higher demand for water, especially on very hot days.
- higher chance of **freezing rain** during fall, winter, and spring, due to more days with temperatures that are just above freezing. This could result in power outages, more needs for road maintenance, and tree damage.
- **more thunderstorms** in the summer, which will **increase damage** from hail, intense winds, and lightning strikes.

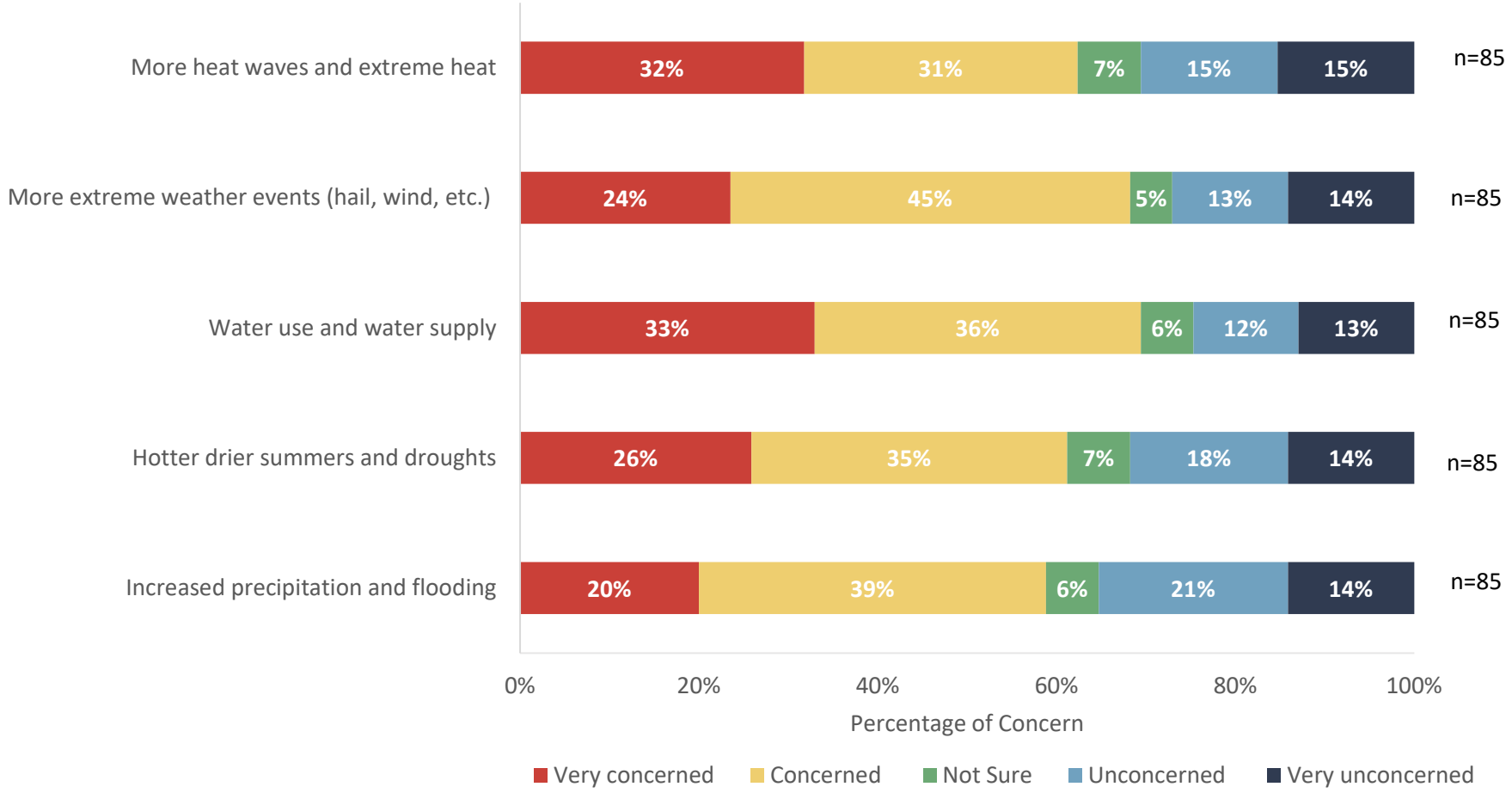
A few **positive examples** include:

- a **longer construction** season and a **longer growing** season, due to a longer period of time without freezing temperatures at night
- more opportunities for **spring recreation,** due to warmer spring temperatures, and a longer **summer recreation season**
- lower winter **heating costs,** due to warmer average winter temperatures

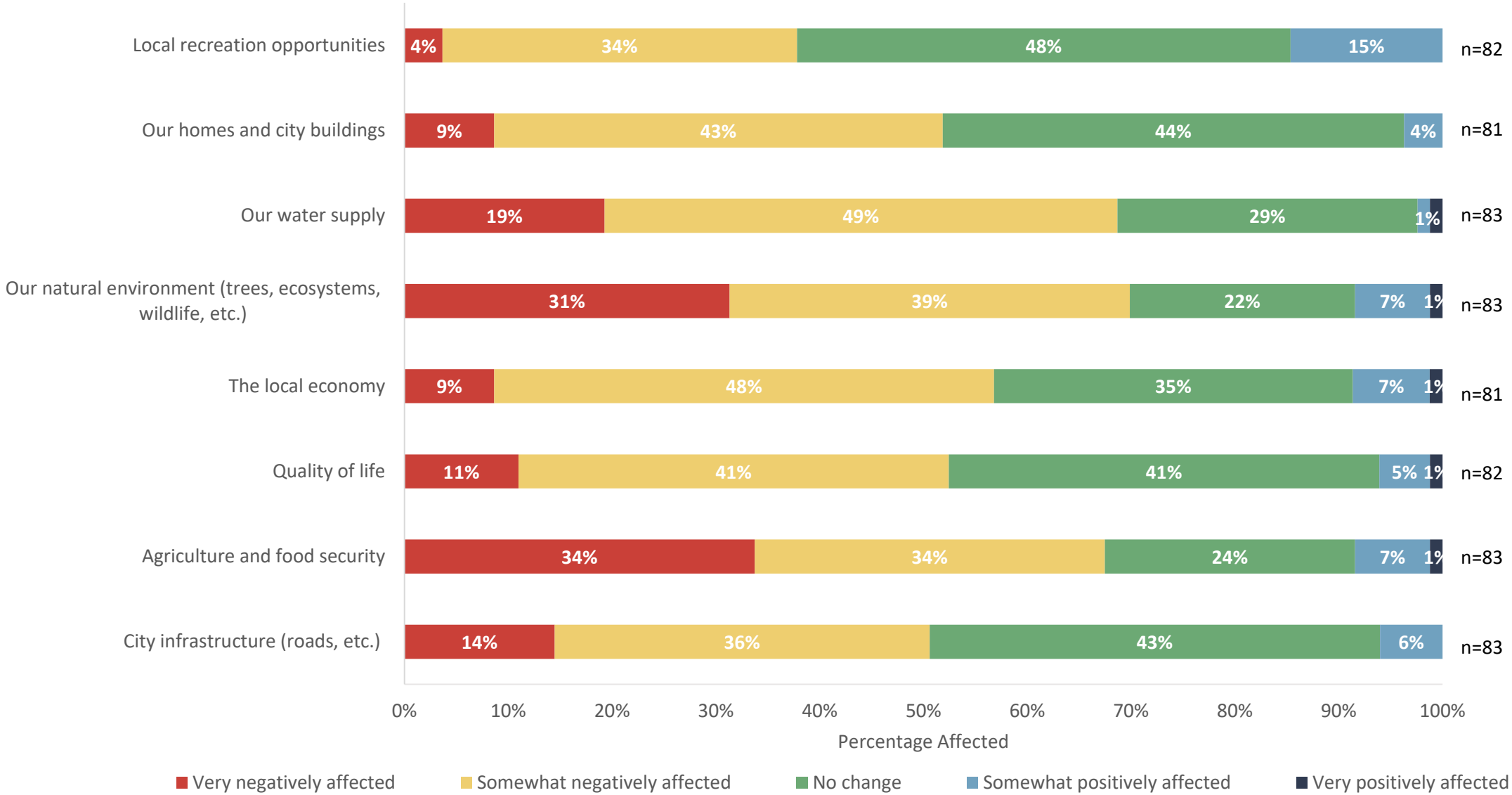
2. How do you feel about these local climate change impacts?



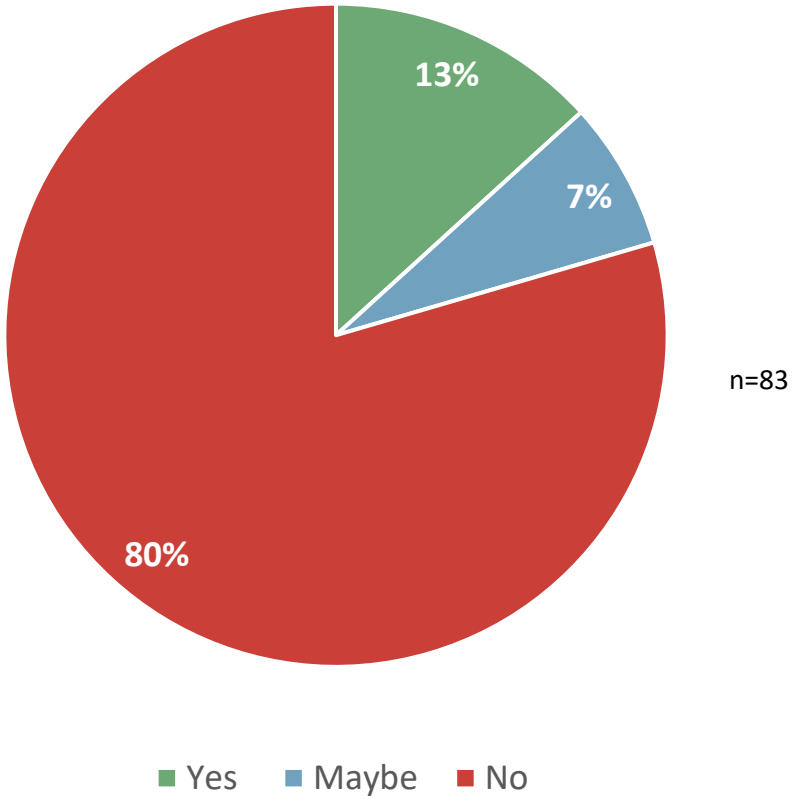
3. How concerned are you about the following impacts



4. How much do you think the following services will be affected negatively by climate change in Spruce Grove?



5. Are you aware of any examples of climate change preparation that are already happening in Spruce Grove?



Q6: How ambitious should the city's greenhouse gas reduction targets be?

Over the past 15 years, the City has reduced its per person GHG emissions by about 38%. This reduction is partly due to the recent shift away from coal to generate electricity in Alberta. Other reasons for this drop in GHG emissions includes:

- Switching all of the streetlights in the city over to LED lightbulbs, which use less electricity
- High standards in new City buildings have resulted in improved energy efficiency
- Spruce Grove residents are generally driving their vehicles less

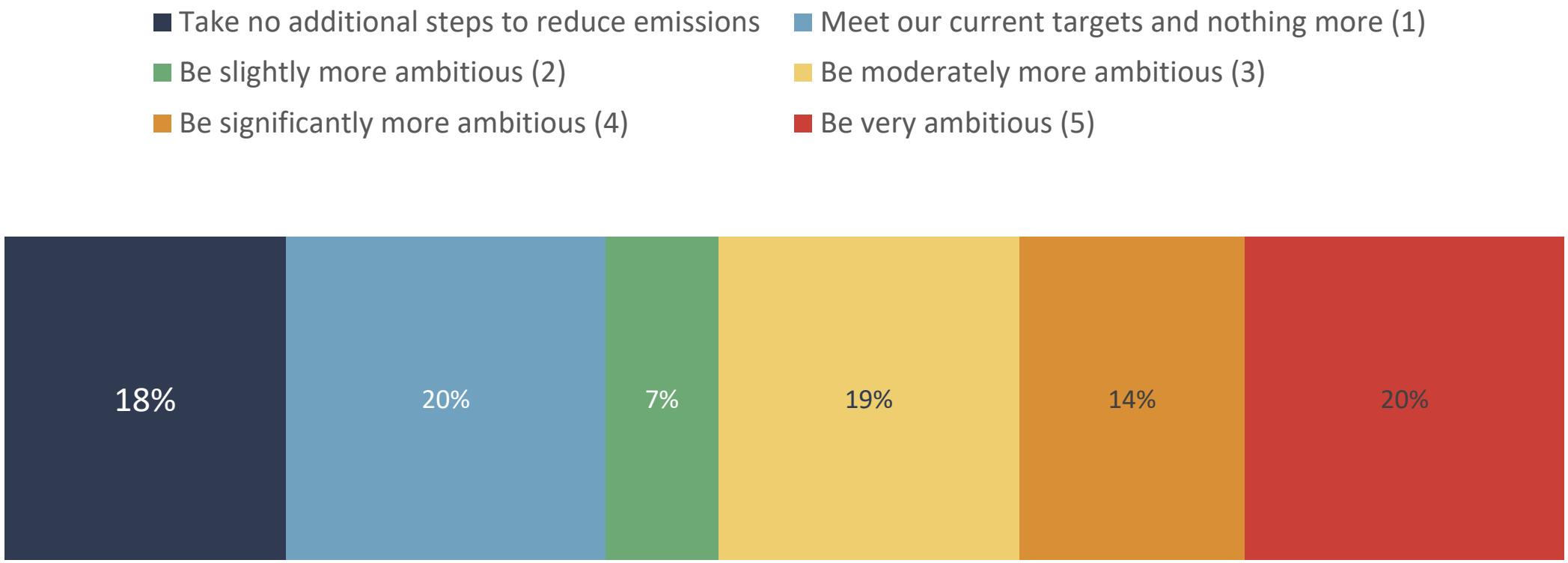
In 2019, emissions from Spruce Grove were 12 tonnes per person. The City is already committed to reducing annual GHG emissions to 9.8 tonnes per person by 2035, a reduction of about 18%. To avoid the worst impacts of climate change, the scientific community recommends that we reduce emissions to 3.0 tonnes per person by 2035, and to 0 (zero) tonnes per person by 2050.

As part of the CCAP, the City is updating its GHG emission reduction targets.

Looking at the options in the table, how ambitious should the city’s greenhouse gas reduction targets be?

- Take no additional steps to reduce emissions
- Meet our current targets and nothing more (aligns with the current city goal of 9.8 tonnes/person by 2035)
- Be slightly more ambitious
- Be moderately more ambitious
- Be significantly more ambitious
- Be very ambitious (would imply that per person GHG emissions would fall to 3.0 tonnes by 2030, and to 0 (zero) tonnes per person by 2050

Q6: How ambitious should the city's greenhouse gas reduction targets be?

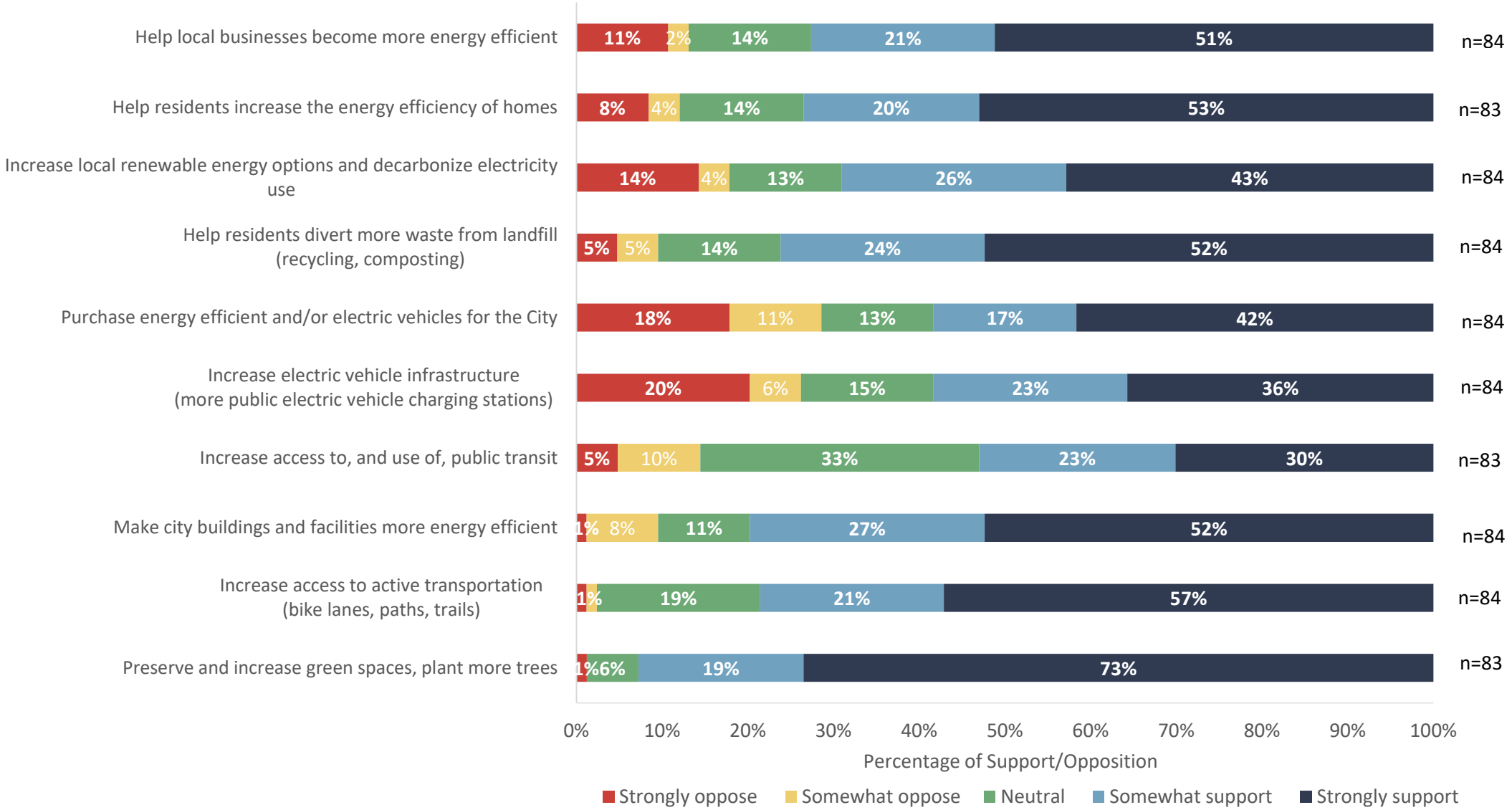


n=83

Q6: How ambitious should the city's greenhouse gas reduction targets be?

- 20% of survey participants felt that the city should take no additional steps to reduce GHG emissions, with 80% wanting at least some additional measures to be taken by the city.
- Approximately 50% of survey participants wanted ‘moderate’ to ‘very ambitious’ action taken, with the remainder wanting either ‘no additional actions’, ‘currently existing actions only’ or ‘slightly more ambitious targets than exist now’.
- Some age differences were observed between responses:
  - 63% of survey respondents aged 18-44 wishing for ‘moderate’ to ‘very ambitious’ action taken by the city to reduce GHGs
  - 40% of survey respondents who were 45 and older wanted ‘moderate’ to ‘very ambitious’ levels of GHG ambition by the city.

7. How much do you support or oppose the following ways to reduce the city's GHG emissions?



OUR CLIMATE FUTURE

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FALL SURVEY RESULTS

Overall information

- A survey on the Climate Change Action Plan was open from September 24 to October 26, 2021
- This survey was published on the Spruce Grove ‘Connect’ website, and was advertised on the city’s social media channels, the Spruce Grove Examiner, in the Greater Parkland Regional Chamber of Commerce newsletter, in a direct email to not for profits and charity groups in Spruce Grove, and on driver message boards
- A total of 34 people responded to the survey
- Results to each survey question are shown in the following slides for these 3 survey topics:
  - Section 1: Preparing for Changes to Local Weather Patterns
  - Section 2: Climate Change Mitigation Ambition
  - Section 3: Climate Change Mitigation Actions

Section 1: Preparing for Change to Local Weather Patterns

If greenhouse gas emissions around the world continue to rise at the same rate as they currently are, by 2050-2080 **we can expect to see a variety of changes to our local weather patterns in Spruce Grove.**

Specifically:

- More frequent periods of multi year **drought**
- More frequent, longer **heat waves** (3 or more days in a row above 30 degrees Celsius)
- More frequent **intense weather** (thunderstorms, windstorms, freezing rain events)
- More **invasive species**
- Reduced **winter recreation** opportunities
- Increased levels of **wildfire smoke**
- A longer **construction season** (opportunity)
- Increased **agricultural productivity** (opportunity)

We asked survey participants:

a) How could these changes affect your life?
b) How could the City prepare for this change?

A summary of the results for this questions are shown on the following slides.

Multi Year Drought:
How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- Won't affect my life
- Possible brown-outs during periods of high air conditioning use
- Poor Air Quality
- Less water in local rivers
- Higher water costs
- Unable to use water for recreation (e.g. splashparks)
- Water shortages
- Increased insect infestation
- Higher electricity use and costs
- Increased change of local fire
- Damage and death to local plants, including sports fields; difficult to maintain home yard and home gardens
- Food shortages
- Water restrictions
- Higher food costs

Multi Year Drought:
What actions could the City take to manage these risks?

- We can't change the weather, don't worry about it
- Don't focus on drought
- Communicate to citizens in an scientifically accurate, unbiased, unpolitical, and easy to understand way what can be done about water conservation, air quality management, soil preservation, etc
- Adequate water storage/pumping
- Free access to community shelters
- Take significant actions to reduce GHG emissions for the greater good
- Lower taxes and allow residents to make their own decisions
- Ban wood burning firepits to reduce fire risk
- For residents, encourage water barrel use
- For the city, find ways to store water from rain for use in parks and boulevard trees
- Designate cooling centres for seniors and the needy
- Water conservation measures
- Ensure that vulnerable populations have a place to go to escape poor air conditions
- Increase the size of local storm water ponds and local water storage tanks
- Encourage citizens to shade their windows and the south side of their homes
- Educate the public on ways to reduce their water and electricity usage
- Reduce city facility dependency on electricity and natural gas by installing solar panels
- Plant more native plants that are drought resistant. Use xeriscaping to reduce landscape water needs.
- Plant more boulevard trees and shrubs
- Revitalize our urban forests
- Year round greenhouses where people can grow garden to have food year round

Heat Waves:

How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- Makes it harder to sleep at night
- Could reduce outdoor recreation options
- Increases overall electricity use due to use for fans and air conditioning
- Move to the basement to sleep
- Higher electricity costs
- Increased mental stress - worrying about friends and loved ones who could be at risk
- Negative health effects for both small children and more seniors
- Potential brownouts if electricity demand is higher than supply
- Could reduce garden production
- Stress and possible death to local trees, shrubs and grass

Heat Waves:

What actions could the City take to manage these risks?

- Increase the amount of air conditioning in city facilities
- Provide easy access to bottled water
- Incentives for solar panels
- Plant more trees - good for cooling the air
- Plant heat tolerant vegetation
- Reduce taxes and allow residents to figure it out for themselves.
- Take drastic actions as a community to reduce energy use
- Ensure parks and recreation areas have a lot of shaded areas.
- Encourage private citizens to use solar power to offset electricity usage
- Make air conditioned public spaces available for vulnerable populations: people without air conditioning, people with health conditions or young children, etc.
- Prepare Emergency Services for heat related illness
- Encourage senior communal housing and schools to ensure that their HVAC systems are adequate.
- Work with local utilities and the government to ensure that the electrical supply is ready to meet peak summer demands
- Identify and promote energy efficient ways to cool homes
- Install more public water fountains and water fountains for pets
- Keep splash parks open during hot periods

More Frequent and Intense weather:

How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- Residential and vehicle property damage
- Increased insurance costs
- Dangerous driving conditions
- Could discourage people from enjoying recreation activities outdoors

More Frequent and Intense weather:

What actions could the City take to manage these risks?

- Improve the city's ability to respond to freezing rain events, high winds, and flooding
- Develop a city wide 'weather info' network to warn citizens of extreme weather, using many methods of communication
- Encourage home owners to check their homes for siding and roof damage to help them withstand intense weather
- Set up assistance programs for those in need of damage repair
- Implement rebates for back water valves for flooding
- Ensure that emergency services have appropriate training and adequate staffing
- Increase storage capacity in storm ponds
- Provide homeowners with guides for weather proofing homes.
- Increase support for the city arborist, since tree damage/ falls could increase during increased severe weather events .
- Require hail resistant roofing/siding/building products on new building .
- Provide supports for retrofitting existing buildings
- Education for people with decks and yards that they should secure loose items before storms hit
- Build new neighbourhoods so they are prepared for intense weather
- Provide homeowners with guides for weather proofing homes

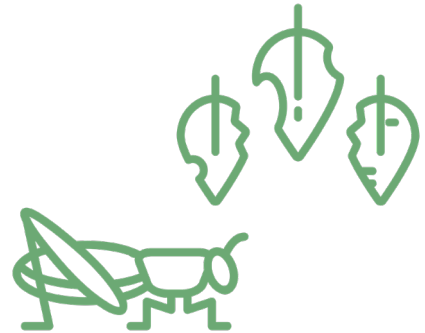
More invasive species:

How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- There will be more pests and diseases on city and residential properties
- More insects outdoors making it less fun to be outside
- Increased demand for pest eradication companies
- Increased use of pesticides
- Negative effects on local farmers
- Loss of plants in natural areas and in gardens

More invasive species:

What actions could the City take to manage these risks?



- Help people understand how to deal with invasive species on their own property. Publish information on species of concern
- Hire an entomologist to plan and deal with pests
- Find ways to remove pests that are non-toxic
- Reward native planting and xeriscaped residential areas.

Reduced winter recreation:

How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- Reduced ability to do snow and ice sports
- This wouldn’t affect me
- I would need to find different recreation activities to do in the winter

Reduced winter recreation:
What actions could the City take to manage these risks?

- Monitor conditions at outdoor rinks
- At some point, re-purpose outdoor rinks for different activities
- Continue to maintain public facilities
- Look for ways to increase other kinds of outdoor activities in winter, like winter markets

Increased levels of wildfire smoke:

How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- Increased breathing difficulties, especially for people with underlying conditions
- I would spend less time outdoors
- I would be physically uncomfortable
- There would be increased stress on air filtration systems in buildings
- We would have increased chances of developing cancer, emphysema, etc.

Increased levels of wildfire smoke:
What actions could the City take to manage these risks?

- Improve indoor recreation complexes with filtered air and enough capacity for people to allow people to be active when air quality outside is bad
- Ban fire pits from using wood
- Keep citizens informed about what the air quality is now and what the forecast for it is, using many types of media
- Provide relief stations for people with health issues and for homeless people
- Require new buildings to meet high air quality standards for filtering pollutants

Longer construction season:
How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- This would lead to better road quality which would be positive
- This would not affect my life
- More construction could lead to slower travel times
- This could increase road construction costs which would increase taxes
- This could lead to road projects being completed faster

Longer construction season:
What actions could the City take to manage these risks?

- The city should improve how it minimizes construction disruption to residents
- Hire higher quality contractors, not the lowest bid contractors
- Spread the same amount of work over a longer time frame to reduce disruptions to residents
- Get larger construction projects completed faster
- Construct active living transportation projects

Increased agricultural productivity:
How could this affect your life, and the lives of other people living in Spruce Grove if it was experienced today?

- Potential to grow more and different food in home gardens, if irrigation/ water is available
- Increased access to fresher locally grown food
- Could be outweighed by drought which will lead to higher food prices

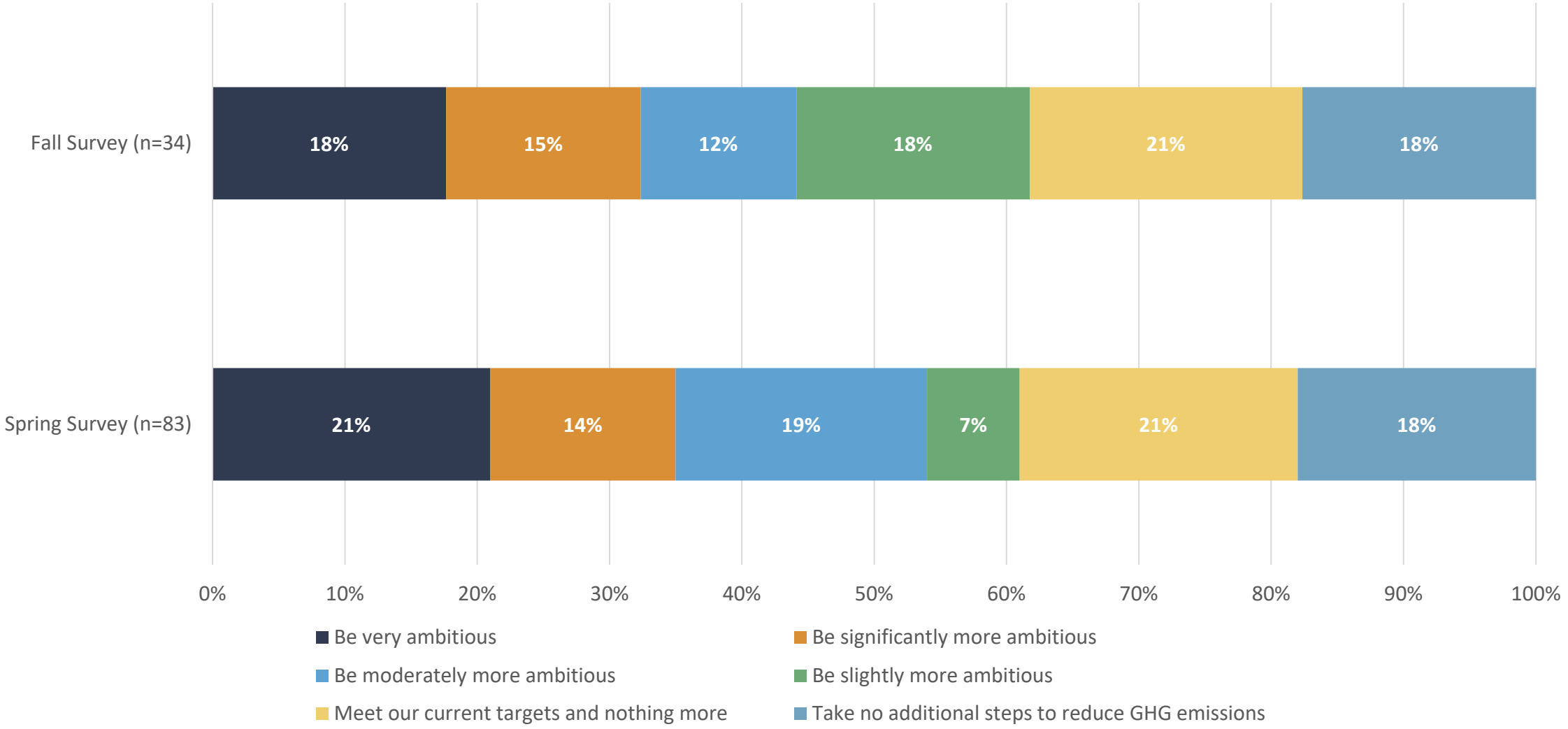
Increased agricultural productivity:
What actions could the City take to manage these risks?

- Provide education to residents about how to get the most out of their gardens with the least use of water
- Create more community gardens
- Promote buying food locally
- Encourage the use of water barrels and other water conservation strategies
- Stop developing over high quality soil

Section 2: Climate Change Mitigation Ambition

- In both the spring and the fall survey, we asked survey residents about how ambitious Spruce Grove's greenhouse gas reduction targets should be
- Results were similar between the two surveys:
  - Approximately 40% of survey respondents think the city should take no further GHG actions, or, only meet current targets
  - Approximately 30% of survey respondents think that the city should be slightly or moderately more ambitious than current targets
  - Approximately 30% of survey respondents think that the city should be very or significantly more ambitious than current targets
- Graphs showing these results are shown on the next slide

How ambitious should the city's greenhouse gas reduction targets be?



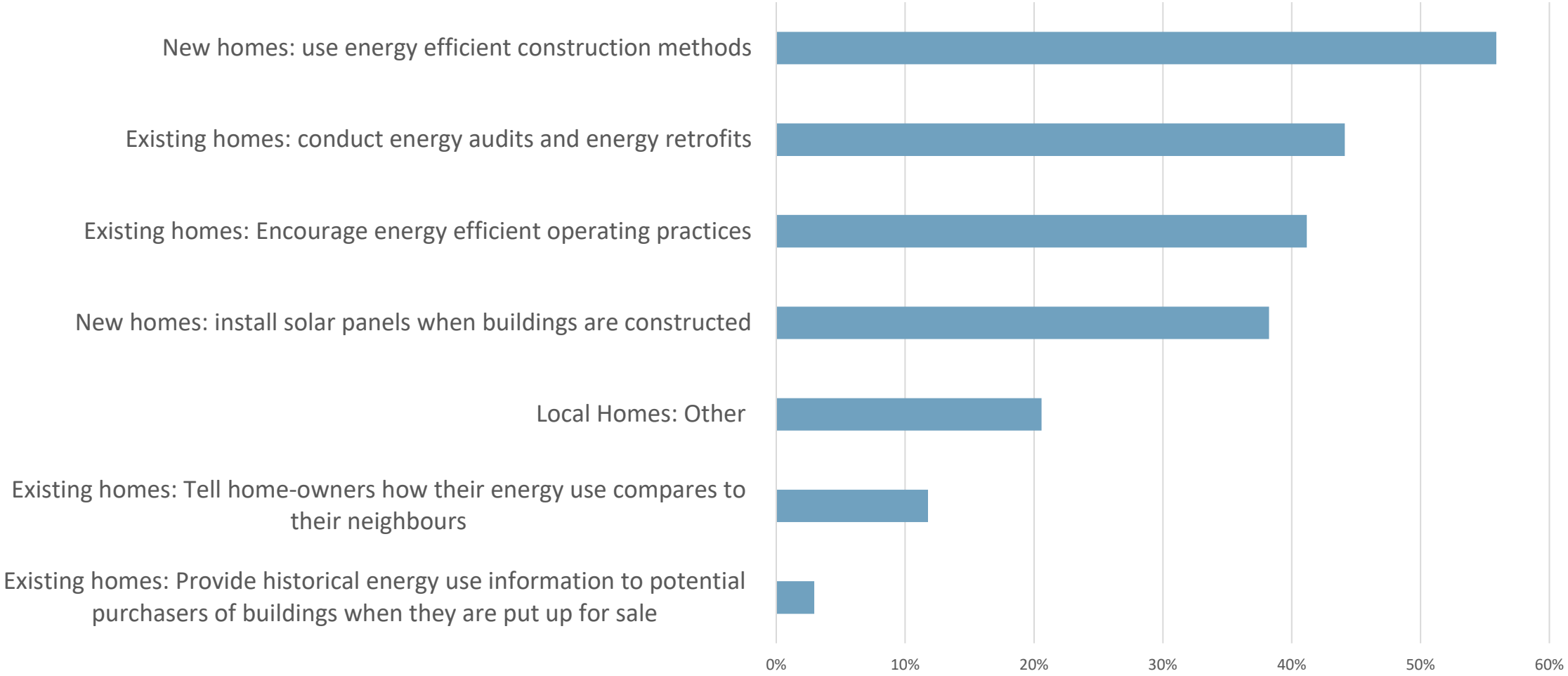
Section 3: Climate Change Mitigation Actions

Greenhouse Gas Reduction Actions

To reduce greenhouse gas emissions across the community, the city is investigating a variety of potential actions. The actions described below are being adopted by some other communities in Alberta, Saskatchewan and Manitoba.

We asked survey respondents which of these actions Spruce Grove should prioritize, split into several categories:

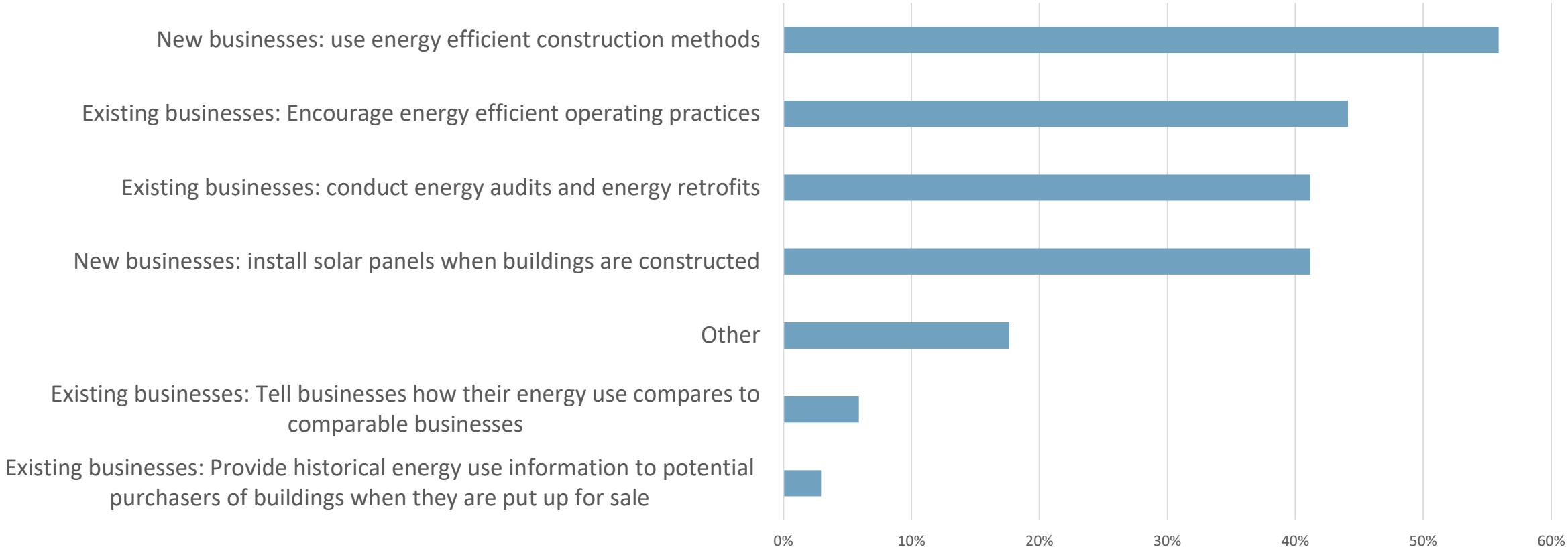
Local Homes: Priority Actions



Other Suggested Actions re: Local Homes

- Use existing programs to do home energy audits
- Regulate the industry better so costs don’t fall to home owners
- Reduce taxes and let local home-owners decide what to do for themselves
- Provide incentives for new and existing homes to install solar panels

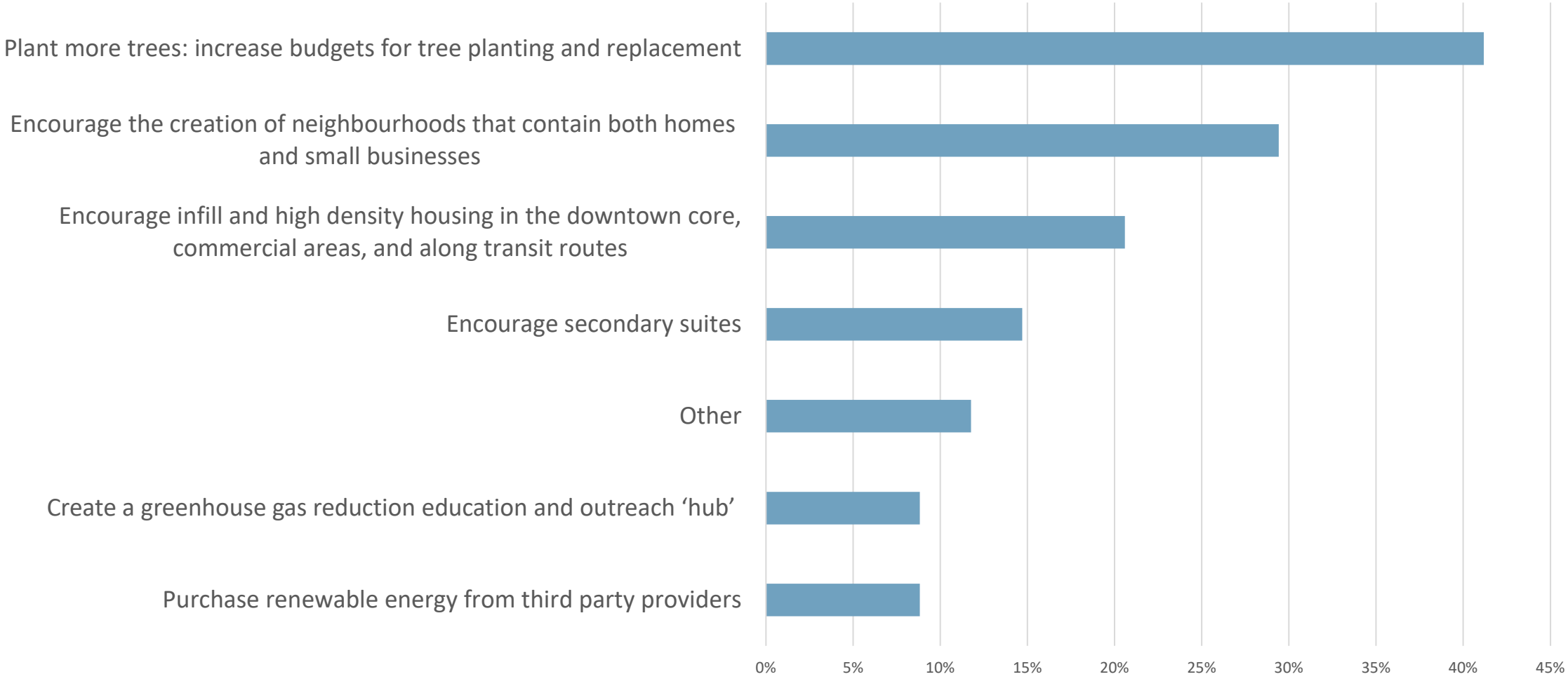
Local Offices and Commercial Space Priority Actions



Other Suggested Actions re: Local Offices and Commercial Space

- Offer rebates for businesses to retrofit
- Reduce regulations and bureaucracy
- Help businesses to conduct energy audits
- Mandate businesses to power most of their electricity from a renewable source

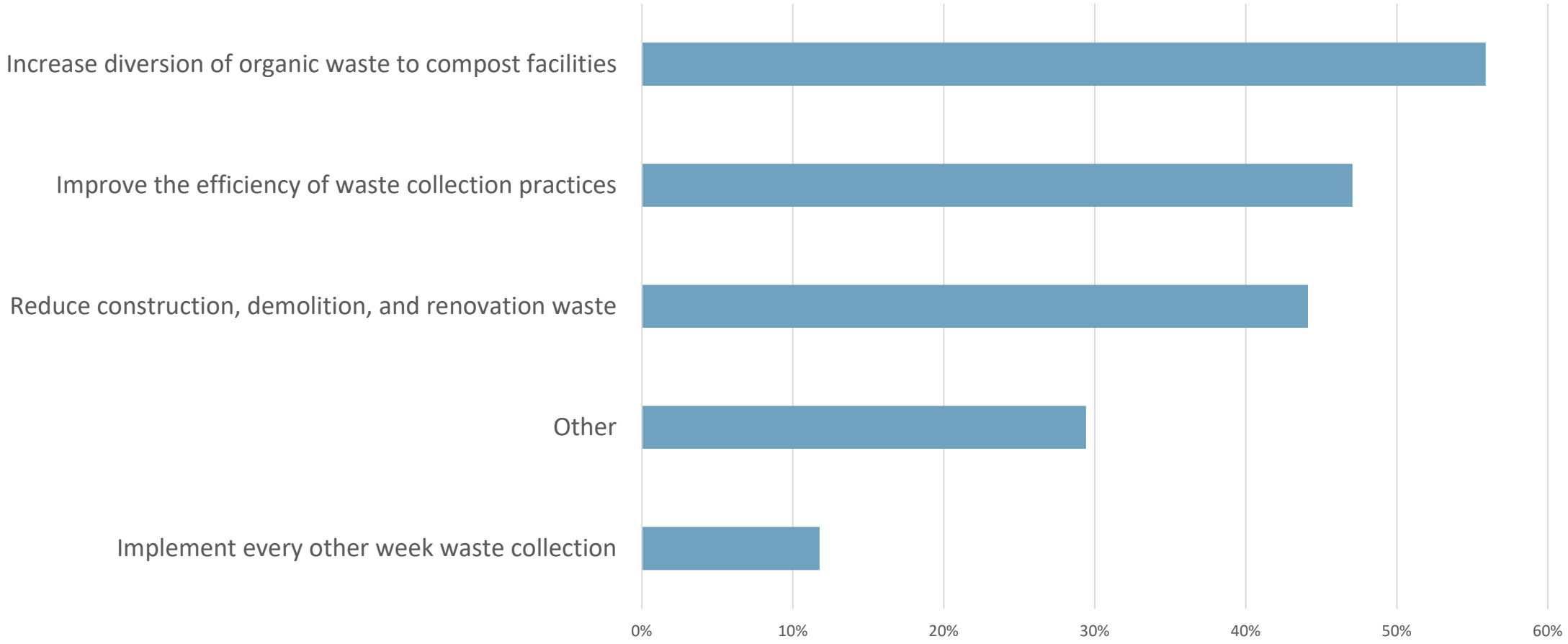
Local Land Use Priority Actions



Other Suggested Actions re: Local Land Use

- Don’t encourage secondary suites
- Make the city more walkable
- Stop building houses that take up the entire lot
- Spend more funds on water quality

Landfill Waste Priority Actions



Other Suggested Actions re: Landfill Waste

- Don’t make it difficult to throw out garbage
- Encourage the federal government to recycle more plastic
- Promote organic sorting in homes and businesses
- Require businesses to stop using non-recyclable packaging
- Fine people who don’t use their green bins correctly
- Improve communication about waste and recycling
- Set up a compost facility that belongs to the city

ALL ONE SKY FOUNDATION is a not-for-profit, charitable organization established to help vulnerable populations at the crossroads of energy and climate change. We do this through education, research and community-led programs, focusing our efforts on adaptation to climate change and energy poverty. Our vision is a society in which ALL people can afford the energy they require to live in warm, comfortable homes, in communities that are resilient and adaptive to a changing climate.

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