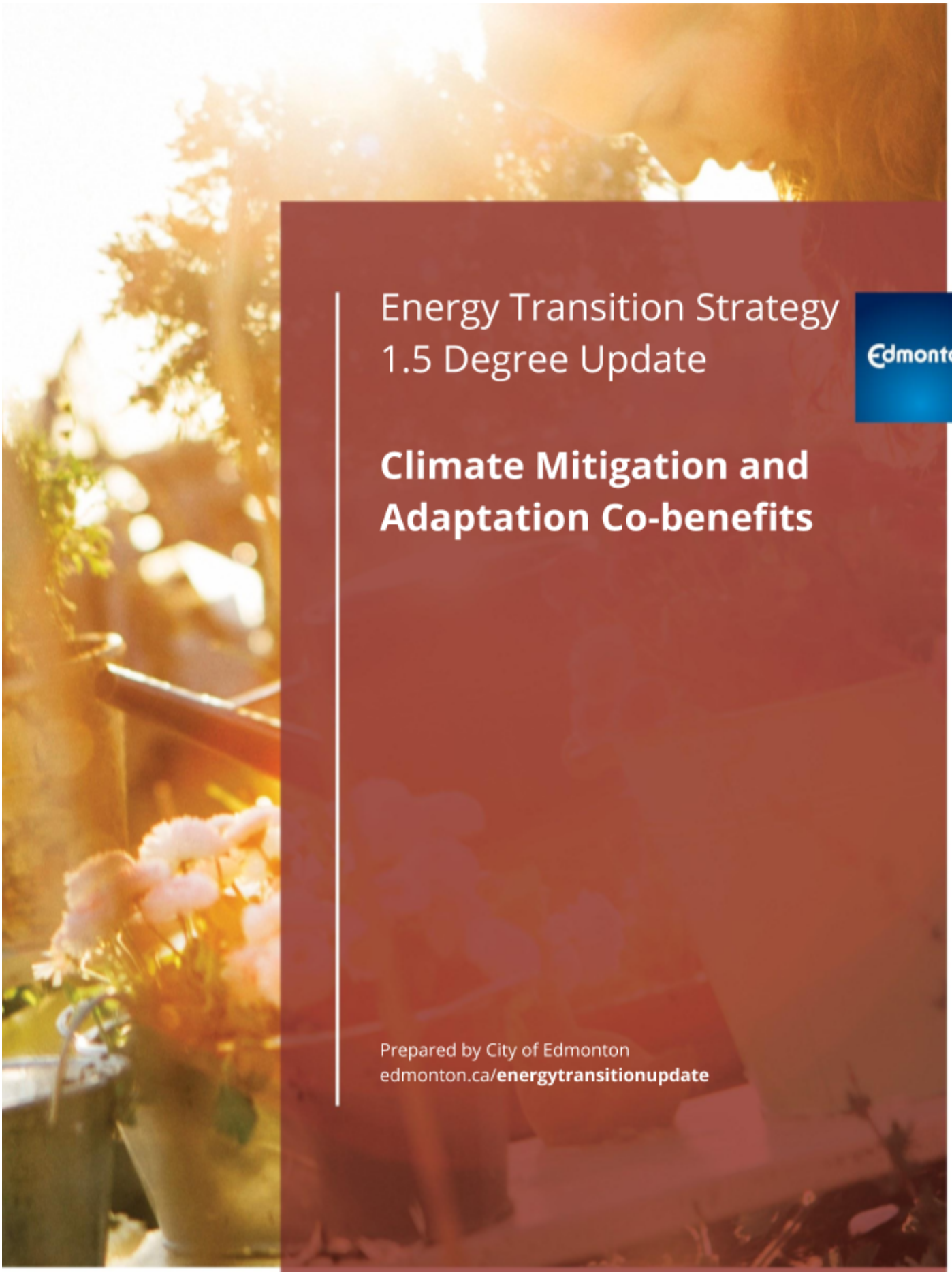

Energy Transition Strategy
1.5 Degree Update

Climate Mitigation and Adaptation Co-benefits

Prepared by City of Edmonton
edmonton.ca/**energytransitionupdate**

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ISSUE IDENTIFICATION

On August 27th, 2019, Edmonton City Council Declared a Climate Emergency and requested that Administration take steps to develop a revised Community Energy Transition Strategy by the end of third Quarter 2020 that aligns the emissions targets and actions with the local carbon budget for City Council's approval.

Council's motion was informed by Administration's report contextualizing Edmonton's current Community Energy Transition Strategy with a local carbon budget that was developed to assess whether or not the 35% below 2005 levels by 2035 greenhouse gas reduction goal was aligned with a global average temperature increase of 1.5 degrees scenario.

The conclusion was that Edmonton was not on track to limit its contribution to global climate change at a level aligned with 1.5 degrees. The report provided to City Council also provided an illustrative pathway to achieve a level of emissions reductions aligned with the 1.5 scenario. The results were summarized within six climate shifts:

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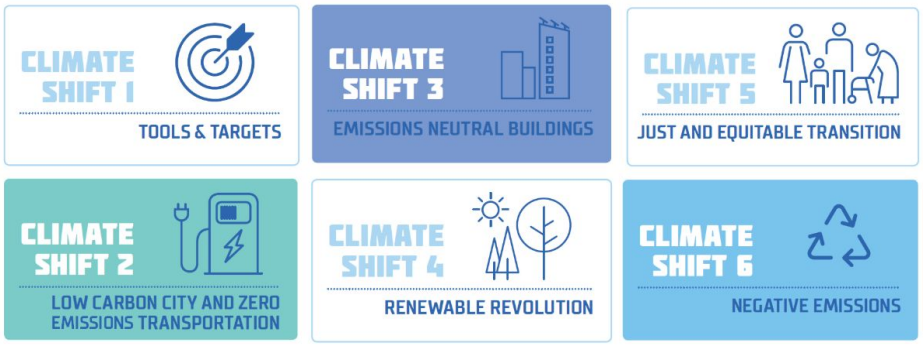

The shifts include 23 modelled actions that would facilitate the emissions reductions required to stay within the local carbon budget and achieve 3 tonnes of emissions per capita by 2030 and carbon neutrality by 2050.

Climate Resilient Edmonton: Adaptation Strategy and Action Plan

Beginning in 2016, the City and various stakeholders worked together to develop a climate change adaptation strategy that investigated the climate change impacts expected to affect Edmonton and how the City can prepare to minimize the negative social, economic, and environmental aspects of those impacts. Climate Resilient Edmonton: Adaptation Strategy and Action Plan

was presented to the Executive Committee of City Council in November 2018, and outlines the strategy and actions the City will take to build climate resilience.

Addressing both climate adaptation and mitigation is necessary to build the overall climate resilience of the City of Edmonton. It is recognized that different mitigation actions can both help and hinder our ability to adapt to climate change. For example, the shade and cooling provided by trees enhances a city's adaptation capacity, but the shade provided by trees can reduce solar energy capacity and generation. Both actions are necessary to be successful, and each approach must be employed with an eye to the right approach for the right locations.

To optimize the City's climate resilience mitigation actions that also increase climate adaptation capacity should be prioritized over those that have no adaptation benefit or reduce the adaptive capacity.

Therefore, to optimize the City's climate resilience mitigation actions that also increase climate adaptation capacity should be prioritized over those that have no adaptation benefit or reduce the adaptive capacity. This policy brief explores the currently defined mitigation actions and highlights where these actions can potentially increase or decrease the adaptive capacity of the City, providing an initial prioritization of the mitigation actions that help build overall climate resilience.

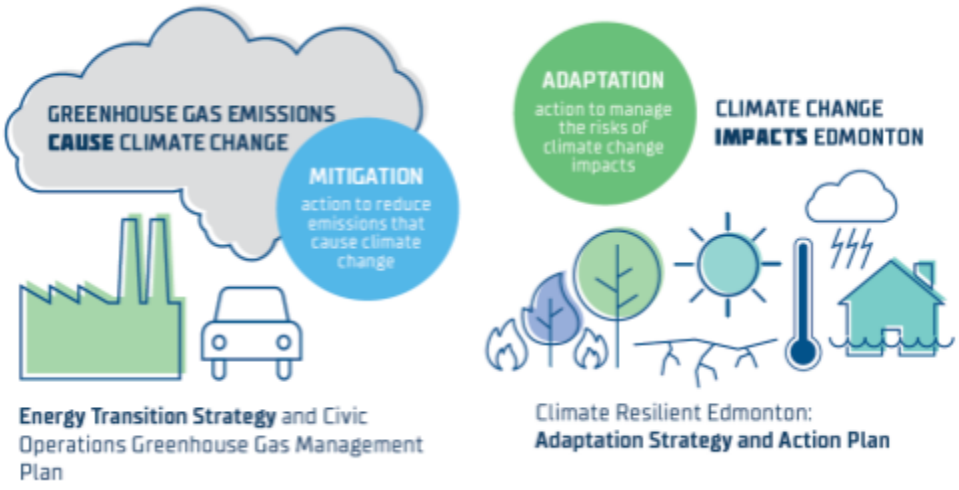

Figure 1: Definitions of climate mitigation and climate adaptation

MITIGATION AND ADAPTATION DIFFERENCES

It is not sufficient to concentrate on either mitigation or adaptation, but a combination of these results in the most sustainable outcomes. Yet, these two strategies do not always complement each other, and can create conflicts between the specific priorities of mitigation or adaptation. This creates a need for these conflicts to be managed, prioritizing those activities that are cost-effective and minimize negative consequences.[1]

Adaptation and mitigation differ primarily based on their overall objectives. Mitigation addresses the causes of climate change, that being the accumulation of greenhouse gas emissions in the atmosphere. Adaptation addresses the impacts of climate change, such as heavier rains, more frequent and / or extreme heat waves, or increasing prevalence of drought. Both approaches are needed to build climate resilience. Even with strong mitigation efforts undertaken the climate will continue to change due to past greenhouse gas releases, and adaptation alone will not be able to eliminate all negative impacts that result from changing climatic conditions.

Adaptation and mitigation also differ in terms of where the results of the actions are felt. Reductions in greenhouse gas emissions from mitigation efforts result in benefits that are global in scale, whereas adaptation efforts will mostly generate local benefits. Both remain important, but achieving the right balance of mitigation and adaptation efforts is a challenge and one that must be evaluated location by location.

INTERSECTION OF MITIGATION AND ADAPTATION

Vulnerability to climate change, greenhouse gas emissions, and the capacity to adapt to climate change and mitigate our impact on the climate is strongly influenced by livelihoods, systems, behaviour and culture.[2] Moving towards an increasingly energy-intensive lifestyle can contribute to higher resource

[1] Laukkonen, Julia; Blanco, Paola Kim; Lenhart, Jennifer; Keiner, Marco; Cavric, Branko; and Kinuthia-Njenga, Cecilia. Combining climate change adaptation and mitigation measures at the local level. Habitat International, Volume 33, Issue 3, July 2009, 287-292. https://doi.org/10.1016/j.habitatint.2008.10.003

[2] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

consumption, driving greater energy production and greenhouse gas emissions. This highlights the importance of adapting our consumption habits to minimize the energy consumed and therefore reduce emissions. Every mitigation action taken helps reduce the adaptation to climate change that is necessary, recognizing that some degree of climate change is already locked in from historical GHG emissions.

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However, this minimization of energy consumed must also consider the social acceptability and regional conditions present to successfully see these actions adopted. Similarly, livelihoods that depend on climate-sensitive sectors or resources may be particularly vulnerable to climate change and climate change policies. Without considering both mitigation and adaptation, economic development and urbanization of landscapes exposed to climate hazards may increase the risk to a city and reduce the resilience of natural systems that help moderate impacts of climate change.

This complexity reveals a need for improving institutions and enhancing coordination and cooperation in governance to help overcome regional constraints associated with mitigation, adaptation and disaster risk reduction. Table 1 explores some common factors that constrain the implementation of adaptation and mitigation actions.

Table 1: Common factors constraining the implementation of adaptation and mitigation options[3]

Constraining Factor	Implications for Adaptation	Implications for Mitigation
Adverse externalities of population growth and urbanization	Increase exposure of human populations to climate variability and change as well as demands for, and pressures on, natural resources and ecosystem services	Drive economic growth, energy demand and energy consumption, resulting in increases in greenhouse gas emissions
Deficits of knowledge, education and human capital	Reduce national, institutional and individual perceptions	Reduce national, institutional and individual risk

[3] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

	of the risks posed by climate change as well as the costs and benefits of different adaptation options	perception, willingness to change behavioural patterns and practices and to adopt social and technological innovations to reduce emissions
Divergences in social and cultural attitudes, values and behaviours	Reduce societal consensus regarding climate risk and therefore demand for specific adaptation policies and measures	Influence emission patterns, societal perceptions of the utility of mitigation policies and technologies, and willingness to pursue sustainable behaviours and technologies
Challenges in governance and institutional arrangements	Reduce the ability to coordinate adaptation policies and measures and to deliver capacity to plan and implement adaptation	Undermine policies, incentives and cooperation regarding the development of mitigation policies and the implementation of efficient, carbon-neutral and renewable energy technologies
Lack of access to national and international climate finance	Reduces the scale of investment in adaptation policies and measures and therefore their effectiveness	Reduces the capacity of developed and developing nations to pursue policies and technologies that reduce emissions
Inadequate technology	Reduces the range of available adaptation options as well as their effectiveness in reducing or avoiding risk from increasing rates or magnitudes of climate change	Slows the rate at which society can reduce the carbon intensity of energy services and transition toward low-carbon and carbon-neutral technologies
Insufficient quality and/or quantity of natural resources	Reduce the ability to adapt, vulnerability to pre-existing non-climatic factors and potential competition for resources that	Reduce the long-term sustainability of different energy technologies

	enhances vulnerability	
Adaptation and development deficits	Increase vulnerability to current climate variability as well as future climate change	Reduce mitigative capacity and undermine international cooperative efforts on climate owing to a contentious legacy of cooperation on development
Inequality	Places the impacts of climate change and the burden of adaptation disproportionately on the most vulnerable and/or transfers them to future generations	Constrains the ability for developing nations with low income levels, or different communities or sectors within nations, to contribute to greenhouse gas mitigation

ANALYSIS

Table 2 explores the identified actions under the 6 Climate Shifts of the updated Community Energy Transition Strategy, and generally evaluates these actions for their contribution to climate adaptation. Specific details underlying each of the actions have a considerable implication for the contribution to climate adaptation, and it is possible that programs can eliminate a negative contribution to climate adaptation if adaptation is considered in their design and implementation.

This table should be considered an initial evaluation of potential implications for the City's adaptive capacity as the Energy Transition is implemented. Those actions with little or no contribution to climate adaptation should consider and reduce the potential negative consequences for climate adaptation in their design and implementation. Actions with a positive contribution to climate adaptation should be streamlined and prioritized to maximize the climate resilience of Edmonton.

Table 2: Community Energy Transition Actions and their Potential Contribution to Climate Adaptation

Climate Shift	Action	Contribution to Climate Adaptation*	Notes
Climate Shift 1: Tools and Targets	Carbon Accounting and Budgeting	()	Helps to understand the City's contribution to climate change, but does not improve knowledge about the risks and impacts due to climate change
	Consumption based GHG Inventory	()	Increased understanding of the implications of City purchasing and how to adapt purchasing to minimize the City's contribution to climate change
Climate Shift 2: Low Carbon City & Zero Emissions Transportation	Building and Land Use Intensification / Densification	+	Improves local-access to necessary goods and services, reducing need for transportation. Improved connectedness within community Reduced disruption of natural ecosystems that assist adaptation In the absence of proper emergency preparation, if intensification / densification occurs in a high climate risk location (i.e. fire / flood) and an event occurs adaptation may be hindered.

	Increased Active Transportation	++	Increases awareness of local climatic conditions and hazards. Increased health and wellbeing of residents Provides additional transportation options / redundancy in transportation system during emergency events
	Increased Public Transportation	++	Provides additional lower cost transportation options / redundancy in transportation system Can be utilized as emergency transportation for large populations in the event of evacuations or other major climatic events Promotes connectedness among residents
	Increased use of Alternative Transportation Fuels	()	Allows for lower impact use of current vehicle stock. Facilitates redundancy / diversification of fuel supply
	Increased use of Electric Vehicles	()	Facilitates redundancy / diversification of fuel supply. EV's can potentially be utilized as

			back-up batteries in emergency situations Potentially provide additional stability / resilience of distribution grid if integrated[4]
Climate Shift 3: Emissions Neutral Buildings	New Buildings are Emissions Neutral	++	Improved air tightness reduces wildfire smoke penetration, providing additional protections during wildfire smoke events. Improved insulation moderates internal temperatures during extreme heat / cold events Reduces the financial risk of fluctuating fossil fuel costs and escalating carbon costs
	Retrofitting Existing Buildings to be Emissions Neutral	++	Increases robustness of current building stock Improved air tightness reduces smoke penetration. Improved insulation moderates internal temperatures during extreme heat / cold events Reduces the financial risk of fluctuating fossil fuel costs and

[4] National Renewable Energy Laboratory, Multi-Lab EV Smart Grid Integration Requirements Study: Providing Guidance on Technology Development and Demonstration, May 2015. https://www.nrel.gov/docs/fy15osti/63963.pdf

			escalating carbon costs
	Home Energy Labelling	()	Provides awareness of the risk of fluctuating fossil fuel costs and escalating carbon costs when making home purchases or rental decisions Could align with climate risk labelling / resilience (i.e. labelling of flood / fire risk of properties)
	Improving Industrial Efficiency	()	Industrial operations can remain competitive despite fluctuating fossil fuel costs and escalating carbon costs
Climate Shift 4: Renewable Revolution	Increased use of Solar PV	++	Increased electrical generation redundancy / distributed generation increasing grid resilience Potential reduction in urban heat island effect / internal heating and cooling load from panel shading[5]
	Increased use of Renewable Natural Gas and Hydrogen	()	Facilitates redundancy / diversification of fuel supply Facilitates continued use of current heating systems while

[5] Masson Valéry, Bonhomme Marion, Salagnac Jean-Luc, Briottet Xavier, Lemonsu Aude; Solar panels reduce both global warming and urban heat island. Frontiers in Environmental Science. Volume 2, 2014. https://www.frontiersin.org/article/10.3389/fenvs.2014.00014

			reducing greenhouse gas emissions
	Increased use of District Energy	+	Increased electrical generation redundancy / distributed generation increasing grid resilience Increased energy efficiency, reducing financial risk of fluctuating fossil fuel costs and escalating carbon costs
	Increased use of Electric Heat Pumps (air source and geoexchange)	()	Facilitates diversification of fuel supply.
	Reduction / Utilization of Waste	+	Facilitates redundancy / diversification of fuel supply Waste utilization facilitates development of circular economy, improving local resilience
	Increased use of Energy Storage	++	Can provide emergency power during climatic events that disrupt the electrical system, improving grid stability
Climate Shift 5: Just and Equitable Transition	Energy Efficient Affordable Housing	++	Reduces exposure to fluctuating fossil fuel costs and escalating carbon costs for vulnerable populations who are disproportionately impacted by climate

			change Facilitates inclusiveness within the energy transition; a major pillar of adaptation
	Reducing Energy Poverty	+	Improves the ability and capacity of vulnerable populations to protect themselves during climatic events
	Increasing Access to Green Jobs	++	Improves the ability and capacity of people to protect themselves during climatic events Improves economic resilience Facilitates diversification of the economy
Climate Shift 6: Negative Emissions	Increasing / Maximizing Natural Carbon Sinks	++	Natural carbon sinks reduce the urban heat island effect, filter stormwater, and improve air quality assisting in adapting to climate change
	Negative Emissions Technology	()	Adaptation can be facilitated if deployed on carbon streams that cannot be replaced with renewable technology. Technology is novel, and must be developed and researched further to determine contribution to adaptation

	Use of Carbon Offset Credits	()	Can facilitate continued use of fossil fuels and detract from a shift towards renewable technology options. The type of offset used will determine how it contributes to adaptation (i.e. natural-based carbon offsets provide a larger contribution to adaptation than offsets for industrial efficiency)

* () : Unclear contribution to adaptation
+ : Some potential for negative consequences to adaptation
++ : Little to no known negative consequences to adaptation

CONCLUSIONS AND RECOMMENDATIONS

The interactions between climate mitigation and adaptation are complex, and there are no simple rules to follow to ensure that a mitigation action does not hamper our ability to adapt to climate change. Mitigation actions must be evaluated individually to ensure that they do not result in negative consequences in our ability to adapt to climate change, and weaken our climate resilience overall. Mitigation actions that have the potential to reduce adaptability can be designed and implemented to reduce or eliminate those negative consequences, and a potential negative consequence for our ability to adapt should not alone be a reason to abandon potential mitigation actions.

It will require focused attention on potential negative consequences and good design and development practices of mitigation programs to be successful at building climate resilience. This will require developing these programs with consideration of the local livelihoods, systems, behaviours and culture to ensure that actions are adopted and effective; ultimately leading to growth in Edmonton's climate resilience.

To continue to enhance the City's climate resilience, both in regards to mitigating climate change and adapting to climate change the following actions are recommended:

1. Develop and apply a 'Climate Resilience' evaluation to be included in all council reports to identify the impact of Council decisions on the City's mitigation and adaptation capacity.
2. Consider the impacts of climate change on mitigation actions, and where possible design / develop methods to reduce negative consequences.
3. Rely on the expertise and advice of the Energy Transition Climate Resilience Committee to provide holistic advice on mitigation actions and the impact of climate change on these actions.
4. Explore and prioritize those mitigation actions that have significant co-benefits for climate adaptation and building climate resilience.