CITY OF SURREY
the future lives here.

# CORPORATE REPORT

NO: R193 COUNCIL DATE: **October 7, 2013**

**REGULAR COUNCIL**

TO: **Mayor & Council** DATE: **October 1, 2013**

FROM: **General Manager, Engineering**
**General Manager, Planning and Development**
**General Manager, Parks, Recreation and Culture**
**General Manager, Finance and Technology**
**Manager, Sustainability**

FILE: **0512-02**

SUBJECT: **City of Surrey Community Climate Action Strategy**

## RECOMMENDATION

The Engineering Department, the Planning and Development Department, the Parks, Recreation and Culture Department, the Finance and Technology Department, and the City Manager's Office recommend that Council:

1. receive as information the draft Surrey *Community Climate Action Strategy*, comprised of a *Community Energy and Emissions Plan* and a *Climate Adaptation Strategy,* a copy of which is attached to this report as Appendix "A"; and

2. authorize staff to proceed to the final consultation process for the *Community Climate Action Strategy* as generally described in this report.

## INTENT

This report presents the final draft *Community Climate Action Strategy* (the "Strategy") and seeks authorization to proceed to the final consultation process in relation to the finalization of the Strategy.

## BACKGROUND

In 1998, the City of Surrey became a member of the Partners for Climate Protection Program (PCP) of the Federation of Canadian Municipalities (FCM), a national program that brings Canadian municipal governments together to reduce the local production of greenhouse gas (GHG) emissions and advance sustainable community development.

On September 29, 2008, Council approved the recommendations of Corporate Report No. R175;2008, titled "Surrey Sustainability Charter", thereby approving the Surrey Sustainability Charter as the guiding policy document for the City. The Charter includes a commitment to developing a climate change action plan as follows:

1. Develop strategies and take action to achieve the goals of the BC Climate Action Charter;
2. Expedite the completion of the five milestones in the FCM Partners for Climate Protection process, including the development of a local action plan that minimizes GHG emissions (Milestone 3); and
3. Create an adaptation strategy to deal with the unavoidable impacts of climate change.

In May 2010, to meet the provincial requirements of Bill 27, the *Local Government (Green Communities) Statutes Amendment Act,* the City included the following GHG reduction targets in the City of Surrey Official Community Plan (OCP):

- 33% per capita GHG reduction by 2020, excluding agriculture and industry; and
- 80% per capita GHG reduction by 2050, excluding agriculture and industry.

On December 7, 2010 Council considered Corporate Report No. R251;2010, titled "Application for Funding from the FCM Green Municipal Fund for the Development of a Community Energy and Emissions Plan" and approved the funding application and the development of a *Community Energy and Emissions Plan* (CEEP). Subsequently, the City was successful in securing $225,000 from the Federation of Canadian Municipalities (FCM) and BC Hydro for the development of the CEEP and related work on climate change adaptation.

In 2011, the International Council for Local Environmental Initiatives (ICLEI-Canada – Local Governments for Sustainability) launched a new Climate Adaptation Planning Initiative which offered participating cities the opportunity to plan for anticipated impacts related to local and regional climate change. Participating cities would work in peer groups with facilitation, support, and direction from ICLEI Canada staff. To join the initiative, ICLEI-Canada required a resolution from interested local governments. During its Regular Council meeting of February 28, 2011, Council considered Corporate Report No. R028;2011 and subsequently approved the City's participation in the ICLEI-Canada Climate Adaptation Initiative.

**DISCUSSION**

Strategic action on climate change will strengthen the resilience of our community in the face of what appears to be inevitable change. The City of Surrey has developed two complementary climate action plans that make up the draft Strategy (attached as Appendix A to this report): the *Community Energy and Emissions Plan* (CEEP) provides a guide to reduce community energy spending and greenhouse gas emissions, and the *Climate Adaption Strategy* (CAS) identifies how the City may be vulnerable to climate change impacts and proposes actions to mitigate risk and cost. Together, these two plans reinforce the City's broader efforts toward establishing Surrey as a prosperous and resilient 21st century urban centre.

The global climate is changing rapidly, and the need for local governments and other orders of government to respond has never been greater. Leading scientists have pronounced the warming of the world's climate as "unequivocal" and point to mounting evidence, including rising average air and ocean temperatures, sea level rise, changing precipitation patterns, and extensive melting of icecaps and glaciers worldwide. Post-industrial human activities and the release of GHG emissions into the atmosphere are the primary drivers of these changes. Human-caused GHG emissions increased by an unprecedented 70% between 1970 and 2004 and are likely to continue their upward trend over the coming decades.

While specific events such as storms and flooding cannot be directly linked to climate change, it is clear that the likelihood and severity of these events are increasing:

> *Indeed, while much research is being conducted into whether it is possible to attribute individual extreme events to climate change rather than natural variability, scientists increasingly conclude that the likelihood of events are probably substantially increased by rising global temperatures. It is therefore important to develop this research to strengthen climate science and to use it to improve climate services to help society adapt to climate change (World Meteorological Organization, The Global Climate 2000-2010, WMO-No. 1103, 2013).*

The release of GHG emissions and the resulting impacts on the climate have far-reaching consequences for our economies, our ecosystems and our social well-being. **Mitigation**, or efforts to reduce GHG emissions, is important to limit the extent of climate change that will need to be addressed in the years to come. However, the persistence of GHGs in the atmosphere means we will experience and must **adapt**, or prepare for, some climate change impacts regardless of global efforts to reduce GHG emissions over the coming decades. Mitigation is an insurance policy, while adaptation is a disaster prevention plan.

Local governments have a unique interest and opportunity in planning for a changing climate. Communities are vulnerable to climate change due to an extensive infrastructure supporting high concentrations of people and economic activity. As the level of government closest to community-scale circumstances, municipalities are well-placed to proactively plan for and respond to affected services. Municipalities also have the ability to influence and lead GHG reductions through land use planning (e.g., densification along major transit corridors), energy supply such as local district energy solutions, and buildings through new construction and retrofits of existing buildings. As rising energy costs confound local government efforts to maintain affordability in their communities, reducing energy use will become an increasing priority.

While local governments may have a unique interest or be better prepared to plan for a changing climate as compared to other orders of government, other orders of government will benefit from local governments who plan for a changing climate, as without this planning, industries and infrastructure of regional, provincial and national significance such as railways, highways and ports may be negatively impacted.

**Community Energy and Emissions Plan (CEEP)**

Surrey businesses and residents spend over $1 billion dollars annually, or $2,300 per capita on energy. Given rising fuel prices, spending is projected to double to over $2 billion dollars by 2030. The vast majority of this spending leaves the community. With rising electricity and oil costs, these expenditures – along with the economic vulnerability of many people – will dramatically increase. The conservation, efficiency and renewable energy strategies proposed in the draft CEEP aim to keep a larger portion of these expenditures in the community, stimulating the local economy.

The CEEP is a 25-year planning framework that establishes energy and emissions priorities for Surrey. Based on rigorous energy modeling of alternate policy pathways, the draft Plan includes

policy tools that support desired energy outcomes, including a viable rapid transit network, building retrofit opportunities, and district energy. GHG reduction strategies are proposed in the areas of land use, buildings, transportation, district energy and solid waste.

Following the CEEP launch in July 2011, a Community Energy and Emission Profile was undertaken to provide greater insight into the City's historic and current energy use and associated emissions. The analysis, based on data developed by the Province, shows 2007 community emissions of carbon dioxide equivalent, or $CO_2e$, in Surrey at 2.15 million tonnes or 4.9 tonnes per capita, with 59% of these emissions from transportation, 37% from buildings, and 4% from waste. Population and employment growth in Surrey was also analysed going forward to 2040, in line with regional population projections; population growth was projected at 65%, with employment growth at 102% by 2040.

With the baseline established, an analysis was undertaken regarding the extent to which existing policies would fulfill the GHG reduction target of a 33% per capita reduction by 2020. This analysis looked at a "business as usual" approach that would rely on GHG reductions from actions already committed to by other orders of government, such as improvements to the provincial Building Code or federal tailpipe emissions standards, and assuming no City action. Public and stakeholder events held in 2011 included an Ideas Workshop with stakeholders, a targeted workshop with BC Hydro, and a Youth Forum. An EnergySHIFT panel and public forum was held in February 2012 to update participants on the CEEP development process and better understand public priorities and sensitivities when it comes to reducing GHG emissions.

Two alternative energy futures were then developed based on different land use, transportation, energy supply, building, and waste policies. The impact of these future energy scenarios were evaluated based on their greenhouse gas impact, as well as priorities such as energy savings, economic development, transit supportiveness, and community walkability. With input from a variety of sources on the preferred path with respect to these scenarios, the consulting team then developed draft GHG reduction strategies that were shared with stakeholders at a workshop in October 2012, and then in revised form at sectoral Round Tables hosted in January and February 2013. A public EnergySHIFT Cafe was also held in December 2012 to update the public on the CEEP process and seek broad input on the various topics like land use and transportation. Throughout the Plan development process, a Community EnergySHIFT website and Facebook page were maintained to update the public, share stories, and seek community input.

The strategies proposed in the CEEP align fully with the revisions contained within the new OCP that is nearing completion as well as the City's rapid transit agenda and district energy expansion goals. Strategic directions in the CEEP include the following:

- Complete, compact, connected corridors supporting a high quality rapid transit network and low carbon district energy systems;
- A framework to meet steadily rising building energy standards through capacity building efforts, the exploration of local incentives, and connecting the development community with existing incentives available for energy efficiency;
- Bike infrastructure around and between Town Centres and the City Centre;
- A suite of green car strategies; and
- Initiatives that build on the City's Rethink Waste program.

Significant per capita and community-wide energy and emission reductions are most achievable in metropolitan core areas; however, municipalities beyond the urban core are the most important communities for action as these are the areas experiencing rapid rates of growth. Strategies have been developed in the CEEP to redirect Surrey's energy and emission trajectory: by 2020, achieving a 22% per capita GHG reduction, increasing by 2040 to a 46% per capita reduction with the largest reductions being made across the transportation sector. Annual community-wide energy savings are projected at $736 million by 2040. Technological advances will accelerate further progress towards these targets, including the development and deployment of low-carbon energy sources for district energy systems. These findings and the targets proposed in the draft CEEP are based on a thorough analysis and modelling process. Staff is considering a revision to the OCP GHG reduction targets to reflect these more defensible and accurate targets.

For those actions within the City's direct control or jurisdiction, Appendix B highlights the departmental actions in each of the plans and identifies a lead City Department and supporting Departments for implementation of each action.

**Climate Adaptation Strategy**

Ensuring Surrey is resilient in the face of climate change impacts is critical to ensuring long-term community well-being, environmental health and a continued vibrant local economy. Identifying possible risks and minimizing vulnerabilities and future costs to the City is also financially prudent and supportive of the Sustainability Charter's economic pillar.

In joining the ICLEI-Canada planning process to develop a climate adaptation strategy, the City has worked in peer groups with facilitation, support, and direction from ICLEI Canada staff. Locally, Surrey along with Vancouver, Delta, the City of North Vancouver and Metro Vancouver are participating in the initiative. Each municipality is working to complete the five milestones with their respective staff teams and are working collaboratively where there are issues of regional significance and where sharing insights and approaches benefits all participants. The planning process has followed ICLEI-Canada's five milestone program.

Key goals identified for Surrey's *Climate Adaptation Strategy* include:

- Minimizing risks and vulnerabilities from climate change impacts;
- Maximizing adaptation co-benefits to achieve multiple sustainability goals;
- Building on existing City initiatives to make best use of resources;
- Partnering with key stakeholders to take coordinated and prioritized action;
- Building adaptive capacity to respond effectively to climate change impacts over time;
- Increasing awareness among the public and City staff to build understanding and capacity related to adaptation; and
- Pursuing continual learning to ensure actions remain relevant and based on best practices.

Using the ICLEI framework, staff assessed projected climate impacts in terms of risk. Through this risk assessment process, it should be noted that no 'catastrophic' or 'very high' risk areas were identified for the City. Thus overall and with proactive action, Surrey is in a strong position to prepare and adapt for impact across all sectors.

Goals and actions have been developed for each of the following sectors:

- Infrastructure;
- Flood Management and Drainage;
- Ecosystems;
- Urban Trees;
- Human Health and Safety; and
- Agriculture and Food Security.

Priority actions identified in the *Climate Adaptation Strategy* include the following:

- Supporting the development of a Regional Flood Management Strategy;
- Enhancing data collection and monitoring specific to Surrey;
- Continuing to improve and protect the quality and quantity of habitat;
- Planting tree species for conditions of a future climate;
- Ensuring adequate tree canopy and root space;
- Encouraging passive building design features; and
- Continuing to build community capacity to reduce vulnerability and increase resilience.

For those actions within the City's direct control or jurisdiction, Appendix B highlights the Departmental actions and identifies a lead City Department and supporting Departments for implementation of each action.

As with the CEEP, the draft *Climate Adaptation Strategy* has been developed in consultation with the community, including one-on-one interviews with key stakeholders and targeted workshops held in February 2013 on ecosystems and human health.

**Costs and Jurisdiction**

While municipalities may bear the greatest and most immediate impacts of a changing climate, it is critical that local governments not be forced to bear the administrative and financial burden resulting from these changes.

There are many areas in which local governments have limited administrative jurisdiction. For example, other orders of government have sole regulatory authority over building codes and automobile efficiency standards, and can influence from a financial perspective directions in sectors such as public transit and community energy supply development. On adaptation, the provincial government is responsible for flood and coastal management and will need to play a critical leadership role in managing sea level rise and increased flooding risk. Clearly, collaboration between Surrey, neighbouring municipalities, utilities, and other orders of government will be critical to making a difference on climate change.

A changing climate will have impacts on industries and infrastructure of regional, provincial and national significance such as railways, highways and ports. Other orders of government have the responsibility to ensure that they plan and fund where necessary the planning and construction of infrastructure improvements necessary to protect these investments.

The draft *Community Climate Action Strategy* includes very high level cost categories for many strategies and actions. Some actions will require new funding and others will be completed with

existing resources; some actions will require partnerships with academic institutions or non-profit organizations, and many will require funding from other orders of government.

As both Plans move to the implementation stage, staff will develop detailed a business case and project work plan for each specific action prior to proceeding. Council will be kept apprised of progress. Some of the actions and related costs will be further refined, for example, in City work plans such as in future editions of the Engineering Department's 10-year Servicing Plan.

Monitoring is also an important component of the Strategy and will be undertaken using indicators drawn from the City's Sustainability Dashboard.

**Final Consultations**

The final consultation process for the *Community Climate Action Strategy* will consist of: forwarding the draft Strategy to all stakeholders who have been involved in development of the two component plans; posting the draft plans on the City's sustainability website; using social media and the EnergySHIFT Facebook page to promote review by the community; and forwarding review timelines and appropriate web links through the sustainability quarterly e-newsletter.

The entities to be consulted as part of this process include such groups as:

- BC Landscape and Nursery Association
- Developers and builders
- Surrey Board of Trade and BIAs
- City Advisory Committees
- NGOs, including Surrey Environmental Partners
- Youth representatives, including the Surrey Youth Sustainability Network
- BC Hydro and Fortis BC
- Translink
- Building Owners and Managers Association of BC
- Canadian Homebuilders Association

Following this period of final review and comment, refinements will be made if necessary and the final Strategy should be ready for Council consideration of final adoption in November 2013.

**SUSTAINABILITY CONSIDERATIONS**

All City Departments continue to pursue sustainability initiatives that further the goals of the Surrey Sustainability Charter. The *Community Climate Action Strategy* addresses several of the Actions identified in the Sustainability Charter, as follows:

- EC 8: Energy Security;
- EC 16: Increased Transit and Transportation to Support a Sustainable Economy;
- EN 1: Energy Efficiency;
- EN 2: Waste Reduction;
- EN 9: Sustainable Land Use Planning and Development Practices;
- EN 10: Integrated Community Energy Master Plans; and
- EN11: Surrey's Commitment to the Climate Change Action Plan.

**CONCLUSION**

A draft *Community Climate Action Strategy* has been developed that is fully aligned with other City programs, bylaws and plans, particularly the revised Official Community Plan, the forthcoming Biodiversity Conservation Strategy, and the City's transportation plans and rapid transit agenda.

The draft *Community Climate Action Strategy* outlines how the City can achieve the GHG reduction targets outlined in the OCP. The *Community Energy and Emissions Plan*, which is an element of the Strategy, includes a focus on energy costs and emission reduction co-benefits, and the *Climate Adaptation Strategy* positions the City to effectively manage risk and increase its resilience to the effects of climate change. Surrey's innovative approach brings the two plans forward together and identifies the important cross-linkages between mitigation and adaptation actions.

Based on the above discussion, it is recommended that Council authorize staff to proceed to the final consultation process for the *Community Climate Action Strategy* as generally described in this report.

Vincent Lalonde, P. Eng.
General Manager, Engineering

Laurie Cavan
GM, Parks, Recreation & Culture

Jean Lamontagne
General Manager, Planning & Development

Vivienne Wilke
GM, Finance and Technology

Anna Mathewson
Manager, Sustainability

AM/mc
q:\admin\managers\corporate reports\2013\community climate action strategy - oct 1 2013 am.docx
MC 10/2/13 5:18 PM

Attachments:
Appendix A:
- Community Climate Action Strategy - Overview document
- Draft Community Energy and Emissions Plan (CEEP)
- Draft Climate Adaptation Strategy (CAS)

Appendix B: A list of Actions in the draft CEEP and CAS, identifying the lead City Department and supporting Departments


# Community Climate Action Strategy

## Reducing Emissions and Adapting to Climate Change

CITY OF SURREY
the future lives here.

# A Prosperous and Resilient Community

Strategic action on climate change will strengthen the resilience of our community in the face of inevitable and uncertain change. The City of Surrey has two complementary climate action plans. The Community Energy and Emissions Plan will guide the community in reducing energy spending and greenhouse gas emissions. The Climate Adaptation Strategy will guide the community in reducing vulnerability to climate change impacts. Together, these two plans reinforce the City's broader efforts at establishing a prosperous and resilient 21st century urban centre.

Taking action is more than just reducing our GHG emissions and preparing for stranger weather. A community that is resilient to climate change has a localized economy, strong and healthy ecosystems, a great transit network, tight-knit neighbourhoods and a strong social fabric; it is walkable, energy efficient, and can thrive through disruptions such as rising energy and food prices or a natural disaster. Through proactive action in Surrey, we can achieve these goals and simultaneously realize a host of community benefits, including economic development, community health and wellness, affordability, and liveability.

The global climate is rapidly changing, and the need for communities to respond has never been greater. Leading scientists have pronounced the warming of the world's climate as "unequivocal" and point to mounting evidence, including rising average air and ocean temperatures, sea level rise, changing precipitation patterns and extensive melting of icecaps and glaciers worldwide. Post-industrial human activities and the release of greenhouse gas (GHG) emissions into the atmosphere are the primary drivers of these changes. Human-caused GHG emissions increased by an unprecedented 70% between 1970 and 2004 and are likely to continue their upward trend over the coming decades. The global atmospheric concentration of carbon dioxide alone has increased from a pre-industrial value of about 280 parts per million (ppm) to 383 ppm in 2007.

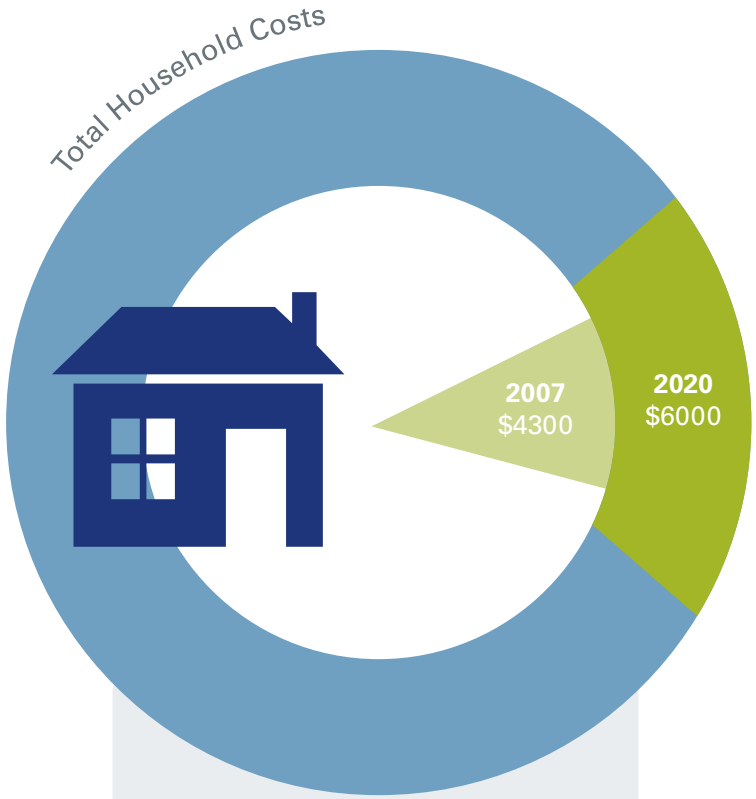
While climate change is global, the local impacts in different regions of the world vary widely. Climate changes projected for Surrey over the long term include:

- Sea level rise and associated erosion, flooding and disturbance of natural and built environments;
- Hotter, drier summers with more high temperature events and droughts impacting human health, ecosystems, water security and agriculture;
- Increased frequency and intensity of rain and wind events causing flooding and disturbance of natural and built environments;
- Increased risk of forest fire, adversely impacting local air quality, human safety and the built environment; and
- Local implications from disruptions in other parts of the world such as rising prices and periodic constraints in agricultural production.

## Why does this matter to communities?

Local governments have a unique interest and opportunity in planning for a changing climate. Communities are vulnerable to climate change due to an extensive infrastructure supporting high concentrations of people and economic activity. Over the coming decades, municipalities will contend with the challenges of extreme weather events, water shortages, rising sea levels, and community health issues exacerbated by climate change. As the level of government closest to community-scale circumstances, municipalities are well-placed to proactively plan for and respond to affected services.

Municipalities also have the ability to influence and lead GHG reductions through land use planning, energy supply such as local district energy solutions, and buildings. As rising energy costs confound efforts to maintain affordability in communities, reducing energy use will become a higher priority.




*Projected increase in Surrey's annual household energy costs*

*The cost of property damage from natural catastrophes has doubled every 5 to 10 years in Canada (Insurance Bureau of Canada, 2003)*

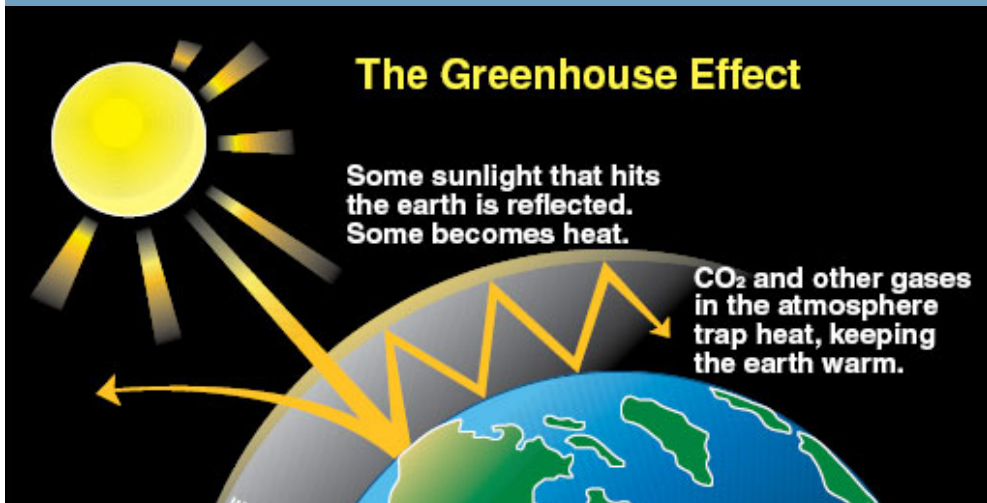
While municipalities may bear the greatest and most immediate impacts of a changing climate, there are many areas in which local governments have limited jurisdiction. Senior levels of government, for instance, have sole regulatory authority over building codes and automobile efficiency standards, and far greater financial authority in sectors such as public transit, community energy supply development, and flood protection infrastructure.

This makes the need for collaboration between Surrey, neighbouring municipalities, utilities, and senior levels of government critical to making a difference on climate change.

## The Greenhouse Effect and Climate Change

Greenhouse gases (GHGs) including carbon dioxide, methane and water vapour occur naturally in the atmosphere, maintaining a temperature that has been favourable for ecosystems and human civilization for 10,000 years. This is the natural greenhouse effect.

Burning oil, coal and gas for energy and clearing forests for cities and agriculture has accelerated the release of carbon dioxide into the atmosphere. Methane emissions have increased from livestock and decomposition of solid waste in landfills. Increased presence of these gases has created an enhanced greenhouse effect. This effect has trapped more heat in the atmosphere, leading to climatic changes such as shifting precipitation patterns, intensifying storms, increasing floods and droughts, reducing snow packs and glaciers, and rising sea levels. Deep GHG reductions will allow us to avoid the most serious consequences of climate change.



## Avoid the Unmanageable and Manage the Unavoidable

The release of GHG emissions and the resulting impacts on our climate have far-reaching consequences for our economies, our ecosystems and our social well-being. Mitigation, or efforts to reduce GHG emissions, is critical to limit the extent of climate change we have to deal with in the years to come. However, the persistence of GHGs in the atmosphere means we will experience and must adapt, or prepare for, some climate change impacts regardless of global efforts to reduce GHG emissions over the coming decades. Mitigation is an insurance policy; proactive adaptation is a disaster prevention plan.

Taking action on climate change therefore requires both mitigation and adaptation. Mitigation is essential to "avoid the unmanageable", while adaptation concurrently aims to "manage the unavoidable." Moreover, a strategic, proactive effort to reduce emissions and plan for anticipated impacts is fiscally prudent, and more cost effective than taking no action.

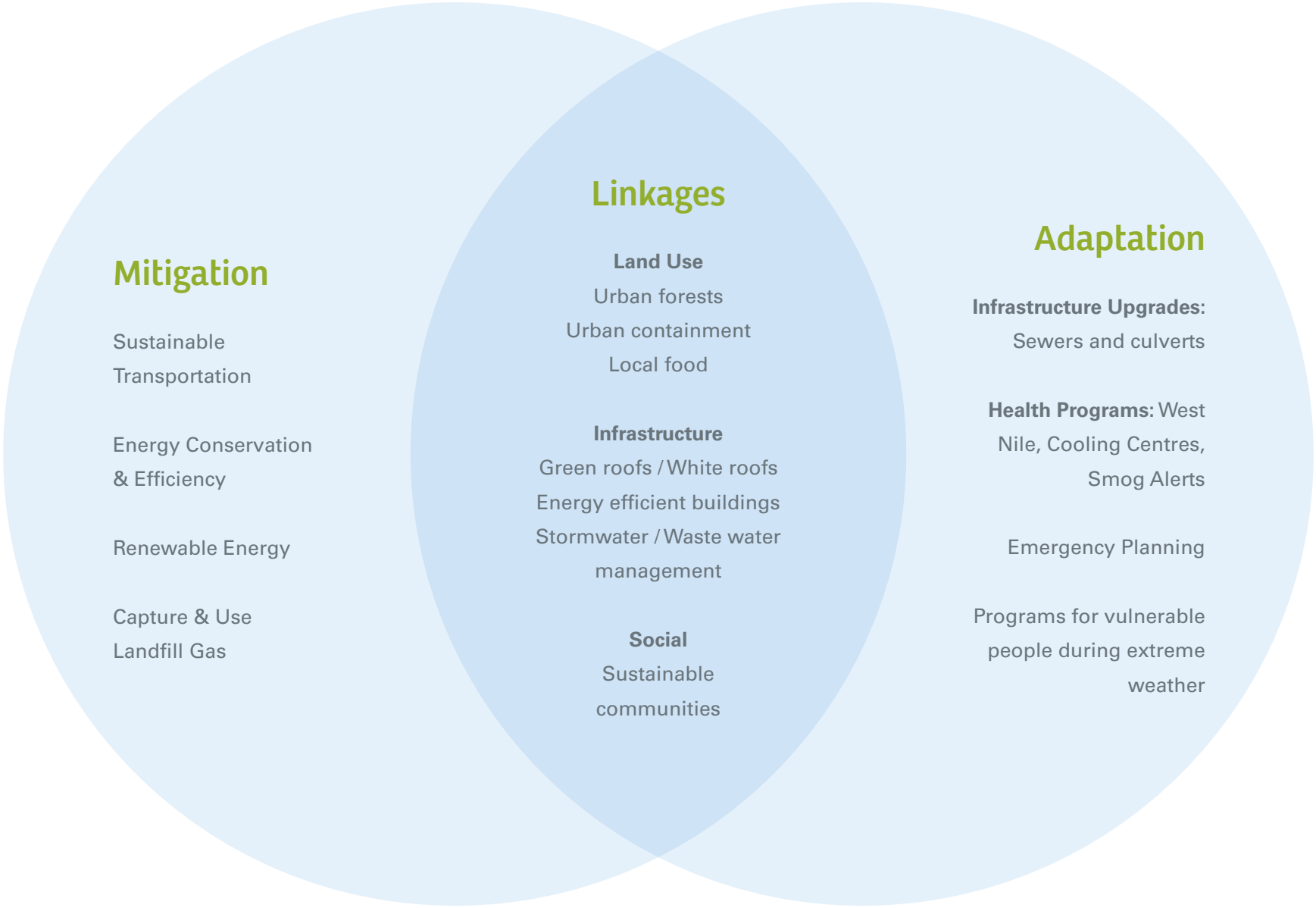
Adaptation and mitigation activities have the potential to be mutually supportive, but require careful planning to ensure strategies do not undermine each other. For example, there are different options to keep people cool as summer temperatures increase. One option would be to increase the installation of air conditioning systems, but the added energy use would be in conflict with the mitigation objective to decrease GHG emissions. By contrast, increasing tree canopy, vegetative cover, and green roofs in the City also has a cooling effect, and acts to make buildings more energy efficient. In this way, the latter option is supportive of both mitigation and adaptation goals.

Adaptation: the initiatives or measures to reduce the vulnerability of human and natural systems to the actual or anticipated effects of climate change.

Mitigation: human intervention to reduce the sources or enhance the sinks of greenhouse gases.

*The Economics of Climate Change report authored by former World Bank Chief Economist Nicholas Stern concluded that "the benefits of strong, early action on climate change outweigh the costs".*

# The Linkages Between Mitigation and Adaptation



# Climate Action in Surrey

Over the past decade, the City of Surrey has increasingly been integrating sustainability into policy, planning and daily business in both corporate operations and the broader community.

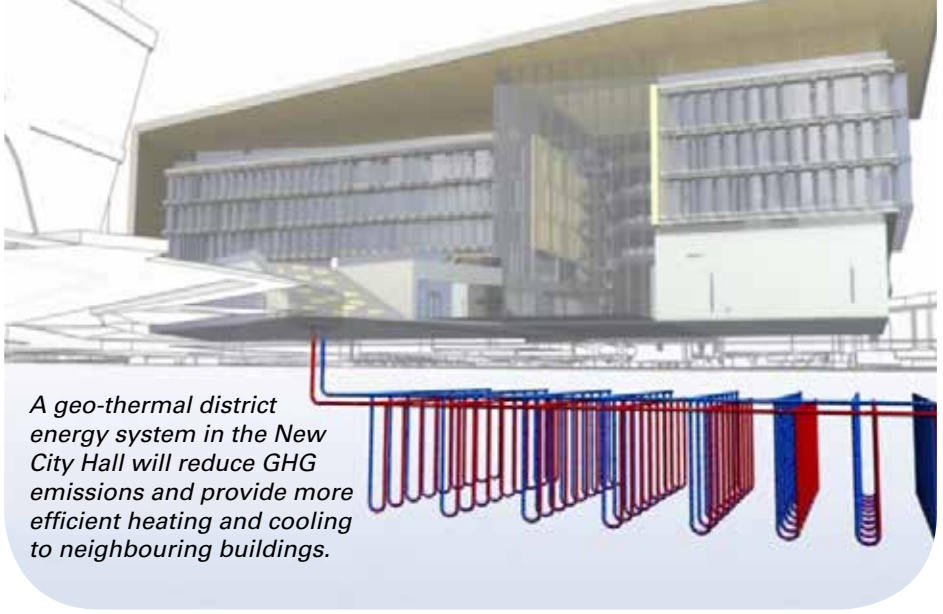
In 2007, the City of Surrey became a signatory to the Province of British Columbia's Climate Action Charter committing to create "complete, compact, more energy efficient" communities and to make progress towards carbon neutrality in its corporate operations.

In September 2008, Surrey City Council unanimously adopted the Sustainability Charter, a comprehensive framework for implementing a progressive, long-term 50-year vision for a Sustainable City. The Sustainability Charter includes a commitment to complete the five milestones in the Federation of Canadian Municipalities' (FCM) Partners for Climate Protection (PCP) program, including developing a local action plan to minimize GHG emissions. A further Sustainability Charter commitment was to create an adaptation strategy to deal with the unavoidable impacts of climate change.

The City has undertaken numerous plans and programs to reduce energy use and GHG emissions across the community. Some of the highlights include:

- Surrey City Centre Community Energy Plan (2007)
- Integrated Energy Master Plan for the Semiahmoo Town Centre (2008)
- Community GHG Reduction Targets in Official Community Plan (2010)
- Creation and co-funding of a Community Energy Manager position with BC Hydro
- Surrey becomes a Solar Community (2010)
- Climate Smart partnership for businesses (2010-2012)
- City Centre Energy Utility created for geo-exchange based district energy (2011)
- Walking Plan (2011)
- Rethink Waste program and organics collection for single family homes (2012)
- Cycling Plan (2012)
- Student Climate Change Outreach & Education (ongoing)

*The new Maple Drainage Pump Station in Crescent Beach improves drainage and reduces the risk of flooding.*



*A geo-thermal district energy system in the New City Hall will reduce GHG emissions and provide more efficient heating and cooling to neighbouring buildings.*

Surrey's strategies for adaptation also aim to build on or complement existing policies and plans that the City has in place. Many of the City's existing initiatives align with or explicitly address climate change adaptation, including:

- Crescent Beach Climate Change Adaptation Study;
- Serpentine / Nicomekl Lowlands Flood Control Plan;
- Development within the Nicomekl and Serpentine River Floodplain Policy;
- Nicomekl and Serpentine Sea Dam Upgrades Options Report;
- Serpentine, Nicomekl and Campbell Rivers – Climate Change Floodplain Review;
- Rainfall Trending Analysis for the City of Surrey;
- Ecosystem Management Study and the Biodiversity Conservation Strategy (forthcoming);
- Natural Areas Management Plan (includes the Vegetation Management Strategy, Tree Hazard Management Strategy, and Fire Management Strategy);
- Community Wildfire Protection Plan;
- Shade Tree Strategic Management Plan (forthcoming) and
- Agriculture Protection and Enhancement Strategy

# Surrey's Community Energy and Emissions Plan and Climate Adaptation Strategy

Two Plans are presented here that form Surrey's Community Climate Action Strategy: the Community Energy and Emissions Plan (CEEP) and the Climate Adaptation Strategy.

As a Plan to reduce energy use and greenhouse gas emissions in key sectors across the community, the goal of the CEEP is to establish Surrey as a model community in the areas of energy supply, reliability, sustainability and climate responsibility. The CEEP provides guidance on how to move towards meeting the ambitious community-wide GHG reduction targets as outlined in Surrey's Official Community Plan. The Plan also encourages local job creation and community re-investment; promotes vibrant, healthy neighbourhoods; and helps residents and businesses proactively address rising energy cost. Strategies are identified to reduce emissions in five areas: land use, buildings, energy supply, transportation, and solid waste.

As part of adaptation strategy planning, Surrey has taken part in a Climate Adaptation Initiative organized by ICLEI Canada – Local Governments for Sustainability. The collaboration has offered participating cities the opportunity to plan for anticipated impacts related to local and regional climate change. Surrey's Climate Adaptation Strategy identifies actions to increase resilience in six areas: infrastructure, flood management and drainage, ecosystems and natural areas, urban trees and landscaping, human health and safety, and agriculture and food security.

# Community Energy and Emissions Plan and Climate Adaptation Strategy Linkages

Strategies have been developed to reduce GHG emissions and simultaneously increase Surrey's resilience to climate change impacts. These mutually reinforcing actions are categorized into five areas:

## Ecosystem Protection, Hazard Avoidance & Compact Land Use

Focusing growth into dense urban land uses allows for the protection of green space, which can strengthen the resilience of ecosystems and improve stormwater management. Directing growth away from hazardous areas like floodplains and steep slopes also reduces exposure to impacts from climate change. Focused growth enables compact, transit-oriented communities which leads to lower transportation and building GHGs.

## Ecosystem Health and Carbon Sequestration:

Healthy trees and ecosystems provide free ecosystem services such as improving water and air quality, providing shade and wind protection, reducing erosion and soil loss, and mitigating flood and stormwater runoff. These natural services increase resilience to climate impacts such as increased rainfall and warmer summer temperatures. They also play an important climate change mitigation role by absorbing carbon from the atmosphere.

## Heat Management and Passive Solar:

Many passive solar strategies designed to improve thermal performance and reduce GHGs (e.g. trees, reduced asphalt, improved insulation and green roofs) also help reduce the urban heat island effect and moderate health risks during heat waves.

## Community Energy Supply and Self-sufficiency:

Increasing storms, rainfall variability, and shrinking snowpack are projected to lead to more disruptions of traditional supplies of hydroelectricity, natural gas and gasoline. Investing in community-based energy systems such as district energy, as well as local, renewable energy supplies such as geo-exchange and biomass, increases resilience to a fluctuating energy supply, while reducing GHG emissions.

In addition, more frequent intense weather events including floods, droughts and storms have the potential to temporarily or permanently disrupt global supply chains with cost implications for imported commodities, particularly food and energy. Increasing self-sufficiency and efficiency in these areas increases resilience in the local economy and reduces GHG emissions associated with transportation.


*Community energy plant*

The following pages provide a summary of the goals and strategies in Surrey's Climate Adaptation Strategy and Community Energy and Emissions Plan respectively, as well as a matrix of where these two climate action efforts are mutually supportive.

## Climate Adaptation Strategy Strategy Summary and Mitigation Linkages

| Climate Adaptation Strategy Goals by Sector | Ecosystem Protection, Hazard Avoidance, and Compact Land Use | Ecosystem Health and Carbon Sequestration | Heat Management and Passive Solar Design | Community Energy Supply and Self-Sufficiency |
|---|---|---|---|---|
| **Cross-Cutting Actions** | | | | |
| Reinforce the Implementation and Enforcement of City Policies and By-laws that Support Resilience | | | | |
| Educate and Engage Surrey Residents and Staff on Climate Impacts and Solutions | | | | |
| **Flood Management and Drainage** | | | | |
| Reach Consensus on a Regional Approach to Flood Management | ✔ | | | |
| Update Planning and Development Guidelines for Floodplains | ✔ | | | |

| Climate Adaptation Strategy Goals by Sector | Ecosystem Protection, Hazard Avoidance and Compact Land Use | Ecosystem Health, Carbon Sequestration | Heat Management, Passive Solar Design | Community Energy Supply, Self-Sufficiency |
|---|---|---|---|---|
| **Infrastructure** | | | | |
| Deliver Proactive Climate Analysis and Management Practices for City Infrastructure | | ✓ | | |
| Support the Design of Climate-Resilient Buildings in Surrey | | | ✓ | ✓ |
| Advance Energy Self-Sufficiency Within the Community | | | | ✓ |
| **Ecosystems and Natural Areas** | | | | |
| Maximize Space for Habitat and Species Migration | ✓ | ✓ | | |
| Actively Manage City's Ecological Assets | ✓ | ✓ | | |
| Support Viability of Highly Sensitive Ecosystems | ✓ | ✓ | | |
| Protect Ecosystem Services Through Development | ✓ | ✓ | | |
| **Urban Trees and Landscaping** | | | | |
| Provide the Required Growing Environment to Sustain Trees | | ✓ | ✓ | |
| Plant Appropriate Species | | ✓ | ✓ | |
| Increase Tree Maintenance Management | | ✓ | ✓ | |

| Climate Adaptation Strategy Goals by Sector | Ecosystem Protection, Hazard Avoidance and Compact Land Use | Ecosystem Health and Carbon Sequestration | Heat Management and Passive Solar Design | Community Energy Supply and Self-Sufficiency |
|---|---|---|---|---|
| **Agriculture and Food Security** | | | | |
| Provide Appropriate Infrastructure for Agricultural Viability | | | | ✔ |
| Encourage Greater Diversity in Local Products and Growing Methods | | | | ✔ |
| Increase Food Self-Sufficiency in the City and Region | | | | ✔ |
| Help Farmers Build Capacity to Adapt | | | | ✔ |
| **Human Health and Safety** | | | | |
| Collaborate with Key Partners on Improving Population Health | | | | ✔ |
| Minimize the Urban Heat Island Effect | | | ✔ | |
| Minimize Risks from Urban-Wildland Interface Fire | ✔ | | | |
| Build Emergency Response Capacity at the City | | | | ✔ |

# Community Energy and Emissions Plan Strategy Summary & Adaptation Linkages

| Community Energy and Emissions Plan Strategies by Sector | Ecosystem Protection, Hazard Avoidance and Compact Land Use | Heat Management and Passive Solar Design | Community Energy Supply and Self-Sufficiency |
|---|---|---|---|
| **Land Use** | | | |
| **General Land Use Strategies** | | | |
| A. Focus Growth | ✔ | | ✔ |
| **Cross-Sectoral Strategies** | | | |
| B. Complete, Compact, Connected Corridors | ✔ | | ✔ |
| C. Compact and Live/Work Housing | | | |
| D. Low Carbon Development Permit Areas | ✔ | ✔ | ✔ |
| E. ENERGYShift Pilot Neighbourhood | ✔ | ✔ | ✔ |
| F. Sustainable Development Checklist | ✔ | ✔ | |

| Community Energy and Emissions Plan Strategies by Sector | Ecosystem Protection, Hazard Avoidance and Compact Land Use | Heat Management and Passive Solar Design | Community Energy Supply and Self-Sufficiency |
|---|---|---|---|
| **Transportation** | | | |
| **Public Transit Strategies** | | | |
| A. Rapid Transit Development | ✔ | | ✔ |
| B. Bus Service Improvements | | | ✔ |
| **Active Transportation + Demand Management** | | | |
| C. Integrated Active Transportation Infrastructure | | | ✔ |
| D. Bicycle Infrastructure Improvements | | | ✔ |
| E. Pedestrian Infrastructure Improvements | | | ✔ |
| F. Transportation Demand Management | | | ✔ |
| **Low Emission Vehicles** | | | |
| G. Green Fleet Management + Vehicle Efficiency | | | ✔ |
| H. Car Sharing Promotion | | | ✔ |
| I. LEV Infrastructure Development | | | ✔ |

| Community Energy and Emissions Plan Strategies by Sector | Ecosystem Protection, Hazard Avoidance and Compact Land Use | Heat Management and Passive Solar Design | Community Energy Supply and Self-Sufficiency |
|---|---|---|---|
| **Buildings** | | | |
| **Cross-Cutting Building Strategies** | | | |
| A. Capacity Building for High Efficiency Buildings | | ✔ | ✔ |
| **Existing Buildings** | | | |
| B. Third Party Retrofit Program Integration | | ✔ | ✔ |
| C. Affordable Housing Energy Retrofit Strategy | | ✔ | ✔ |
| **New Construction** | | | |
| D. Third Party Incentive Promotion | | ✔ | ✔ |
| E. Local Incentive Program Development | | ✔ | ✔ |
| F. Basic Building Standards Strategy | | ✔ | ✔ |
| **District Energy** | | | |
| A. City Centre District Energy Extension | | | ✔ |
| B. New Node & Corridor Evaluation | | | ✔ |
| C. Detailed Policy, Planning & Promotion | | | ✔ |
| **Solid Waste** | | | |
| a) Zero Waste Residents, Businesses, and Institutions | | | |
| b) Zero Waste Construction and Deconstruction | | | |
| c) Sr Government Sustainable Packaging + Extended Producer Responsibility | | | |
| d) Sustainable Planning & Design for Energy Recovery from Waste | | | ✔ |

# CONCLUSIONS

These two climate action plans form Surrey's Community Climate Action Strategy, fulfilling key commitments made in the Sustainability Charter and under the Partners for Climate Protection Program. The City is taking an innovative, integrated approach in bringing these two Plans forward together, and identifying ways to better link mitigation and adaptation efforts.

The Community Energy and Emissions Plan outlines how the City will move towards the GHG reduction targets as outlined in the Official Community Plan; it identifies critical initiatives to reduce energy consumption and spending,  and limit GHG emissions in the areas, transportation, buildings, waste and energy supply and land use. The Climate Adaptation Strategy provides a framework for managing the uncertainty and risks of future climate change impacts, so that the City becomes more resilient to these changes.

The Community Climate Action Strategy will lead to a range of community benefits beyond reduced emissions and energy use, including economic development, community health and wellness, affordability, and liveability. The strategic actions outlined in the respective plans will further reinforce the City's broader efforts at establishing a prosperous and resilient 21st century urban centre.

BC hydro powersmart

FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS
GREEN MUNICIPAL FUND
FONDS MUNICIPAL VERT

# ACKNOWLEDGEMENTS

The City of Surrey received financial assistance to prepare the Community Climate Action Strategy from the Federation of Canadian Municipalities (FCM) Green Municipal Fund. Further assistance to prepare the Community Energy and Emissions Plan was provided by BC Hydro.

The preparation of this strategy was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

## Contact Us

**CITY OF SURREY**
**Sustainability Office**

**604.591.4128**
**sustainability@surrey.ca**

## City of Surrey Mayor and Council

MAYOR
DIANNE WATTS

COUNCILLOR
TOM GILL

COUNCILLOR
BRUCE HAYNE

COUNCILLOR
LINDA HEPNER

COUNCILLOR
MARVIN HUNT

COUNCILLOR
MARY MARTIN

COUNCILLOR
BARINDER
RASODE

COUNCILLOR
BARBARA STEELE

COUNCILLOR
JUDY
VILLENEUVE

www.surrey.ca/sustainability

FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS
GREEN MUNICIPAL FUND
FONDS MUNICIPAL VERT

BC hydro powersmart

CITY OF SURREY
the future lives here.

# Surrey Community Energy & Emissions Plan

CITY OF SURREY
the future lives here.

August 2013
Draft Final Version 3.0

# Acknowledgements

Under the guidance of Council, the Sustainability Office managed the development of the Plan with the active involvement of an Interdepartmental Steer Committee.

## Financial Support & Guidance

The generous support of the Federation of Canadian Municipalities Green Municipal Fund, and the BC Hydro Sustainable Communities Group has supported significant analysis and engagement for developing the *Community Energy & Emissions Plan*.

## Public and Stakeholder Engagement

Input from public, private and social sector stakeholders as well as many local citizens and businesses contributed greatly to this Plan. Please see the appendices for further details.

## Advising

Alex Boston, Bud Fraser, Micah Lang, Aaron Licker, Megan Shaw and Sean Tynan with Golder Sustainable Communities led analysis, engagement, and policy development across all sectors. Alex Charpentier and Mike Hommenuke with Kerr Wood Leidal assisted with district energy analysis. John Steiner with Urban Systems was a transportation advisor.

Cover Image: Century Group

# Executive Summary

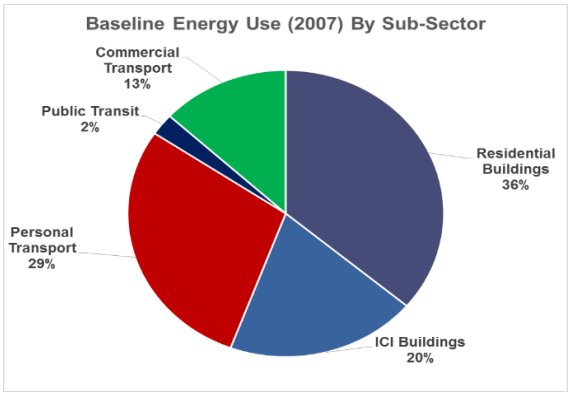
This Plan tackles the twin challenges of climate change and energy insecurity. Short-term actionable strategies reinforce diverse core community priorities.


The Plan builds on and makes recommendations to existing City policies to strengthen climate and energy integration into ongoing municipal business activity. The Plan maximizes synergy with a complementary Climate Adaptation Strategy.

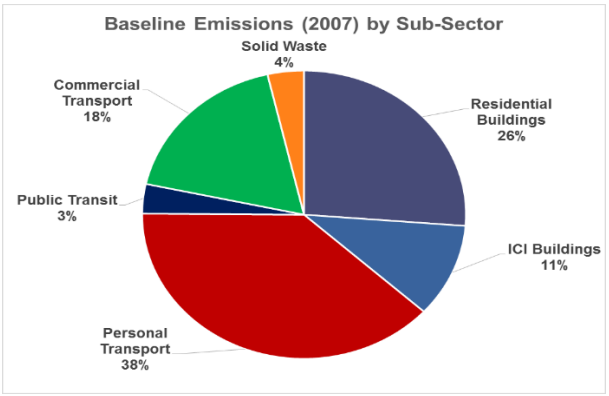
## Current Energy & Emissions Context

Over the period of this Plan, Surrey's population will rise from 560,000 to 740,000. Surrey's future is of fundamental interest to energy utilities, transportation agencies, and waste managers in British Columbia. Surrey's rapid growth and sheer size make it the single largest municipal player shaping future building and transportation energy demand, and waste volumes in the province. Surrey activities register on province-wide meters. By mid-century, Surrey will be BC's largest city. Surrey's *Community Energy & Emissions Plan* can constrain demand at smart meters, gas pumps, and traffic lights.

A slight majority of community-wide energy consumption is concentrated in the buildings sector. Because of the province's hydroelectric dominated grid a majority of greenhouse gas emissions is in transportation.




Energy Use by Sector and Sub-Sector




Emissions by Sector and Sub-Sector

In the base year, 2007, businesses, residents and institutions generated 2 billion tonnes of carbon dioxide equivalent ($CO_2e$) and consumed 42.5 million gigajoules of energy across its buildings, transportation activity and solid waste.

In 2007 average per capita GHGs was 4.9 tonnes per year. This per capita emission performance is not significantly different from the municipal average across the region:

- Per capita emissions are similar to most municipalities in the region.
- Building emissions are lower due to younger stock and less commercial floor space per capita.
- Transportation emissions are higher due to a disproportionately high share of short haul freight vehicles, and longer distances travelled by personal automobile for work and services.
- Transit and active transportation trips are lower due to lower transit services, and less proximate employment and services.

If no action is taken by the City and senior governments, total emissions would rise 30% from 2007.

In 2007, total energy consumed cost residents, businesses and institutions amounted more than $1 billion. If no action is taken to manage energy and emissions, community-wide spending would rise to $2 billion by 2030, and more than 2.5 billion by $2040.

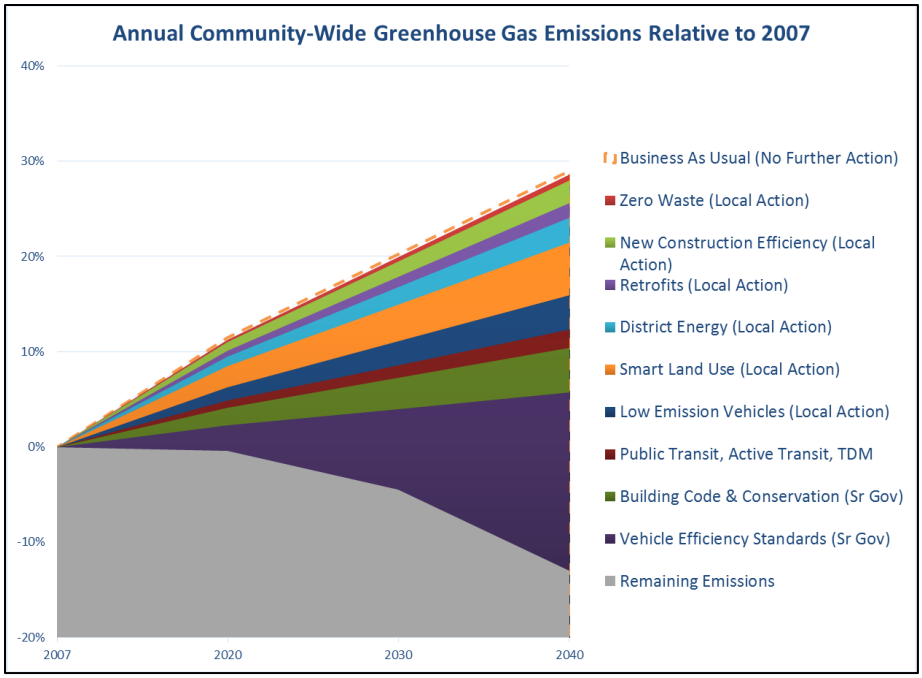
In 2007, less than 1% of households spent 10% or more of their household income on energy. Due to steadily rising building and transportation fuel costs, and stagnant household income growth, almost 20% of Surrey households are expected to spend more than 10% of their household income on energy in 2020. This will alter most families' spending behavior, but could have significant negative implications to lower and lower middle income families.

## Strategic Directions

The Plan's strategic directions include:

- **Complete, compact, connected corridors** to support a high quality **rapid transit network** and a constellation of **low carbon district energy systems,** building on the City's transportation, land use and district energy policy and planning excellence.
- All ages and abilities **bike infrastructure** around and between town centres and city centre to reduce congestion, support safe, cost effective transport, and promote physical fitness, complementing the City's growing active transportation investment.
- A **building energy retrofit agenda** to reduce energy spending, support housing affordability, and create jobs.
- A suite of **green car strategies** to support low emission vehicles, vehicle electrification, car sharing, and commercial fleet cost and carbon management, complementing the City's innovations in alternative transportation fuels.
- **A framework to meet steadily rising building energy standards**, delivering long term energy savings to homes and businesses, and improved building durability and occupant health and comfort.
- Guidance to build on the city's **zero waste agend**a with specific strategies for residential, commercial, institutional, and construction sector markets.

Implementing these strategies will require a concerted effort by Council and staff, as well as active engagement with residents and businesses, the construction industry, community stakeholders, and, critically, partnerships with provincial and federal governments, utilities and TransLink.




**Emission Reduction Wedges from 2007:** 50% cuts in GHGs relative to Business As Usual are achieved through a suite of municipal strategy wedges and senior government action.

## Future Energy & Emissions

Implementing the strategies in this Plan will support cutting greenhouse gas emissions in half on a per capita basis from 2007, and by 41% on a total community wide basis relative to a future with no action taken to manage energy and emissions. The greatest emission reductions are across the transportation sector: -60% on a per capita basis and -30% on a community wide basis relative to 2007 levels. Annual, community-wide energy savings are projected to be 20% below the Business As Usual future in 2030 or $360 million in savings, and 30% below BAU or $736 million by 2040.

## Strategy & Target Summary

Strategies are organized across six sectors, supported by a section on cross cutting institutional priorities. Key targets are established for each sector. On a community wide basis, the Plan has two targets:

- Reduce per capita residential GHGs 50% by 2040 and 20% by 2020
- Reduce per capita energy consumption 33% by 2040 and 20% by 2020

**Land Use** strategies focus mixed use growth in town centres and corridors. Greenfield development uses leading sustainability practices. Diverse housing types a support diverse households and incomes. Strategies support higher efficiency buildings, transit, walking and cycling.

### Strategies

- Focus Growth and Green Greenfields
- Complete, Compact, Connected Corridors
- Compact and Live/Work Housing
- Low Carbon Development Permit Areas
- Pilot Sustainable Energy Neighbourhood
- Sustainable Development Checklist Update

### Key Target

- Increase resident walking distance to transit 20% by 2040 and 10% by 2020

**Transportation** strategies build on the land use plan to support a high quality rapid transit network, extensive active transportation infrastructure, and diverse low emission vehicle opportunities for residents and businesses. These strategies accelerate a transition to attractive, low carbon transportation options.

### Public Transit Strategies

- Rapid Transit Development
- Bus Service Improvements

### Active Transportation + TDM Strategies

- Integrated Active Transportation Infrastructure
- Bicycle Infrastructure Improvements
- Pedestrian Infrastructure Improvements
- Transportation Demand Management

### Low Emission Vehicle Strategies

- Green Fleet Management + Vehicle Efficiency
- Car Sharing Promotion
- LEV Infrastructure Development

### Key Targets

- Reduce personal vehicle driving distances 7% by 2040 and 4% by 2020.
- Increase bicycle route kilometres 70% by 2040 and 33% by 2020.

**Building** strategies aim to build the capacity of staff and the construction industry to meet steadily rising building standards and increase energy retrofit rates primarily in more affordable residential buildings.

### Cross-Cutting Building Strategies

- Capacity Building for High Efficiency Buildings

### Existing Building Strategies

- Third Party Retrofit Program Integration
- Affordable Housing Energy Retrofit Strategy

### New Construction Strategies

- Third Party Incentive Promotion
- Local Incentive Program Development
- Basic Building Standards Strategy

### Key Targets

- Increase annual retrofit rate of existing buildings to 2% from 1%
- Improve energy performance beyond typical new construction by 10% from 2015-2040

**District Energy** strategies build on the corridor and node focused land use development strategies to support extension of City DE utility services within City Centre and to contiguous high potential areas, and the evaluation of opportunities in other higher density nodes for diverse business models.

### Strategies

- City Centre District Energy Extension
- New Node & Corridor Evaluation
- Detailed Policy, Planning & Promotion

### Key Target

- Targets under development

**Solid Waste** strategies continue with existing policies and plans to reduce total waste, increase recycling rates and virtually eliminating organics from landfills with specific strategies for residential, commercial, institutional, and construction sector markets.

## Strategies

- Zero Waste Residents, Businesses & Institutions
- Zero Waste Construction & Deconstruction
- Sustainable Packaging & Extended Producer Responsibility
- Sustainable Planning & Design for Energy Recovery from Waste

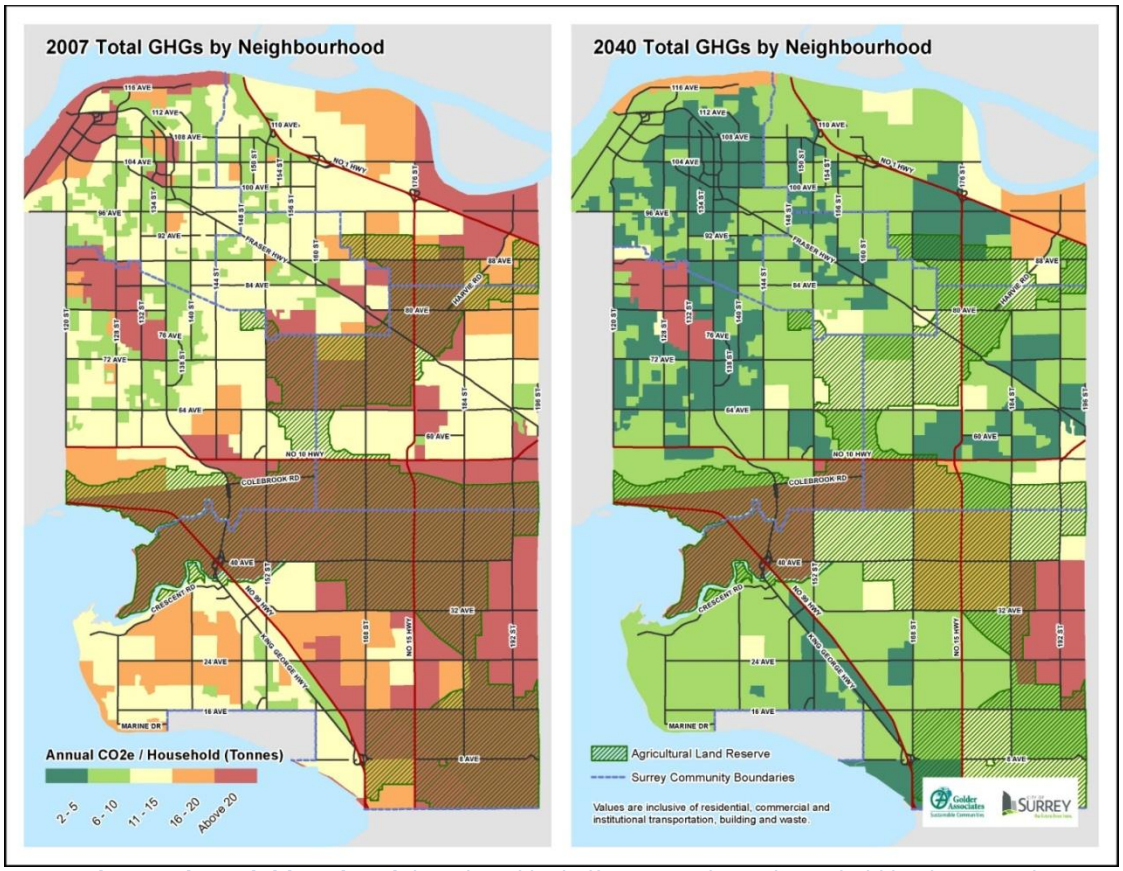
## Key Target

- Divert 75% of solid waste to recycling and composting by 2020 and 85% by 2040

**Cross Cutting Strategies** support implementation and foster alignment within the municipality, and amongst key stakeholders.

## Strategies

- Low Carbon Sustainability Lens
- Carbon Pricing Revitalization & Clean Air and Healthy Communities Fund
- Community & Corporate Carbon Management Integration




**Total GHGs by Neighbourhood**, is reduced by half measured on a household basis. Complete, compact, transit and pedestrian oriented neighbourhoods have the lowest carbon intensity.

# Table of Contents

# I Context

Part I establishes the situational context for the *Community Energy & Emissions Plan's* strategies, including a vision and goals, core priorities to support and climate change adaptation synergies, a discussion of the relevance of climate change and energy to communities, provincial and local action to date, and finally an energy and emission profile for the base year.

## 1 Introduction

For more than a century Surrey has been a way point through which British Columbia's defining economic, social and environmental activity has moved. First Nations and traders went up the Fraser River; furs came down. Prospectors went up Yale Road; gold came down. Forest, mining, and agricultural products moved East and West across the Northern Railway. Goods moved North and South along the Pacific Highway. Today, Surrey is becoming an important destination for one of this century's most vital economic, social, and environmental priorities: low carbon, sustainable energy.

### 1.1 Vision

Surrey's *Community Energy & Emissions Plan* vision:

> *Surrey will advance sustainable energy and low carbon solutions that support the long-term health, affordability, prosperity, and mobility of residents, businesses and institutions. Where we live and work and how we move around will become increasingly efficient. How we use and dispose of resources will become increasingly smart. We will support energy generation that is more resilient to changes in energy commodity prices and disruptions to traditional energy systems. We will work with public, private, academic and social sector organizations to advance innovative and pragmatic opportunities. Our efforts will improve community liveability and regional air quality while making an important contribution to global climate protection.*

### 1.2 Goals

The *Community Energy & Emissions Plan* has several inter-related goals:

- Lay out short-term actionable strategies and provide direction over a long term 2040 horizon.
- Support the City's Sustainability Charter, and complement core community priorities through the strategies.
- Provide direction for integrating strategies with climate change adaptation.
- Provide a base year energy and emission profile.
- Develop strategies to address the following objectives:
  - minimize energy demand and greenhouse gas emissions (GHGs) in buildings and transportation systems, and promote low carbon energy supply;
  - provide direction for land use planning that supports energy and GHG management in these sectors;
  - reduce waste GHGs.
- Build on and make recommendations to existing City policies so as to best integrate climate and energy into ongoing municipal business activity.

- Develop defensible targets for emission reductions over a medium term 2020 horizon and long term 2040 horizon and provide relevant indicators to support detailed planning, implementation and monitoring.

## 1.3 Surrey's Challenge & Opportunity

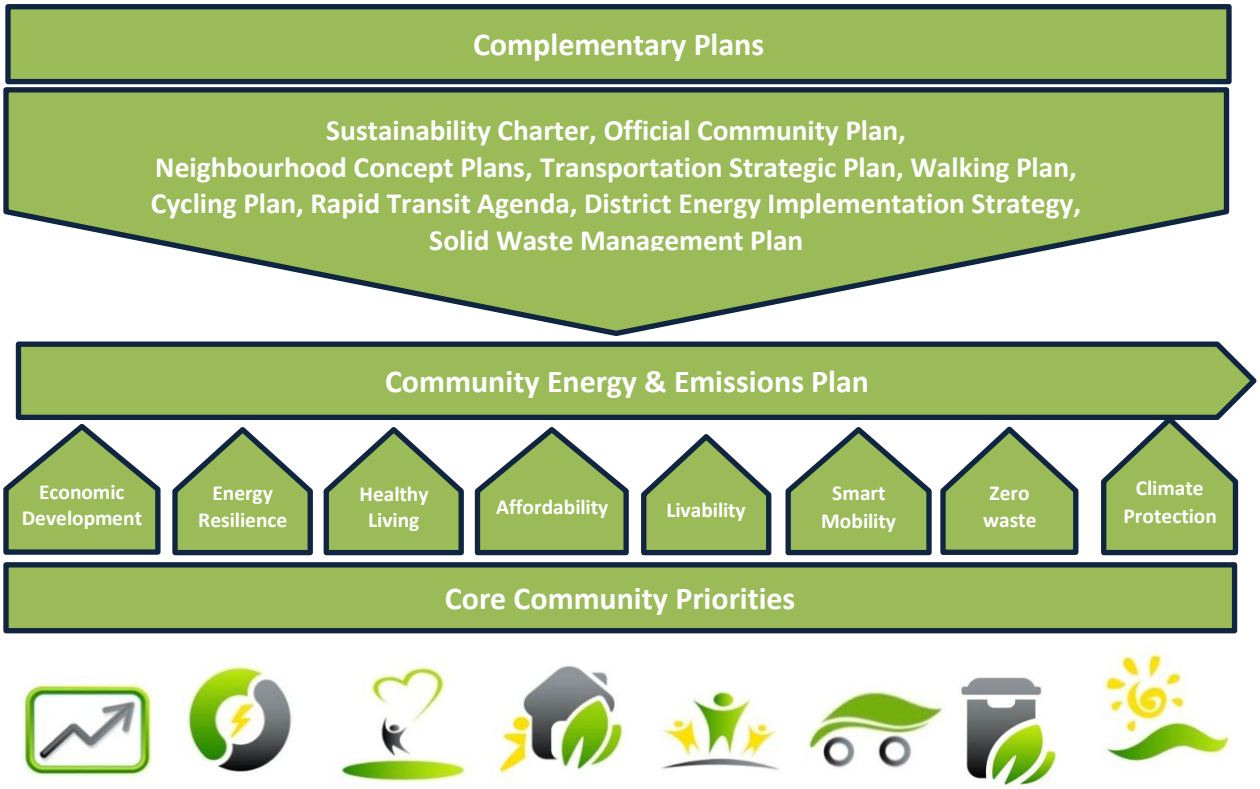
Surrey's future is of fundamental interest to energy utilities, transportation agencies, and waste managers in British Columbia. Surrey's growth projections and sheer size make it the single largest municipal player shaping future building and transportation energy demand, and waste volumes in the province. Surrey activities register on province-wide meters. Surrey's *Community Energy & Emissions Plan* can constrain demand on smart meters, at fuel pumps, and traffic lights.

Decoupling population and job growth from energy consumption, waste and greenhouse gases is a long-term challenge for the City that will be addressed by good policy and planning, embracing technological innovation, collaborating within and beyond the community, and committing to action.

As a rapidly growing and relatively young city, Surrey is representative of a shift in the locus of metropolitan activity across North America. It is in communities like Surrey that the vast majority of growth is occurring. Surrey aims to make an important contribution to the sustainable nature of growth in these new cities.

## 1.4 Strategic Policy Context

Surrey's Community Energy & Emission Plan shapes, and is in turn, shaped by some of the City's most important policy and planning activities.



The plan consolidates action in each pillar of Surrey's Sustainability Charter. Eight core community priorities are addressed:

- **Economic Development:** Building energy retrofits and local, low carbon energy generation creates jobs; a significant portion of dollars from avoided energy spending stimulates the local economy;
- **Energy Resilience:** Lower transportation costs, more efficient housing and smart, neighbourhood energy systems increase resilience to changing energy supplies and prices;
- **Healthy Living:** Walkable neighbourhoods improve health outcomes, and low emission vehicles and reduced car dependency improves air quality;
- **Affordability:** Walkable, transit-supported neighbourhoods and energy efficient homes reduce long-term household expenditures;
- **Community Liveability:** Complete, compact development and good design strengthens the social and economic vitality of our neighbourhoods ;
- **Smart Mobility:** Quality transit, good walking, biking and road network design, green cars and focused commercial and residential growth supports efficient transportation;
- **Zero Waste:** A sustainable solid waste and resource management agenda can complement GHG reduction and energy resilience; and
- **Climate Protection:** Low carbon land use, transportation, buildings and waste management reduces climate change impacts locally, regionally and globally.

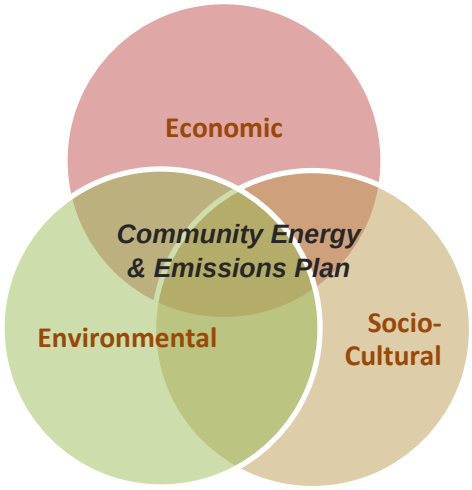



**Figure 1: Community Energy & Emission Plan nested within the Sustainability Charter**

# 2 Report Structure

This Plan is organized into three major parts, in addition to a set of appendices.

## Part I: Context

Part I establishes the context for the *Community Energy & Emissions Plan*.

- The *Vision, Goals* and *Strategic Context* are articulated
- The *Methodology* for developing the Plan is described, including an overview of the modeling and mapping and key engagement activities
- *Climate, Energy and Our Community* provides an overview of these twin challenges and their relevance to community with a major focus on community energy vulnerability due to rising energy prices. The provincial and local policy context is discussed.
- Opportunities for *Climate Change Mitigation and Adaption Integration* are identified.
- Surrey's current *Energy and Emissions Profile* is analyzed.

## Part II: Taking Action

Part II is the essence of the Plan.

- An *Energy and Emission Forecast* discusses the impact of the major strategy wedges on a community wide and sectoral basis, and delineates the Plan's key targets.
- This is followed by a delineation of strategies that includes essential background analysis, along with targets and indicators, organized under six sections:
  - *Land Use*
  - *Transportation*
  - *Buildings*
  - *District Energy*
  - *Solid Waste*
  - *Cross Cutting Strategies*

## Part III: Implementation Framework

Part III provides implementation and monitoring guidance.

- A multi-criteria *Prioritization Matrix*
- An *Implementation Framework* with high level resource and timeline information.
- *Monitoring and Indicator Tables* to support detailed implementation planning and monitoring

## Section IV: Appendices

Select reference and background materials are provided as appendices.

- References
- Engagement Activity Participation
- District Energy Technical Memorandum
- BC Hydro Power Conservation Analysis
- Detailed Modeling Methodology

# 3 General Methodology

This Plan was developed with active engagement amongst the City and key stakeholders, rigorous analysis, and innovative policy and planning. A summary of the CEEP development process is described below in Figure 1. CEEP Development Process Overview

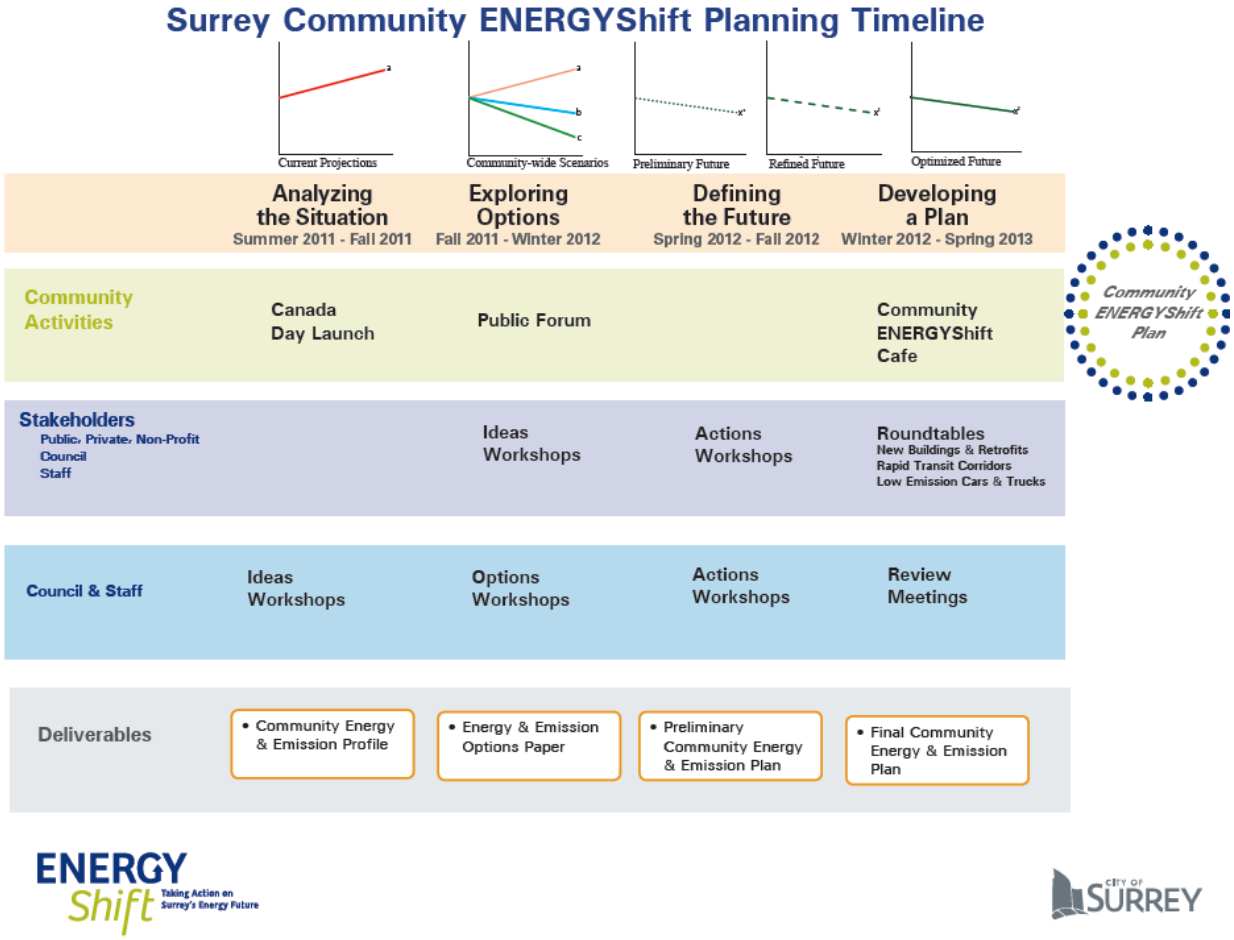



**Figure 2: Community Energy & Emissions Planning Process Overview**

The Plan was developed over four phases. This is followed by a description of the engagement, modeling and mapping processes.

## Phase I: Analyzing the Situation

During the first phase, the project team worked with City staff and the project steering committee to examine existing activities, community priorities, challenges and opportunities. The key deliverable was the *Community Energy and Emission Profile* which provided a baseline understanding of current energy and emissions performance and understanding of major variables driving and constraining growth.

## Phase II: Exploring Options

The Plan's second phase focused on exploring options. This involved strategic "big picture" thinking to develop several broad scenarios comprised of strategies that could be led by the City. A public forum, staff workshops and Council consultation were held to further examine community priorities and

brainstorm strategies. The key deliverable was a *Community Energy & Emission Plan Options Paper* outlining several distinctive futures, largely defined by intensity of effort. As well as the energy and emission implications, the major strategy bundles were subjected to a multi criteria analysis so they could be evaluated across each scenario.

## Phase III: Defining the Future

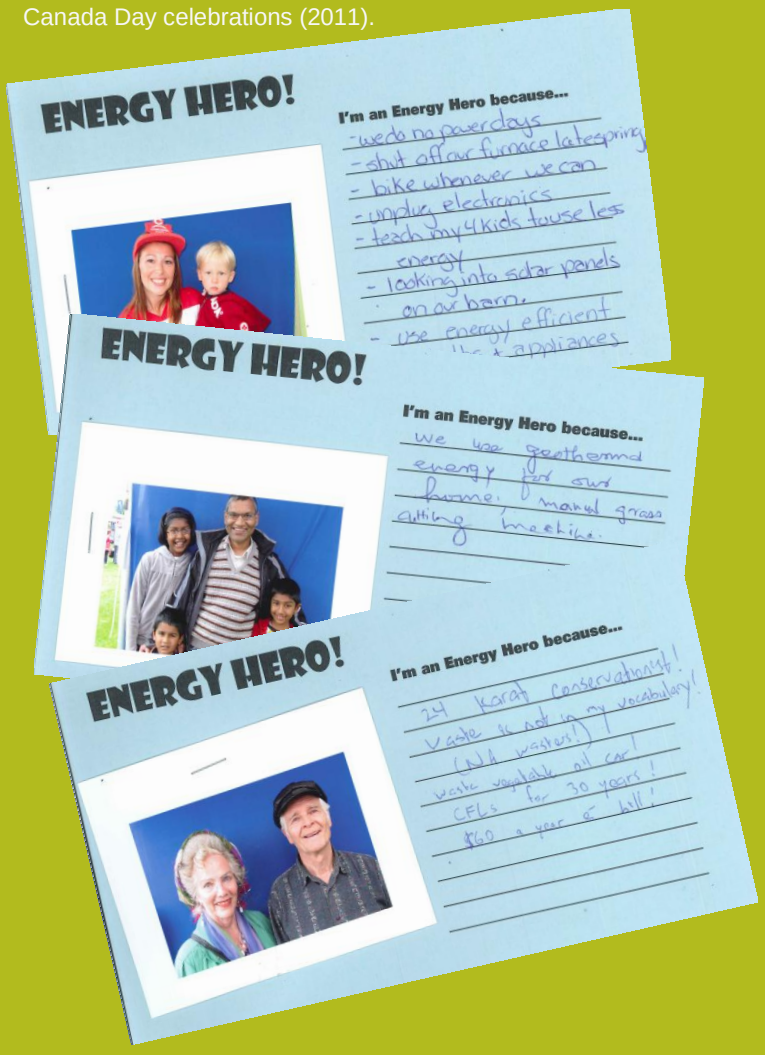
The third phase consolidated previous work into a set of draft strategies which were reviewed iteratively with the public, key stakeholders, City Council, and City staff. This phase led to a set of draft *Community Energy & Emissions Plan* strategies.

## Phase IV: Developing a Plan

The final phase focused on strengthening and finalizing the Plan. Roundtables were held with key stakeholders including BC Hydro, Fortis BC, TransLink, Metro Vancouver, members of the construction and development industry, other government agencies, local businesses and associations, and non-profits involved in green buildings and transportation. The project committee and key City staff then refined the priority and implementation framework while the project team updated strategies and re-calculated the energy and emission implications to provide a final projection. During this phase the project team finalized the *Community Energy & Emissions Plan*.

### Local Energy Heroes

As well as hearing about what the City could do, hundreds of Surrey residents told us about their heroic efforts to save energy at Canada Day celebrations (2011).



## 3.1. Key Public and Community Stakeholder Engagement Activities

**In July, 2011,** the City kicked off engagement at Surrey's Canada Day celebration. Thousands shared their thoughts on City priorities to support sustainable energy.

**In September and October, 2011**, the City organized workshops with key stakeholders to identify high level strategies and priorities to inform the Plan's development. A youth focused event solicited strategy ideas and a vision for a low carbon community. Youth

**In February, 2012**, over 100 people attended a Panel Discussion and Open House. Participants indicated a high degree of support for energy retrofit programs, renewable energy and increased efficiency in new buildings, high speed transit, active transportation infrastructure, and low emission vehicles.

**In December, 2012**, Surrey residents were invited to refine and supplement actions that would actively involve residents across the community in managing GHG emissions.

**In January, 2013**, the City collaborated with BC Hydro to host roundtables with local businesses, commercial-transportation-oriented companies, builders, developers and the construction industry.

**Figure 5:** Surrey residents share their thoughts on sustainable energy over mixed drinks – bike-powered smoothies – at Canada Day, 2011.

**Figure 5:** More than 100 people attended an Open House, Panel, and Discussions in January, 2013. Moderated by CBC's Mark Forsythe, panelists were (left to right): Penny Priddy (Surrey Board of Trade Social Policy Committee), Nimal Rajapakse (Simon Fraser University Dean of Applied Sciences), Nancy Olewiler, (TransLink Board Chair), and Gordon Price (Simon Fraser University City Program),

**Figure 5:** The City hosted several workshops to gain input from the public, staff, and key stakeholders in developing the Community Energy & Emissions Plan.

## 3.2. Technical Analysis: Modeling & Mapping Summary

Golder's Community Energy and Emissions Modeling and Planning tool CEEMAP was used to project future energy and emissions. CEEMAP uses several dynamic, interactive modules that incorporate quantitative assumptions about strategies to estimate energy use and greenhouse gas emissions across a neighbourhood, community or region. CEEMAP integrates inputs from the following categories:

- Socio Economic Data, e.g. residential and employment population.
- Land Use & Community Design, e.g. location and density of commercial and residential buildings.
- Transportation Technology & Patterns, e.g. number and type of automobiles, transit routes and frequency.
- Building Type & Performance, e.g. single detached or multi family home type, building energy rating, retrofit rate.
- Heat & Electricity Supply, e.g. electricity from grid or other, specific district energy technology, building-scale.
- Solid Waste Management, e.g. waste composition and mass, management practice.

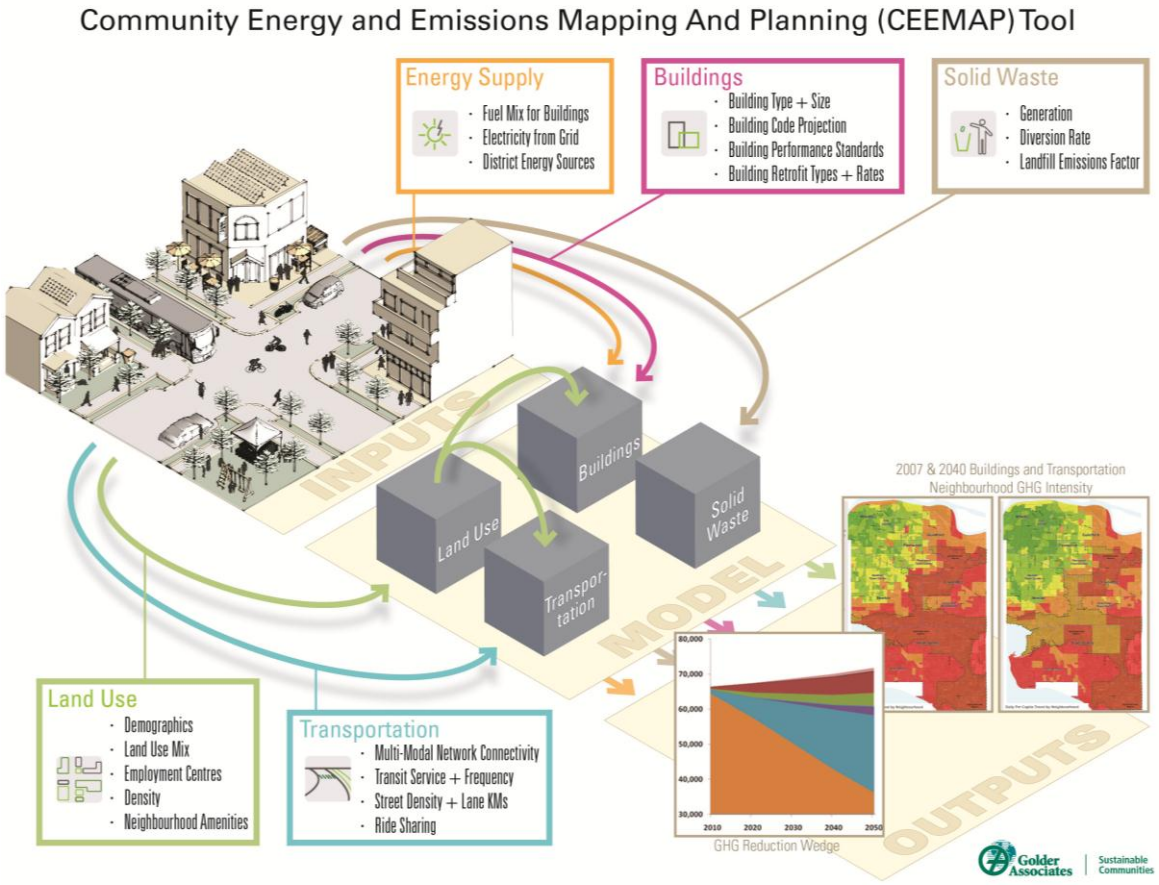



**Figure 6: Graphical Representation of Golder's CEEMAP Tool**

To start the process, a baseline model is populated using values for the year for which the best data is available. In this case 2007 is used – the year from which Surrey will measure achievement of its greenhouse gas reduction targets.

Values for these indicators are then projected into the future based on the type and intensity of strategies that the City is planning to implement. For example, a building retrofit strategy would change the energy performance of a specific number of existing buildings per year by a specific amount. A ride share strategy would change the number of vehicles travelling to specific destinations. [1]

CEEMAP then uses empirically-derived knowledge of the relationship (i.e. function) between these indicators (i.e. model inputs) to calculate changes energy and emissions changes (i.e. model outputs) at future milestone years (in this case at 2020 and 2040).

As well as changes to energy use and greenhouse gas emissions, CEEMAP generates other outputs such as vehicle kilometres travelled by neighbourhood and across the community and building energy consumption by neighbourhood. Additional outputs developed by the tool include illustrative charts and maps.

Because so many indicators influencing energy and emissions in transportation and buildings as well as energy supply are influenced by location, current and future conditions are graphically shown using maps generated through Geographic Information Systems (GIS).

See *Detailed Technical Modeling Methodology* in the *Appendix* for a more detailed description of the model inputs and their energy and emission relationships.

## Targets

Targets help organizations meet their strategic priorities. They help muster the intellectual, financial and social resources necessary to advance a strategy as well as monitor progress and, in turn, make coarse adjustments.

Local Government Act requirements to include GHG reduction *targets, policies and actions* in Official Community Plans have given much greater stature to community GHG targets. At the same time, the urgency of our energy security and climate stabilization challenges will ultimately demand more defensible and strategic quantitative evaluation of strategies by all levels of government.

This planning process has generated targets and indicator values used in the modelling process. These targets and the associated indicator values can be refined and updated over time as more detailed planning and implementation work is undertaken for specific strategies.

[1] CEEMAP also considers the impact of senior government policies on community activity. BC Building Code updates, for example, will change the energy rating of future buildings, and vehicle Tailpipe Standards will change the performance of future vehicle stock.

# 4 Climate, Energy and Our Community

The twin challenges of climate change and energy security have significant global and local implications.

## 4.1. Climate Change Challenges

The relative stability of the earth's climate over the last 10,000 years has allowed human civilization to flourish. However, through burning oil, coal, and gas, and by clearing large tracts of land for housing, forestry and agriculture, humans have increased carbon dioxide concentrations in the atmosphere to levels not seen for at least 650,000 years. These heat-trapping gases are contributing to an incremental rise in global temperatures disrupting natural and physical systems upon which human health and prosperity depend. The most recent International Panel on Climate Change (IPCC) report concluded that global emissions need to peak before 2015, with 50-85% reductions below 2000 levels by 2050 to avoid tipping points that will cause "dangerous" disruptions to the atmosphere, such as severe agricultural collapses, water shortages, droughts and sea level rise (IPCC, 2007).

The economics are also increasingly clear. Commissioned by the British Government and authored by former World Bank Chief Economist Nicholas Stern, the Economics of Climate Change estimated the costs of reducing greenhouse gas emissions to a safe level were one percent of global gross domestic product; compared to a loss of up to 20% of global GDP if we do nothing. Stern concluded that 'the benefits of strong, early action on climate change outweigh the costs' (HM Treasury, 2009). Communities are vulnerable to climate change due to an extensive infrastructure supporting high concentrations of people and economic activity. Insurance Bureau of Canada data show costs of property damage from natural catastrophes doubling every 5 to 10 years and has attributed much of this growth to climate change (Insurance Bureau of Canada, 2003). From floods to fires and windstorms, BC communities have been experiencing higher and higher costs. Many local governments have begun to realize that when disaster strikes, they are on the front lines.

Changes projected in Surrey include:

- Sea level rise and associated erosion, flooding and disturbance of natural and built environments.
- Hotter, drier summers with more high temperature events and droughts impacting human health, water security and agriculture.
- Increased frequency and intensity high rain and wind events causing flooding and disturbance of natural and built environments.
- Increased risk of forest fire in or near Metro Vancouver, adversely impacting local air quality.
- In addition, the community will experience the local implications from disruptions in other parts of the world such as rising prices and periodic constraints in agricultural production.

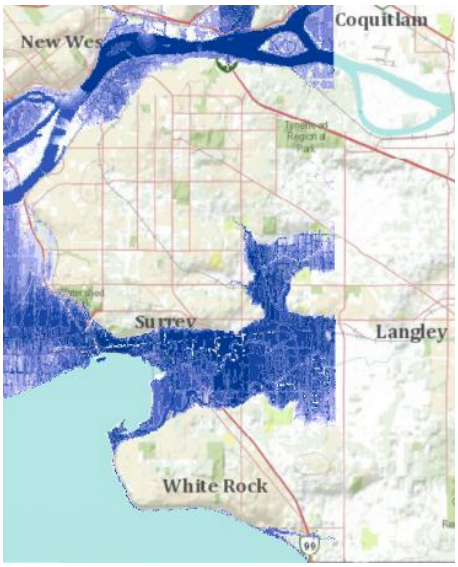



**Figure 7: Surrey's Floodplain** will grow due to sea level rise. This is a high level 2100 projection **(BC Ministry of Environment, 2011)**. Parts of the community are already at risk during intense rainfall, snowmelt, high tide, and storm events or a combination of thereof. The *City's Climate Adaptation Strategy* has prioritized flood risk mitigation as a high priority.

### The Greenhouse Effect & Climate Change

Greenhouse gases including carbon dioxide, methane and even water vapour occur naturally in the atmosphere maintaining a temperature that has been conducive for ecosystems and human civilization to flourish for 10,000 years. This is the natural greenhouse effect. Burning oil, coal and gas for energy and clearing forests for cities and agricultural has released an additional 30% carbon dioxide into the atmosphere since the beginning of the industrial revolution. Methane emissions have also increased from livestock and decomposition of solid waste in landfills. The increased presence of these gases has created an enhanced greenhouse effect. This greenhouse effect has trapped more heat in the atmosphere leading to climatic changes such as shifting precipitation patterns and intensifying storms leading to floods and droughts; reducing snow packs, glaciers and sea ice leading to rising sea levels, hydro-electric insecurity; changing ecosystems allowing pine bark beetles to endure warmer winters. Deep GHG reductions will enable people and the planet to avoid the most serious consequences of climate change.

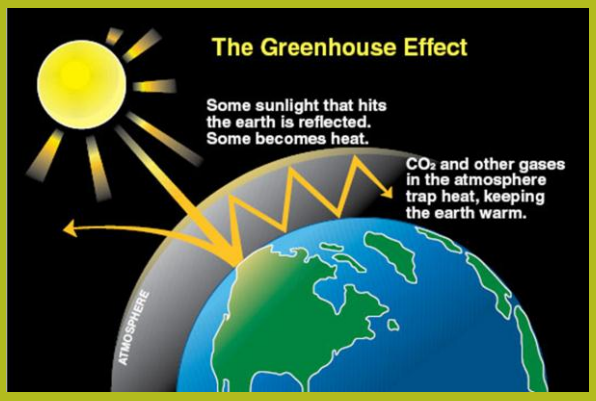



**Figure 8 The Greenhouse Effect** (University of Washington).

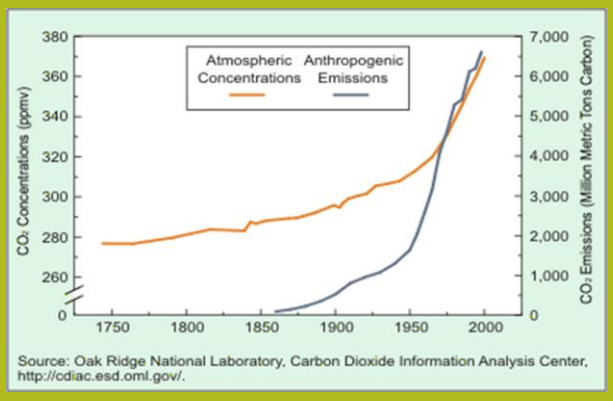



**Figure 9 Trends in Atmospheric Concentrations and Anthropogenic (human generated) CO2 Emissions** (Oak Ridge National Laboratory, US DoE)

## 4.2. Energy Security Challenges

Energy inputs to our economy and society have dramatically risen over the last half century. Virtually everything we consume and do in our communities depends on industrial energy systems. The International Energy Agency expects global energy demand to increase 45% by 2030. While traditional energy resources will continue to be available for a long time, costs for most fuels are projected to rise due to the rising cost of production, and rising demand. (BC Hydro, 2012) (US Department of Energy/Energy Information Administration, 2013)

- Oil prices are projected to rise from the current price of $95 a barrel to $115 to $136 per barrel by 2025 (rising 20-40%).
- Natural gas prices are expected to rise from current prices of $3.50 to $4.00 per million BTUs to $5.7 to $6.5 per million BTUs (rising 63-86%).
- Provincial electricity rates are projected to rise from current prices of $30 per MWh to $60 per MWH by 2025 (rising 100%)

The volatility in oil and natural gas prices expected by most industry and government sources is potentially worse than rising energy costs. These fluctuations create uncertainty about the future, compromising budget forecasting and long term planning for many institutions, including municipalities, businesses, households, transportation authorities, utilities.

Additionally, many conventional feedstocks are also vulnerable to climate changes such as growing variability and unpredictability in hydro-electric reservoir levels from changes in precipitation patterns to refinery disruptions in coastal areas due to coastal storm events (Intergovernmental Panel on Climate Change, 2007).

## 4.3. Local Energy Vulnerability

At the household level, energy spending is projected to rise 7% per annum. When combined with household income growth – rising at only 2% per annum -- energy spending growth will have significant implications for households and communities. In the Plan's base year, less than 1% of households spent 10% or more of their household income on energy. By 2020, almost 20% will.

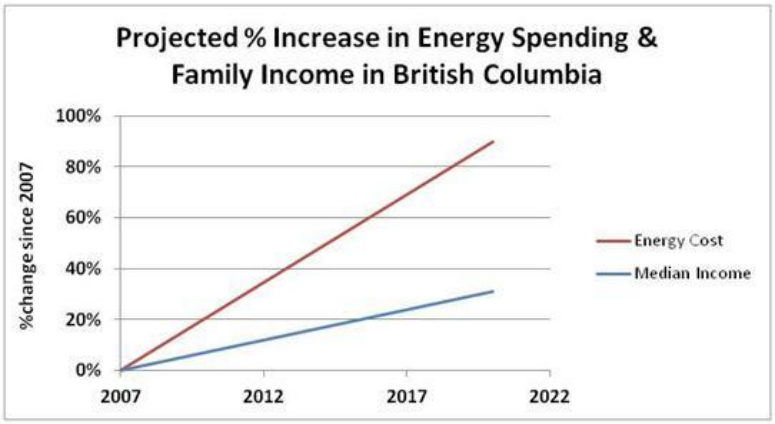



**Figure 10: Project Increase in Energy Spending Relative to Household Income** Total energy spending is projected to rise 7% per annum while household income is projected to rise 2% per annum. **(BC Hydro, 2012) (US Department of Energy/Energy Information Administration, 2013)** Household income estimates are based on historical trend from 2002 to current projected forward (BC Stats). Prices are in nominal dollars.

Under these circumstances, high income households may reduce travel and luxury good spending. Medium income households may to eat out less and alter food and transportation choices. Low income households may confront health implications, eating less and cheaper foods, and potentially reducing home heating, below healthy levels.

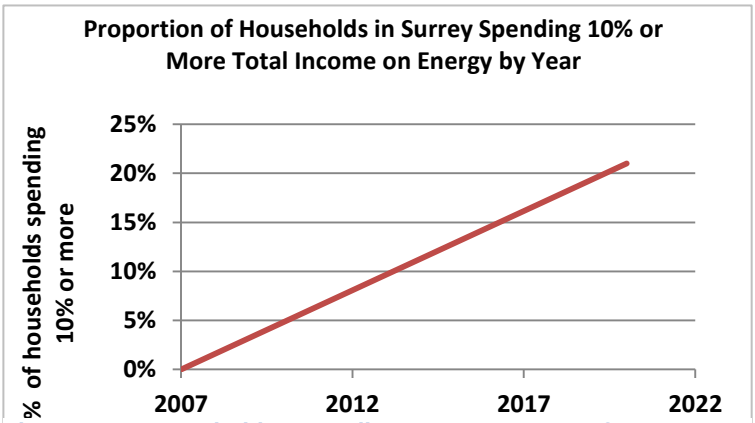



**Figure 11: Households Spending 10% or more of Income on Energy**: this share rises from under 1% in the base year 2007 to almost 20% in 2020.

Over the longer term, rising energy vulnerability could affect where people work and eventually where they live (e.g. smaller, more energy efficient homes close to transit). Low to medium income households in large houses in car-oriented neighbourhoods far from jobs will be more vulnerable than equivalent income households in smaller dwellings in transit oriented developments.

Because fuel-related energy spending has lower local benefit relative to most other household expenditures, local economic activity will decline. Businesses that benefit from discretionary spending such as restaurants, entertainment services, book stores and health clubs, will be most impacted. Low income workers in these sectors could be doubly impacted, reducing purchasing power first and work weeks second. Homeowners with tight budgets risk mortgage default and foreclosure with significant implications to lenders and the broader economy.

## 4.4. Provincial Carbon & Energy Policy Context

In light of the scientific evidence on the dangers of climate change, the BC Government announced in 2007 a commitment to reduce provincial GHG emissions 33% below current levels by 2020 and 80% by 2050. While a number of factors influenced these specific target levels, fundamentally these are the magnitude of reductions necessary at a global level to avoid dangerous, runaway climate change.

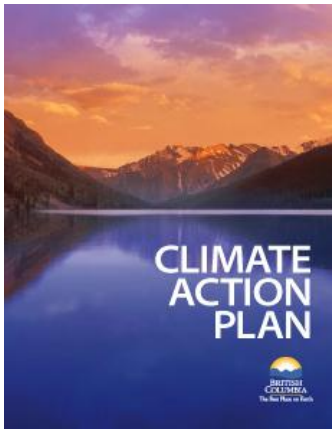
This commitment reinforced work by BC Hydro and several provincial ministries to accelerate energy performance improvements in new construction and conservation in existing buildings motivated by growing power supply shortfalls, marketplace changes, as well as climate change concerns.

These developments have driven a series of policy and planning changes that are playing out at the community level, influencing builders, developers, home and business owners, and certainly municipalities. While carbon and energy management priorities may wax and wane, the trend supports a lower carbon, more energy efficient future. Surrey's Community Energy and Emissions Plan facilitates this transition and helps build capacity for residents, businesses, builders, developers and trades for current and future changes.

### BC Carbon & Energy Management Policy & Planning Chronology

- **Throne Speech** 2007

  The BC Government announces an ambitious agenda and bold targets to tackle climate change. "The science is clear. It leaves no room for procrastination… "The more timid our response, the harsher the consequences…"




- **Climate Action Charter** 2007

  Hundreds of BC municipalities sign a charter to collaborate with the province to mitigate climate change impacts. Amongst other goals, they would take action to create "complete, compact, more energy efficient rural and urban communities."

- **Reduction Targets Act** 2007

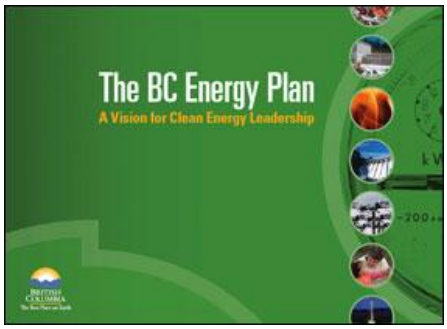
  BC legislates a target to reduce greenhouse gases 33% below 2007 levels by 2020 and 80% by 2050.

- **BC Green Communities Act** 2007

  Amongst other changes, this Act requires Official Community Plans to include: "…targets for the reduction of GHGs… and policies and actions... [for] achieving those targets." The Act catalyzes Community Energy and Emissions Plan development.

- **BC Energy Plan** 2007

  The BC Government adopts a target of achieving 50% of incremental power demand through conservation by 2020. Strategies are outlined to advance performance in new residential and commercial buildings.




- **LiveSmart BC** 2007

  A new conservation program is established focusing on buildings first and also low emission vehicles. Approximately $100 million has been invested up to 2012, leveraging almost $1 billion in economic activity.

- **Climate Action Plan** 2008

  The Climate Action Plan outlines key initiatives to achieve its greenhouse gas reduction targets.

- **Energy Efficient Buildings Strategy** 2008

  This Strategy included a commitment to the highest efficiency standards in Canada, adopted targets and actions to reduce average energy demand per home 20% by 2020, and reduce energy intensity in commercial buildings 9% by 2020.

- **BC Building Code Update** 2008

  For the first time, energy efficiency is introduced into the code, reducing energy demand up to 27 per cent for new homes and 18 per cent for new commercial and institutional buildings, compared to the 1997 Model National Energy Code.

- **BC Hydro Sustainable Communities** 2008

  BC Hydro establishes an innovative Power Smart program to work through local governments. The program supports Community Energy Managers, Community Energy and Emission Plans, Neighbourhood Energy Plans, and District Energy.

- **Carbon Tax** 2008

  BC establishes a revenue neutral tax, starting at $10/tonne on the combustion of all fossil fuels rising to $30/tonne by 2012 where it is now frozen.

- **BC Clean Energy Act** 2010

  The *Clean Energy Act* increased the BC Government's commitment to incremental power demand through conservation to 66% by 2020.

- **FortisBC Long Term Resource Plan** 2010

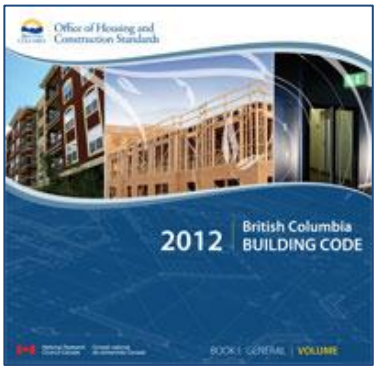
  FortisBC strengthens its commitment to integrated energy and carbon solutions with new investments in conservation and efficiency for existing buildings and new construction, and augmenting strategies for low carbon district energy.

- **Clean Energy Vehicles** 2011

  A new program incentivizes take up of clean energy vehicles, including aggressive electric vehicle charging station deployment program.

- **BC Building Code Update** 2013

  Energy efficiency is even more prominent in this update. One of two energy standards will be chosen for large buildings – both of which have prescriptive and performance paths. Performance standards for windows and heating equipment, and a new efficiency section are being introduced for wood frame buildings.




- **BC Hydro Integrated Resource Plan** 2013

  BC Hydro renewed its commitment to generate low carbon energy to support BC's GHG reduction targets, and meet two-thirds of traditional new demand through conservation, strengthening its Power Smart programs.

## 4.5. City of Surrey: Taking Action on Climate & Energy

The City of Surrey has increasingly been integrating sustainability into policy, planning and daily business in both its corporate operations and the broader community.

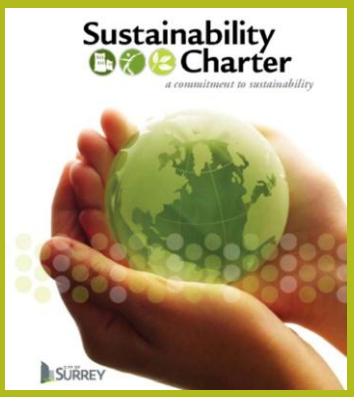
In 2007, the City of Surrey became a signatory to the Province of British Columbia's Climate Action Charter committing to "creating complete, compact, more energy efficient rural and urban communities" and to becoming carbon neutral with respect to its operations by 2012.

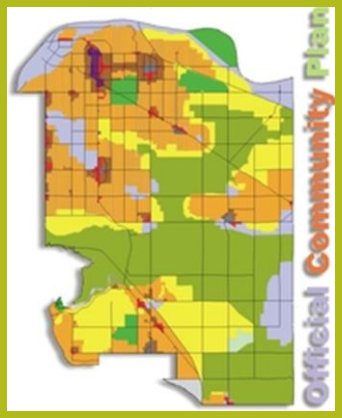
In 2008, Surrey City Council unanimously endorsed the Surrey Sustainability Charter, a 50 year vision to become more sustainable. The Charter included an ongoing commitment to completing the five milestones of the PCP process and developing a local action plan that minimizes GHG emissions through the application of a range of established best practices.

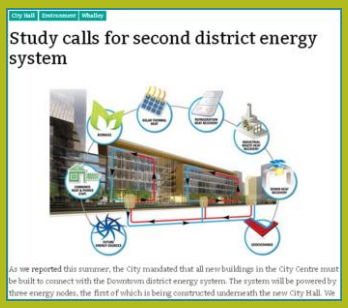
There are numerous policies, actions and commitments the City has undertaken to advance its carbon and energy management agenda:

- FCM Partner for Climate Protection (1996)
- Surrey Energy Efficiency Workshop (2007)
- Grandview Heights Geoexchange Study (2007)
- Surrey City Centre Community Energy Plan (2007)
- Integrated Energy Master Plan for the Semiahmoo Town Centre (2008)
- Sewer Heat Recovery Feasibility Study (2008)
- Transportation Strategic Plan (2008)
- Community GHG Reduction Targets (2010)
- Community Energy Manager Position (2010)
- Surrey becomes a Solar Community (2010)
- Corporate Emissions Action Plan (2010)
- District Energy Utility & District Energy Manager (2011)
- Grandview & Campbell Heights District Energy Pre-Feasibility Assessment (2011)
- Organics Collection – Pilot Studies (2011)
- ICLEI Climate Adaptation Initiative (2011)
- Surrey Walking Plan (2011)
- Rethink Waste Program (2012)
- West Clayton Neighbourhood Energy Study (2011)
- Surrey Cycling Plan (2012)
- City Centre District Energy Development (2013)
- Climate Smart Training for Business (2010-Current)
- Official Community Plan Update (In Progress)
- Rapid Transit Planning (In Progress)
- Student Climate Change Outreach & Education (In Progress)
- Surrey City Centre Plan Update (In Progress)
- Community Energy & Emission Plan Development & Implementation (In Progress)

## Taking Action on Climate, Energy & Sustainability




## 4.6. The Role of Local and Senior Government

While they have limited direct control over most community energy and emission activity, municipal decisions *influence* almost half of GHG emissions in Canada[2]. This influence is pre-eminent in land use planning including location and density of growth and commercial, residential and institutional buildings and green space, building types, as well as street, pedestrian, and cycling infrastructure design and network, and broader urban design. Policy and planning in these areas powerfully shapes transportation, building, and energy supply opportunities. Waste management practices, and other infrastructure decisions also shape emissions.

Municipalities can also raise awareness and facilitate action by businesses, developers, individuals and other community actors. Of all levels of government, municipalities have the most direct relationship with citizens through the services they deliver. If personal carbon footprints are going to shrink, it is in part because local governments will help individuals and households step more lightly.

Municipal focus and intensity and focus of effort on energy and carbon management should be informed by the spheres of influence of different levels of government over energy and emission activity. There are many instances where influence is shared with senior governments, and there are many cases where one level of government has primary influence. Key areas of senior government primary influence:

- **Regulatory authority over building codes and automobile efficiency standards** which has huge influence over community energy and emission activity.
- **Financial authority is greater provincially and federally** and is critical in sectors like public transit and community energy supply development.

This does not mean municipalities should not take action to strengthen building or vehicle efficiency. However, it does mean local action must be strategically focused. For example, while provincial and federal governments should drive the most change on improving building codes, municipal governments can take a leadership role at the margins, preparing the local development sector for change, facilitating market transformation, experimenting with innovation in modest but important ways. Foremost, however, local government permitting and inspection can build local capacity to meet basic building standards.

Achieving the magnitude of emission reductions necessary to avoid the most serious climate change consequences, and building prosperous, resilient, sustainable communities, nevertheless, fundamentally requires collaboration amongst municipalities, utilities, transit authorities, and senior governments.

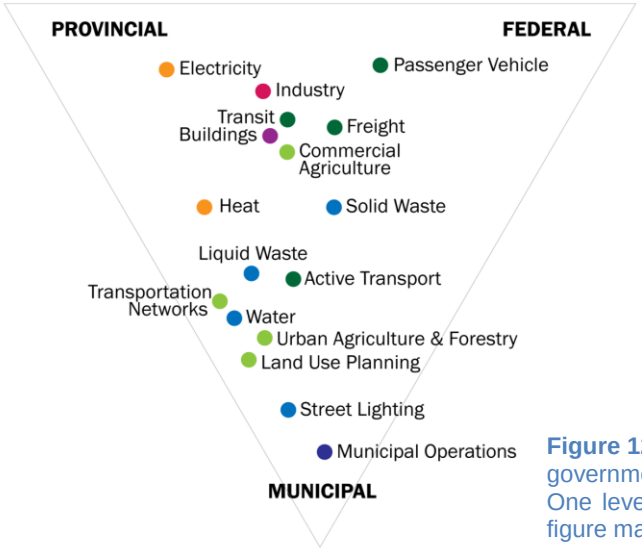



**Figure 12: Government Spheres of Influence:** Different levels of government share influence over energy and emission activity. One level typically has greater influence over some sectors. This figure makes generalizations that do not hold true in all contexts.

[2] Several sources arrive at similar values: Torrie, Ralph. (1998) Municipalities Issue Table Foundation Paper prepared for the Federal National Climate Change Process; BC Ministry of Environment, BC Ministry of Community Development (2008).

# 5 Climate Change Mitigation & Adaptation Integration

Reducing the magnitude and/or rate of climate change is a fundamental goal of the *Community Energy & Emissions Plan*. As such, the CEEP is a ***mitigation*** plan.

Atmospheric concentrations of GHGs, nevertheless, are at levels that lock in some climate change. ***Adaptation*** measures allow impacts to managed, reducing vulnerability for human and natural systems.

Taking action on climate change therefore requires both mitigation and adaptation. Mitigation is essential to "avoid the unmanageable", while adaptation concurrently aims to "manage the unavoidable" (World Bank, 2012). Moreover, a strategic, proactive effort to reduce emissions and plan for anticipated impacts is fiscally prudent, and more cost effective than taking no action.

As well as a *Community Energy and Emissions Plan*, the City has developed a *Climate Adaptation Strategy*. Together, they form Surrey's *Community Climate Action Strategy*.

Surrey's *Climate Adaptation Strategy* has actions to increase resilience in six areas: infrastructure, flood management and drainage, ecosystems and natural areas, urban trees and landscaping, human health and safety, and agriculture and food security

## 5.1 Adaptation & Mitigation Strategy Linkages

Adaptation and mitigation activities have the potential to be mutually supportive, but require careful planning to ensure strategies do not undermine each other. For example, there are different strategies to keep people cool during heat waves. One strategy would involve installing more air conditioning systems. However, additional energy use would likely undermine GHG reductions and mitigation goals. By contrast, increasing tree canopy, vegetative cover, and green roofs also has a cooling effect, and, also acts to increase building energy efficiency. This latter strategy addresses both mitigation and adaptation goals.

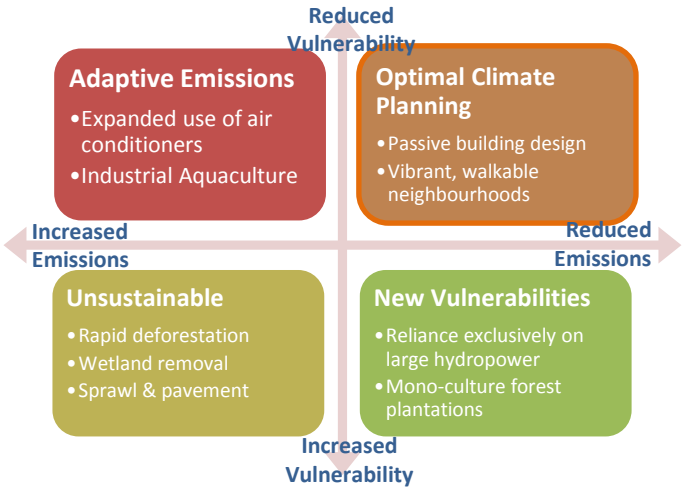



**Figure 13: Adaptation-Mitigation Linkages & Trade Offs:** While not always possible, climate planning and municipal decisions should aim to support activity that reduces GHG emissions and climate change vulnerability. (Adapted from Cohen and Waddell, 2009)

The *Community Energy and Emissions Plan* has a number of strategies that support adaptation. They can be categorized in two general strategy types (see Table 1 and Table 2Table 2 for details):

- **Mutually** Reinforcing Strategies: By their very nature, these strategies simultaneously reduce GHGs, and vulnerability to climate change impacts.
- **Complementary** Strategies: Some mitigation strategies have the potential to integrate adaptation. due to the relative ease by which a mitigation strategy can facilitate adaptation.

As adaptation and mitigation strategies moves into detailed implementation planning, there is a growing opportunity to maximize these synergies.

| Mutually Reinforcing Strategies | By their very nature there are a number of strategies that simultaneously reduce GHGs and vulnerability to climate change impacts. |
|---|---|

| Mitigation Strategy | | Mutually Reinforcing Adaptation Strategy | |
|---|---|---|---|
| **Pedestrian & Transit-Oriented Land Use** reduces personal vehicle GHGs and building energy demand with multi-family homes that provide better thermal performance.<br><br>Ecosystem protection that involves urban forest management can also sequester carbon. | + | **Ecosystem Protection & Hazard Avoidance** can entail green space and forest protection to strengthen the adaptive capacity of species and ecosystems, and enhance stormwater management. Directing growth away from hazardous areas (e.g. floodplains) reduces exposure to climate change impacts. |   |
| **Passive Solar Design** improves insulation, lighting, heating, cooling and ventilation without mechanical or electrical systems. Opportunities include site selection, landscaping, shading, non-mechanical ventilation, street and building orientation, layout, *and* green roofs and white/cool roofs. | + | **Heat Management** is practiced at building, site and neighbourhood scales to reduce heat islands. Strategies can share the same objectives as passive design and include diverse management approaches including trees, forests and broader landscaping, site and building material and colour selection, highly permeable site/pavement design, green and white roofs. |  |
| **District Energy and Efficiency** limit GHGs by displacing or reducing energy from fossil fuel combustion. District energy systems are more resilient to energy price shocks or energy commodity constraints or disruptions as they can use a diversity of fuels. | + | **Climate Resilient Energy Systems** reduce energy requirements, and/or generate energy locally from renewable sources to reduce the risk of losing energy or paying a premium for energy due to climate change impacts. Impacts include storms disrupting oil refineries, natural gas distribution, or electrical transmission, and low snowpack reducing hydroelectric reservoirs. |  |

| Complementary Strategies | Some mitigation strategies have the potential to integrate adaptation due to the relative ease by which a mitigation strategy can facilitate adaptation. |
|---|---|

| Stormwater + Biodiversity Management | Building Rain + Wind Proofing | |
|---|---|---|
|  |  | **Example:** A Development Permit Area can be used to improve thermal building performance thus reducing GHGs. Moreover, this tool can also be very effective for managing stormwater, and reducing infrastructure and ecosystem vulnerability due to intense rainfall. |

**Table 1: Mutually Reinforcing & Complementary Adaptation & Mitigation**

**Table 2: CEEP Strategies Supporting Adaptation**

| Mitigation Strategies by Sector | Mutually Reinforcing Strategies | | | Complementary Strategies | |
|---|---|---|---|---|---|
| | **Ecosystem, Protection & Hazard Avoidance** - Transit Oriented Land Use | **Building + Site Heat Mngmnt** - Passive Solar Design | **Climate Resilient Energy Systems** - District energy + efficiency | **Bio-diversity + Storm water Mngmnt** | **Building Rain + Wind Proofing** |
| ***Land Use*** | | | | | |
| Focus Growth & Green Greenfields | ✓ | | ✓ | ✓ | |
| Complete, Compact, Connected Corridors | ✓ | | ✓ | ✓ | |
| Compact and Live/Work Housing | ✓ | | | | |
| Low Carbon Development Permit Areas | ✓ | ✓ | ✓ | ✓ | ✓ |
| Neighbourhood Sustainable Energy Pilot | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sustainable Development Checklist | ✓ | ✓ | | ✓ | ✓ |
| ***Transportation*** | | | | | |
| Rapid Transit Development | | | ✓ | | |
| Bus Service Improvements | | | ✓ | | |
| Integrated Active Transportation | | | ✓ | | |
| Bicycle Infrastructure | | | ✓ | | |
| Pedestrian Infrastructure | | | ✓ | | |
| Green Fleets & Vehicle Efficiency | | | ✓ | | |
| Car Sharing Promotion | | | ✓ | | |
| LEV Infrastructure Development | | | ✓ | | |
| **Buildings** | | | | | |
| Capacity Building for Building Efficiency | | ✓ | ✓ | ✓ | ✓ |
| Third Party Retrofit Program Integration | | ✓ | ✓ | | ✓ |
| Affordable Housing Energy Retrofits | | ✓ | ✓ | | ✓ |
| Third Party Incentive Promotion | | ✓ | ✓ | | |
| Local Incentive Program Development | | ✓ | ✓ | | ✓ |
| New Construction Code Compliance | | ✓ | ✓ | | |
| **District Energy** | | | | | |
| City Centre District Energy Extension | | | ✓ | | |
| New Node & Corridor Evaluation | | | ✓ | | |
| Detailed Policy, Planning & Promotion | | | ✓ | | |
| **Solid Waste** | | | | | |
| Zero Waste Residents & Businesses | | | | | |
| Zero Waste Construction & Deconstruction | | | | | |
| Sustainable Packaging & Extended Producer Responsibility | | | | | |
| Sustainable Design for Energy Recovery | | | ✓ | | |
| **Cross Cutting Strategies** | | | | | |
| Low Carbon Sustainability Lens | | | | ✓ | ✓ |
| Carbon Pricing Revitalization & Clean Air and Healthy Communities Fund | ✓ | | | | |
| Community & Corporate Carbon Management Integration | ✓ | | | | |

# 6 Energy & Emission Profile

This section provides an overview of energy use and greenhouse gas emissions in the City of Surrey for the base year - 2007. This is the earliest year for which good data can be easily procured, largely through BC Ministry of Environment's Community Energy and Inventory initiative. Emission reductions from strategies in this Plan will be calculated from this base year.

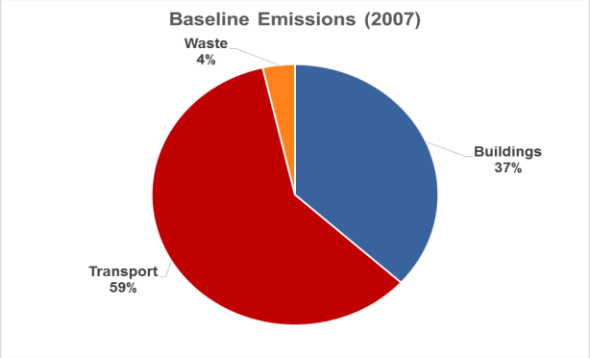



Figure 14: Emissions by Sector

As with most communities in BC, Transportation is responsible for a majority of emissions.

Solid waste is a relatively small contributor to Surrey's greenhouse gas emissions at just 4%.

This total does *not* include large industrial buildings.

Table 3: Baseline Energy Use and Emissions

| City of Surrey Baseline Energy Use and Emissions (2007) | | | |
|---|---|---|---|
| **Sector** | **Energy Use** (Gigajoules) | **Emissions** (Tonnes CO2e) | **Emissions per capita** (Tonnes CO2e) |
| **Residential Buildings** | 15,340,000 | 566,000 | 1.3 |
| **Commercial and Institutional Buildings** | 8,290,000 | 227,000 | 0.5 |
| **Passenger Transportation** | 12,210,000 | 828,000 | 1.9 |
| **Commercial Transportation** [W] | 1,040,000 | 387,000 | 0.9 |
| **Public Transportation** [X] | 5,570,000 | 72,000 | 0.2 |
| **Waste** | n/a | 78,000 | 0.2 |
| **Total - All Sectors (excluding large industry)** | **42,450,000** | **2,158,000** | **4.9** [Y] |
| **For information purposes only** [Z] | | | |
| **Large Industrial Buildings** | 3,257,222 | 118,185 | 0.3 |

[W] Commercial transportation includes both commercial vehicles and tractor-trailer vehicles, displayed as separate line-items in the CEEI. Within the Commercial sub-category, only officially registered commercial vehicles are included. Many passenger vehicles are used for a combination of personal and commercial use, especially for small businesses.

[X] Public Transportation emissions, including electricity use for existing SkyTrain stations, are estimated here but not included in the CEEI.

[Y] There are some emissions not typically included as part of a "community profile," including "large industrial buildings," listed here.

[Y] Values do not sum perfectly due to rounding.

[Z] Electricity consumption for Large Industrial buildings has been estimated by Golder Associates to supplement information not provided within the CEEI.

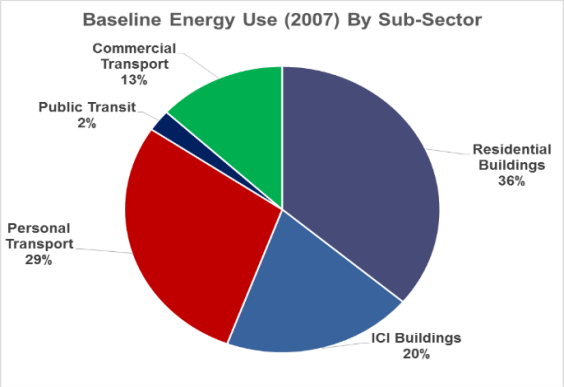



Figure 15: Energy Use by Sector and Sub-Sector

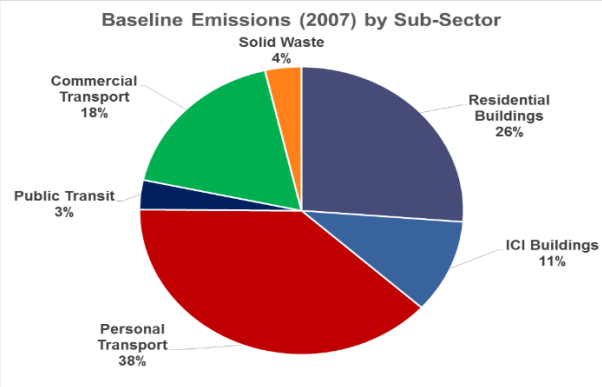



Figure 16: Emissions by Sector and Sub-Sector

A majority of energy is used by Buildings. ICI (Industrial, Commercial, and Institutional) buildings exclude large industrial facilities.

Emissions are not proportionate to energy use as there are different fuel sources and types, each with a different emissions factor. Buildings are responsible for a smaller share of emissions than energy use in part due to their use of electricity from BC's grid, which has an extremely small emissions footprint.

## 6.1. Energy Costs and Spending in Baseline Year

Communities spend a significant amount on energy. In 2007, Surrey's citizens and businesses spent over $1 billion on energy used for buildings and vehicles. Approximately two thirds of this is from the Residential sector and one third from Industrial, Commercial, and Institutional (ICI) sectors.[3]

Within the Building sector, it is important to note that fuel costs and total energy costs are significantly different from each other. Fuel costs include only each unit of fuel consumed (for example, 1 gigajoule of Natural Gas). However, utilities charge fixed fees as well. These fixed fees are included in the analysis below. These fixed fees may be excluded in future iterations of analysis as fixed costs they are not likely to be affected by policy changes, and to make energy costs more consistent with the Transportation sector, which does not have fixed energy service costs.

Table 4

| Sector | Energy Consumption in Baseline Year (GJ) | Total Spending in Baseline Year | *Per Capita* spending in baseline year |
|---|---|---|---|
| Residential, Passenger | 28,590,000 | $733,192,000 | $1,650 |
| Institutional & Commercial | 13,860,000 | $303,180,000 | $680 |
| Total | 42,450,000 | $1,036,372,000 | $2,330 |
| **In $2012** | | | |

[3] Excludes Large Industrial buildings and associated energy use and spending.

## 6.2. High Level Comparison with Regional Average

Although total per capita emissions in Surrey are comparable to the rest of the region, the relative contribution of buildings and transportation is measurably different. Surrey has significantly higher transportation emissions per capita, while building emissions are significantly lower.

**Table 5: Surrey Comparison with Metro Vancouver Average**

| Emissions Indicator | Notes | Surrey | Metro Vancouver | Data Source |
|---|---|---|---|---|
| **Total Emissions *per capita*** (Tonnes $CO_2e$ *per capita* per year) | Includes transportation, buildings, and solid waste. Surrey has lower building emissions due to relatively younger building stock, and less commercial floor area due to lower average job/resident ratio. | 5.0 [x] | 5.1 | CEEI |
| **Building Emissions *per capita*** (Tonnes $CO_2e$ *per capita* per year) | Newer buildings tend to be more efficient than older buildings. Surrey has a higher share of new buildings than the Metro Vancouver average. | 1.8 | 2.1 | CEEI |
| **Ratio Single-Detached to Multi-Family dwellings** (% of single detached dwellings) | Multi-family dwellings generally use less heat per occupant than single-family detached buildings, and higher-density (i.e. multi-family) neighbourhoods are generally characterized with less driving. | 43% Single Detached | 35% Single Detached | CEEI |
| **Transportation Emissions** (Tonnes $CO_2e$ *per capita* per year) | The difference in *per capita* emissions can be attributed to higher tractor-trailer ownership/use and more vehicle kilometres travelled (see below) than regional average. | 2.9 [y] | 2.1 | CEEI |
| **Average Passenger Vehicle Driving Distance** (Vehicle kilometres travelled *per capita* per year) | Annual total kilometres travelled by passenger vehicle (cars and light trucks). This higher value is due to proximity to jobs within region, services locally, and high quality transit access. | 7,400 | 6,000 | Metro Vancouver Trip Diaries |
| **Transportation Modal Split** (% of trips by mode) | Share of trips based on mode of transportation, including driving, public transit, school bus, bicycle, walk, and other. (This measure does not account for distance travelled by mode.) | Drive: 80.5%<br>Transit: 10%<br>School: 0.7%<br>Bike: 0.5%<br>Walk: 7.7%<br>Other: 0.6% | Drive: 72.6%<br>Transit: 14%<br>School: 0.7%<br>Bike: 1.5%<br>Walk: 10.3%<br>Other: 0.9% | Metro Vancouver Trip Diaries |
| **Waste Emissions** (Tonnes $CO_2e$ *per capita* per year) | Surrey's waste is managed by Metro Vancouver. All Metro Vancouver communities have similar *per capita* emissions in baseline year. | 0.2 | 0.2 | CEEI |

[x] *The Community Energy and Emission Inventory value for Surrey's per total community wide emissions is 5.0 Tonnes of CO2e. The enhanced inventory developed for this Plan has a value of 4.9 Tonnes of CO2e/annum.*
[y] *The Community Energy and Emission Inventory value for Surrey's per capita transportation emissions is 2.9 Tonnes of $CO_2e$. The enhanced inventory developed for this Plan has a value of 3.0 Tonnes of CO2e/annum.*

## 6.3. Baseline Energy & Emission Maps

These brief descriptions explain the map series on the following pages. The methodology is described in the Appendix.

### Summary Map of Community-Wide Energy and Emissions

**Map: Modeled $CO_2$ by Sector**

- Modeled results for 2011 show residential buildings and private transportation as leading sources of emissions
- Modeled Total CO2 city-wide (excluding Commercial & Freight Transport) for 2011 is approx. ~2,450,000 tonnes of CO2
- Mix of emissions totals reflects density, land use mix, age of housing and access to transportation as well as other key locational factors

### Maps of Energy and Emission Drivers

**Map: Residential Density**

- Residential density is calculated as gross households per hectare by dissemination area
- Residential density drives down transportation emissions as well as residential building emissions through occupancy
- Densest areas are in older redeveloping neighbourhoods as well as in areas of new urban development

**Map: Commercial Density**

- Commercial density is calculated as gross number of employees per hectare by dissemination area
- Commercial density drives down transportation emissions through land use mix (i.e. access to jobs) and through service clustering
- Densest commercial areas are currently in industrial office parks, along highways and in town centres

**Map: Access to Services - Grocery Stores**

- Walking distance to local services serves as in important indicator for sustainability as well as transportation emissions
- Typically people will only walk to local services if they are within a 10 minute walking distance of their dwelling
- As mix use development increases, the availability of local services for residents increases and residential transportation emissions go down

### Maps of Sectoral Energy & Emissions

**Map: Modeled Building Energy Intensity**

- Modeled Results of CEEMAP Building Model
- Energy Intensity is function of structure age and type
- Generally, newer residential buildings are the most efficient and thus the lowest average energy intensity
- Industrial and agricultural areas typically have the highest average energy intensity

**Map: Modeled Per Capita Travel (Vehicle kilometres traveled)**

- Modeled Result of CEEMAP Transportation Model

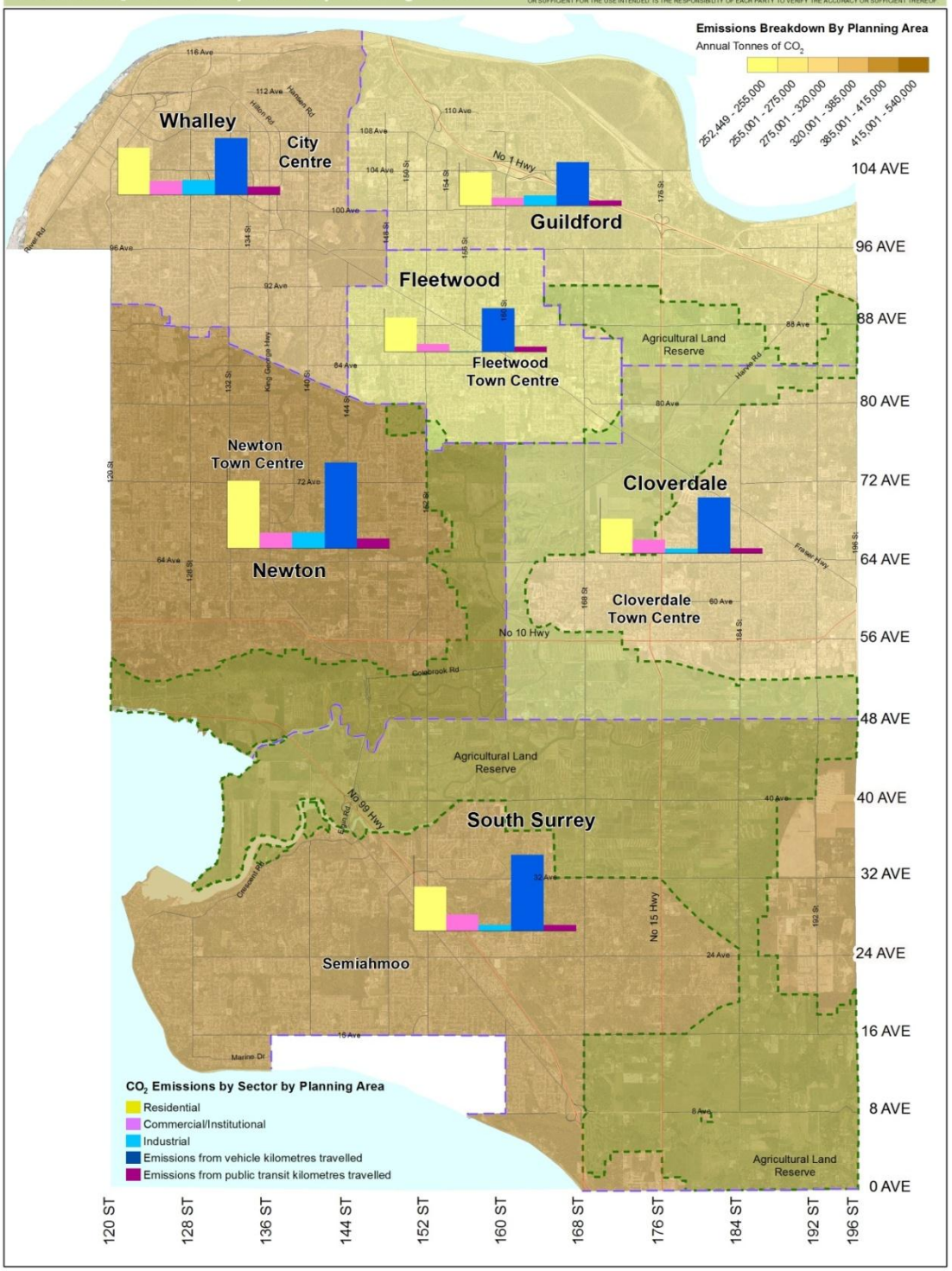
CITY OF SURREY

PLANNING AND DEVELOPMENT DEPARTMENT

## Modeled $CO_2$ Emissions by Sector by Planning Area 2011

PRINTED: JULY 9, 2011

SURREY DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THE MAP OR PLAN HEREIN IS ACCURATE OR SUFFICIENT FOR THE USE INTENDED. IS THE RESPONSIBILITY OF EACH PARTY TO VERIFY THE ACCURACY OR SUFFICIENT THEREOF




In 2011, $CO_2$ emissions for the City of Surrey totalled approximately 1.79 million tonnes of $CO_2$. Of the total emissions, 45% were from transportation, 42% were from residential buildings, 8% were from industrial buildings, and 5% were from commercial buildings. Of the planning areas, Newton had the highest annual emissions (accounting for 25% of total emissions). VKT have been modeled by HB Lanarc and calibrated to Surrey transit data. All data as displayed is estimated, and should be interpreted for informational purposes only.

Golder Associates
Sustainable Communities

CITY OF SURREY

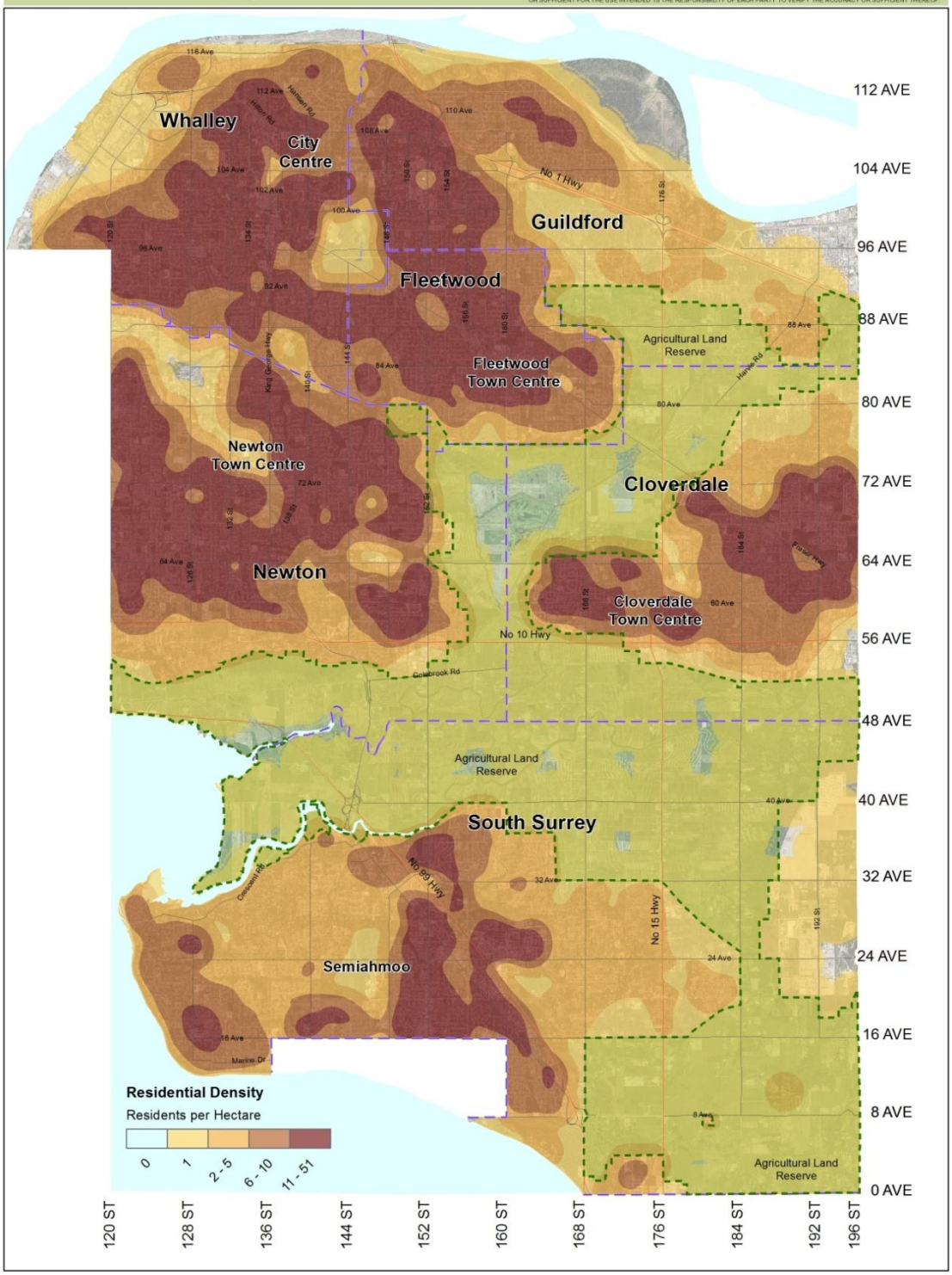
PLANNING AND DEVELOPMENT DEPARTMENT

## Modeled Residential Density 2011

0 500 1,000 2,000 Meters

PRINTED: JULY 9, 2011

SURREY DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THE MAP OR PLAN HEREIN IS ACCURATE OR SUFFICIENT FOR THE USE INTENDED. IS THE RESPONSIBILITY OF EACH PARTY TO VERIFY THE ACCURACY OR SUFFICIENT THEREOF.




In 2011, there were approximately 477,000 residents in the city of Surrey. Of the total residents, about 23% are youth under the age of 16. Resident distribution has been modeled by HB Lanarc using population figures sourced from the City of Surrey and Census Canada. All data as displayed is estimated, and should be interpreted for informational purposes only.

Golder Associates
Sustainable Communities

CITY OF SURREY

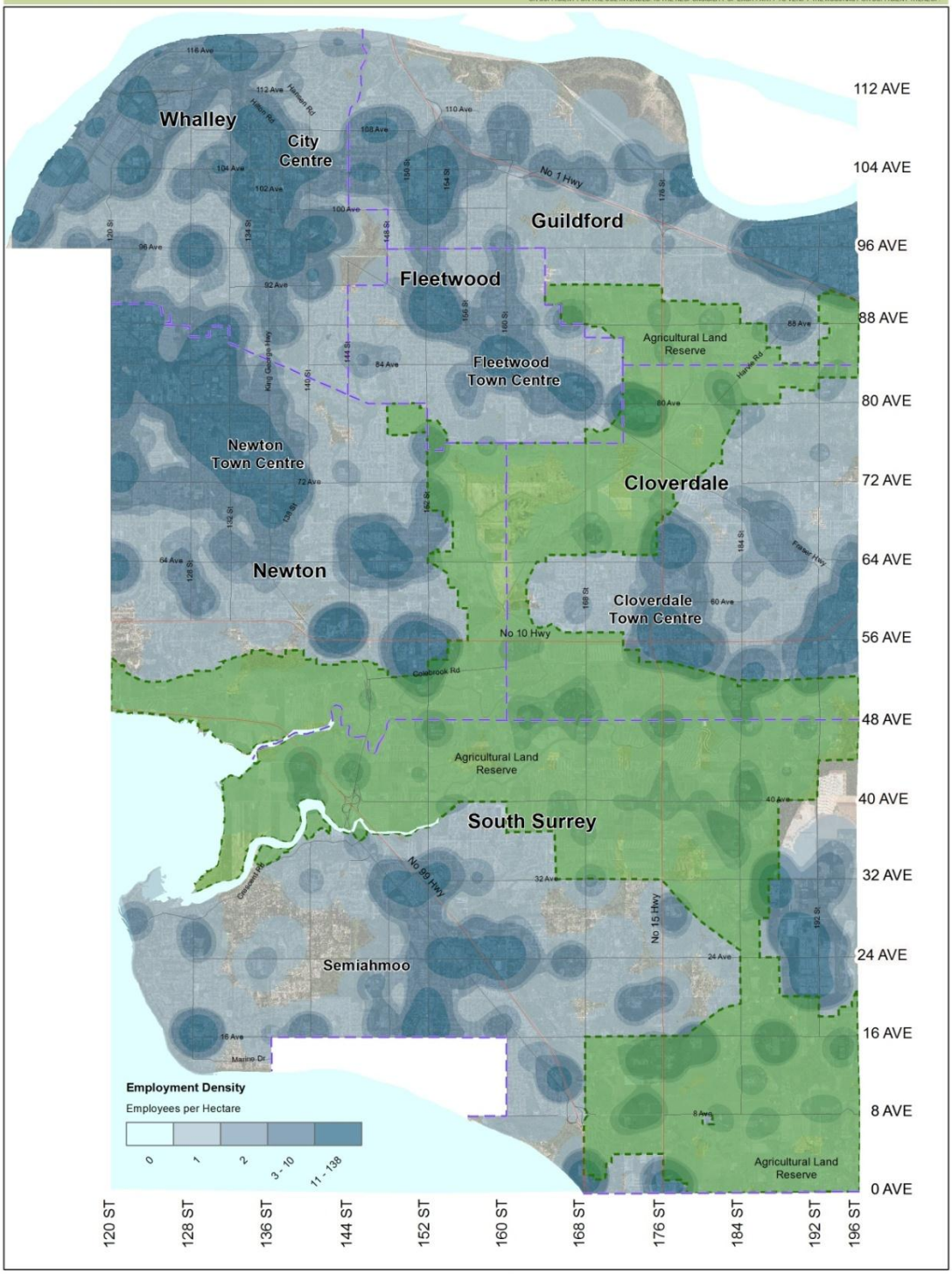
PLANNING AND DEVELOPMENT DEPARTMENT

## Modeled Employment Density 2011

Meters 0 500 1,000 2,000

PRINTED: JULY 8, 2011

SURREY DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THE MAP OR PLAN HEREIN IS ACCURATE OR SUFFICIENT FOR THE USE INTENDED. IS THE RESPONSIBILITY OF EACH PARTY TO VERIFY THE ACCURACY OR SUFFICIENT THEREOF.




In 2011, there were approximately 151,000 jobs in the City of Surrey. This averages out to about 1 job per every 3 working-age residents of Surrey. The highest concentrations of jobs per hectare were found in the City Centre and Newton Town Centre (both areas have about 138 jobs per hectare). Employment distribution has been modeled by HB Lanarc using employment figures sourced from the City of Surrey. All data as displayed is estimated, and should be interpreted for informational purposes only.

Golder Associates
Sustainable Communities

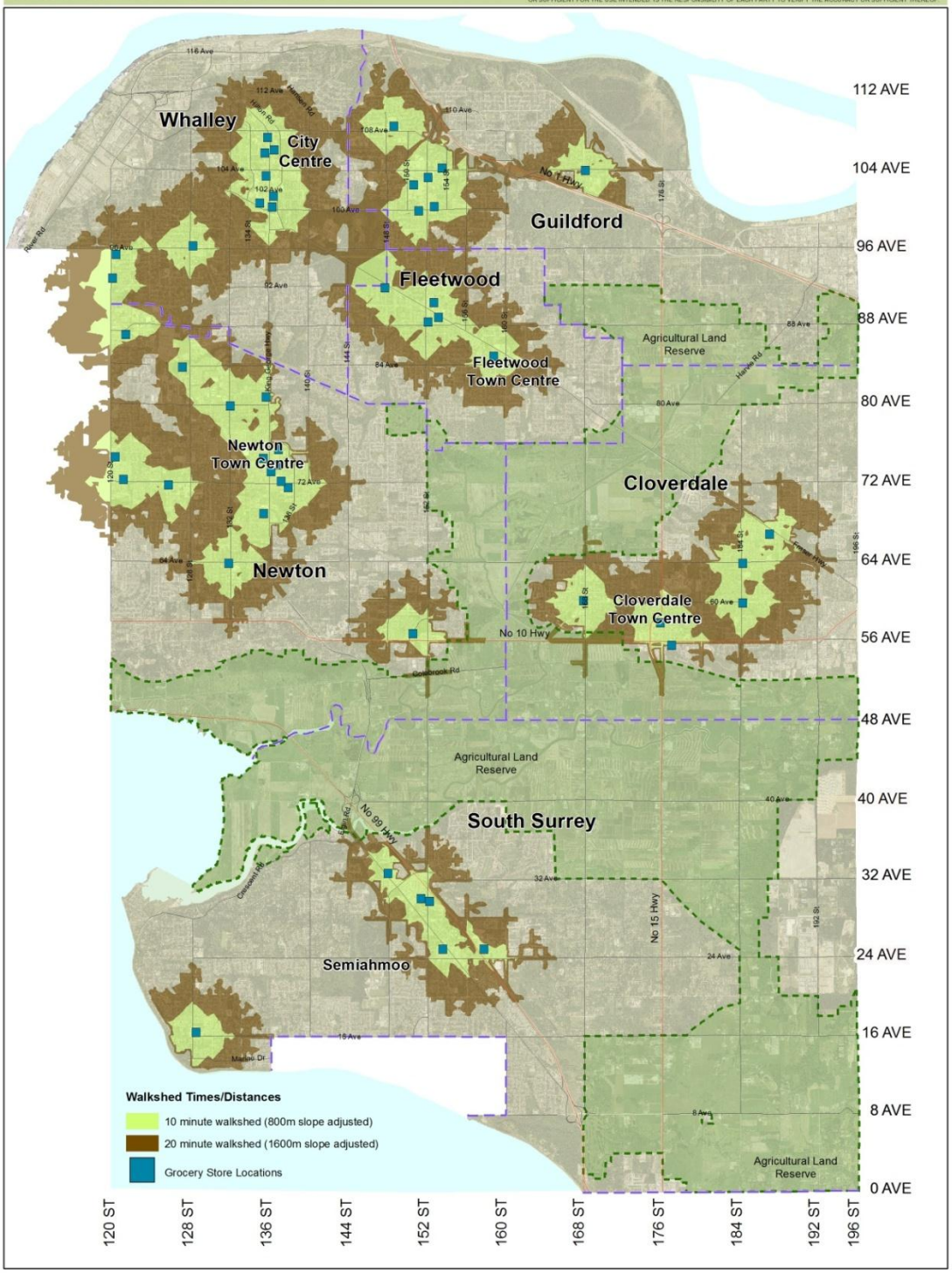
CITY OF SURREY

PLANNING AND DEVELOPMENT DEPARTMENT

## Modeled Access to Grocery Stores 2011

PRINTED: JULY 8, 2011

SURREY DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THE MAP OR PLAN HEREIN IS ACCURATE OR SUFFICIENT FOR THE USE INTENDED. IS THE RESPONSIBILITY OF EACH PARTY TO VERIFY THE ACCURACY OR SUFFICIENT THEREOF.




In 2011, 25% of households live within a one-way 10 minute walk to a grocery store, and 60% of households live within a 20 minute one-way walk to a grocery store.

Grocery store locations have been sourced from City of Surrey data, and should be interpreted for informational purposes only.

Golder Associates
Sustainable Communities

CITY OF SURREY

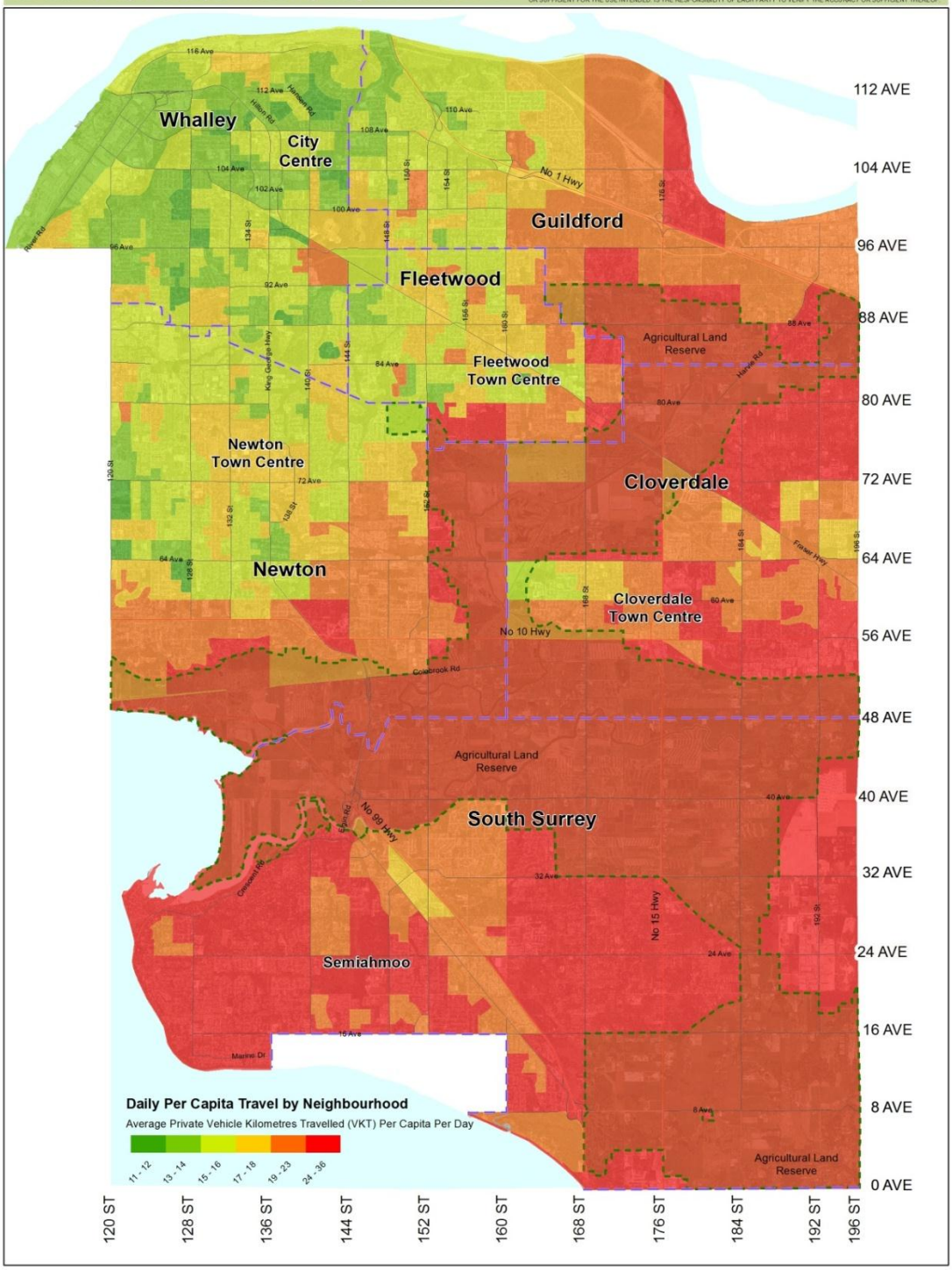
PLANNING AND DEVELOPMENT DEPARTMENT

## Modeled Daily Per Capita Travel by Neighbourhood 2011

0 500 1,000 2,000 Meters

PRINTED: JULY 8, 2011

SURREY DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THE MAP OR PLAN HEREIN IS ACCURATE OR SUFFICIENT FOR THE USE INTENDED. IS THE RESPONSIBILITY OF EACH PARTY TO VERIFY THE ACCURACY OR SUFFICIENT THEREOF.




In 2011, the average daily vehicle kilometres travelled (VKT) per capita was 18 km/day. Total daily travel resulting from internal residential trips was 9,904 km. VKT have been modeled by HB Lanarc and calibrated to City of Surrey transit data. All data as displayed is estimated, and should be interpreted for informational purposes only.

Golder Associates
Sustainable Communities

CITY OF SURREY

CITY OF SURREY

PLANNING AND DEVELOPMENT DEPARTMENT

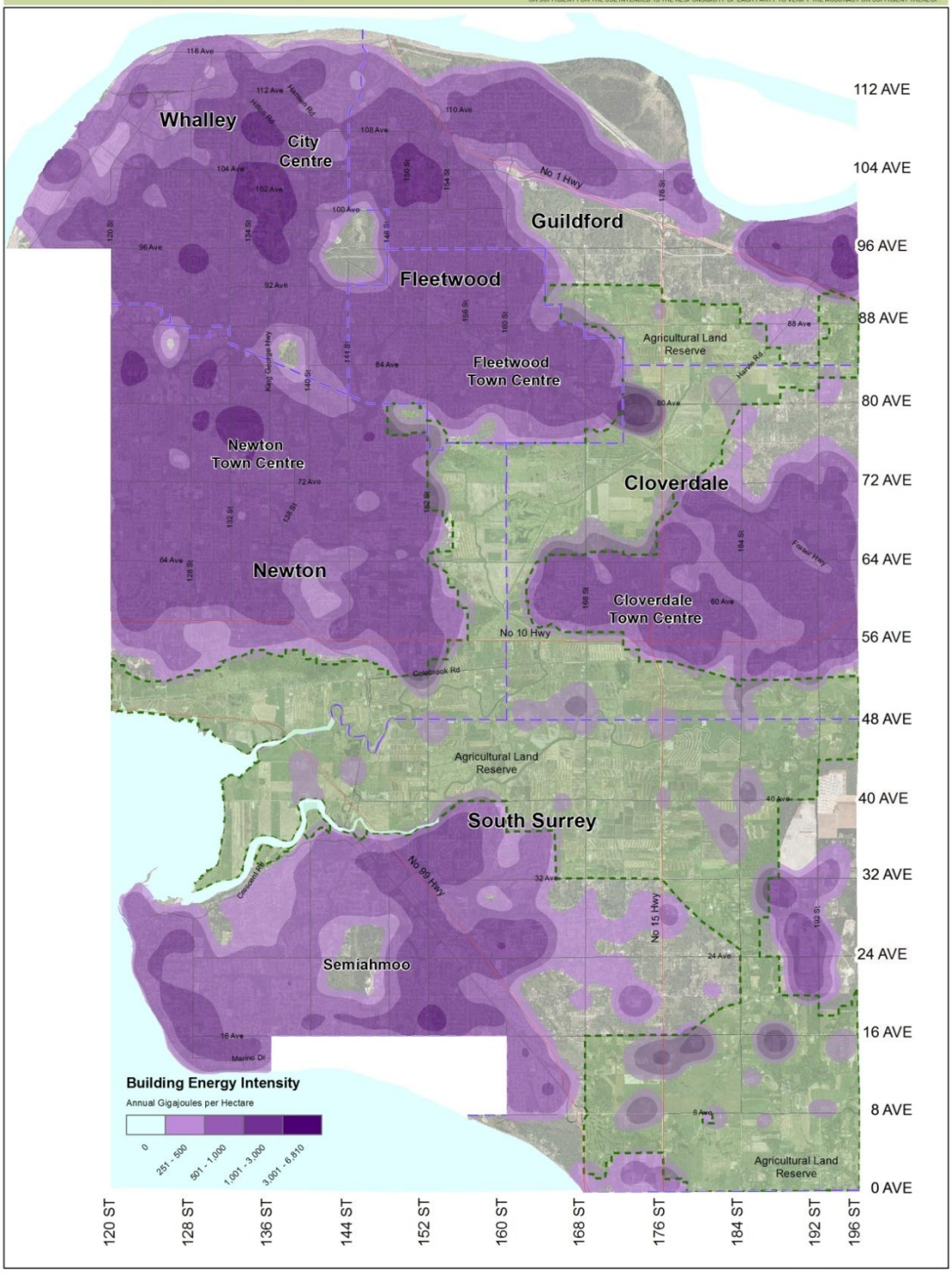
## Modeled Building Energy Intensity 2011

0 500 1,000 2,000 3,000 Meters

N

PRINTED: JULY 8, 2011

SURREY DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THE MAP OR PLAN HEREIN IS ACCURATE OR SUFFICIENT FOR THE USE INTENDED. IS THE RESPONSIBILITY OF EACH PARTY TO VERIFY THE ACCURACY OR SUFFICIENT THEREOF




In 2011, annual building energy intensity totalled approximately 26 million Gigajoules for the entire City of Surrey. Of energy use, 66% is consumed by residential buildings, 21% is consumed by commercial or institutional buildings, and 13% is consumed by industrial buildings. Energy consumption has been modeled by HB Lanarc using data sourced from the City of Surrey and BC Hydro. All data as displayed is estimated, and should be interpreted for informational purposes only.

Golder Associates
Sustainable Communities

# II Taking Action

Part II details the strategies. They are organized by energy and emission sector, accordingly:

- Land Use
- Buildings
- Waste
- Transportation
- District Energy

There is an additional section on institutional strategies to support implementation:

- Cross Cutting Strategies

Each section includes key targets and additional opportunities along with essential background analysis and recommendations for each strategy. The first section analyzes the strategies' energy and emissions impact on a community wide and sectoral basis, summarizes the key supporting targets, and discusses the energy savings.

## 1 Energy & Emission Forecast

Many strategies within and across sectors are mutually reinforcing. To quantify their energy and emission impact, related strategies are aggregated into emission reduction wedges (Figure 17).

Most strategies and, in turn, emission reduction wedges are driven by local City of Surrey action. Two senior government wedges, however, are notably important in driving emission reductions at the community level: building codes, and vehicle efficiency standards.

Energy and emission changes are evaluated from the base year, 2007, to 2040. 2007 is the base year for two inter-related reasons. This is the first year the BC Government aggregated data for municipalities under the Community Energy and Emission Inventory Initiative and is the basis for establishing the base year inventory / energy and emission profile. Secondly, the BC Government announced its ambitious climate action agenda in 2007 and most institutions in BC

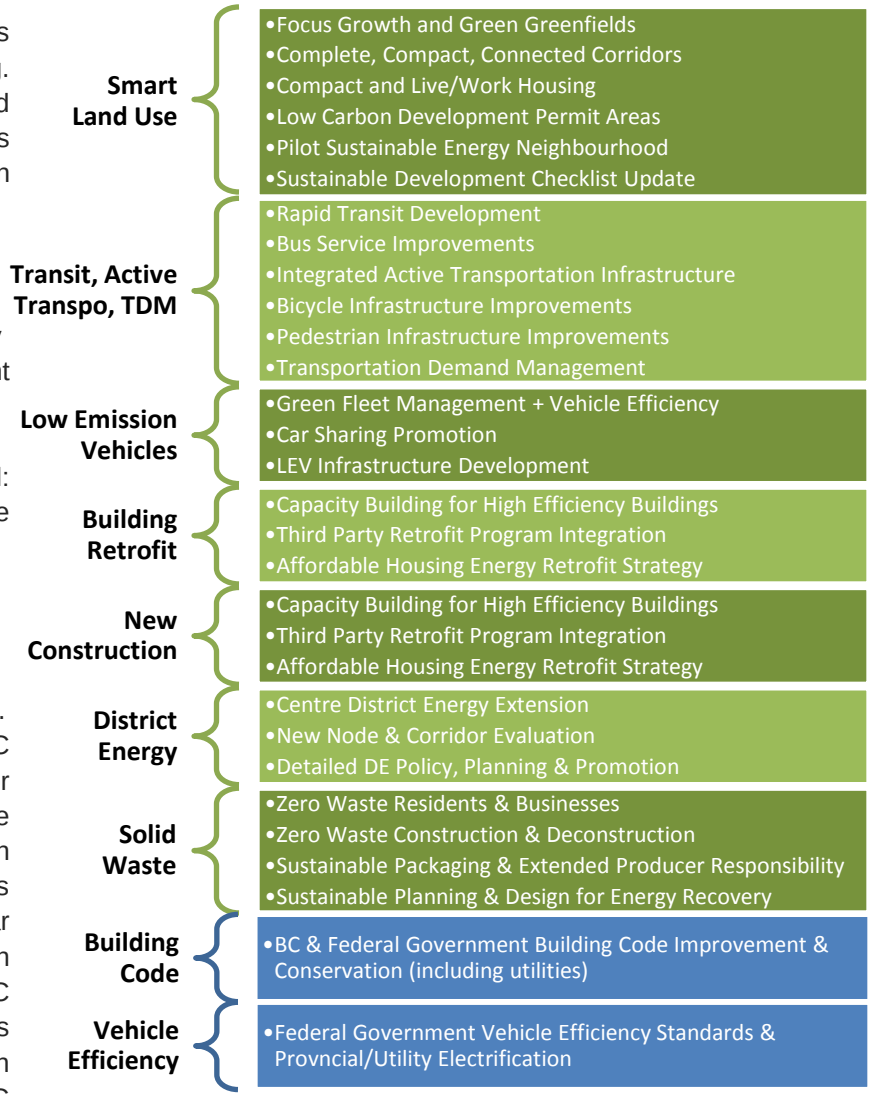



**Figure 17: Emission Reduction Wedges:** green wedges are local action; blue wedges are senior government action

are using this year as the base year for measuring emission reductions. The plan's final milestone, 2040, aligns with the City's Official Community Plan Update.

In this section and under each energy and emission sector, the projected impact of strategies is reported using key indicators. Indicator reporting is also provided for 2020, an interim milestone that supports medium term detailed implementation planning, and monitoring and evaluation.

As well as focused City efforts, achieving the reductions in energy demand and emissions outlined in this Plan will require active participation of residents and private, public and social sector organizations. Senior governments will also need to follow through on vehicle efficiency and building code/conservation supported by utilities, as well as continued TransLink transit service expansion. Senior government partnership and investment will be critical to implement key strategies, notably transit investment.

## 1.1 Total Community-Wide Energy and Emission Synopsis

Implementing the strategies in this Plan will reduce greenhouse gas emissions by half on a per capita basis from 2007, and by 41% on a total community wide basis relative to Business As Usual. The greatest emission reductions are across the transportation sector: -60% on a per capita basis and -30% on a community wide basis relative to 2007 levels (Table 6).

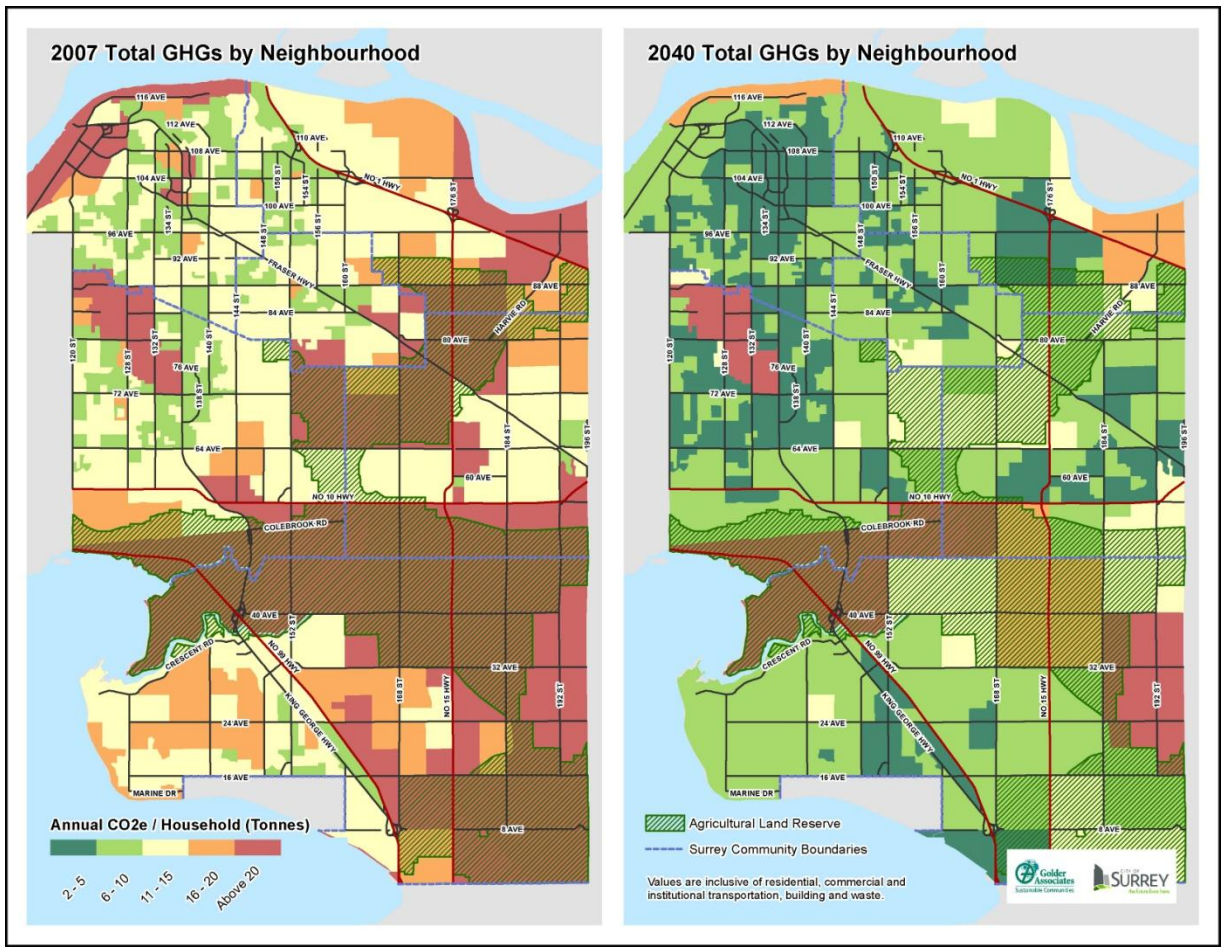



**Figure 18: Total GHGs by Neighbourhood**, inclusive of residential, commercial and institutional activity is reduced by half measured on a household basis.

Transportation emission reductions are the result of integrated land use changes that support transit and active transportation modes, more extensive transit and active transportation infrastructure, and significant senior government regulation and market transformation of low emission vehicles.

The building sector realizes almost 30% improvement in per capita performance, driven by improved performance in new construction efficiency beyond typical new buildings, an accelerated retrofit rate, and a robust district energy agenda. Local and senior government efforts are both required to deliver these strategies. Due to sizeable population and employment growth, nevertheless, there are significantly more dwellings and commercial floor space resulting in building sector emission growth on a community wide basis. (See Table 6 and Figure 18: Total GHGs by Neighbourhood, inclusive of residential, commercial and institutional activity is reduced by half measured on a household basis.)

Waste GHGs drop almost 60% on a per capita basis relative to 2007, and 40% overall due to significant recycling and composting, and a reduction in waste volumes.

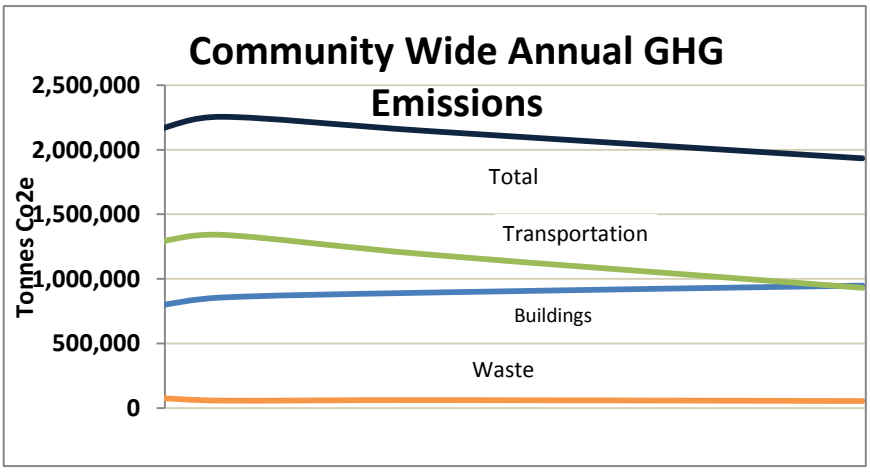
The extent and location of population and employment growth are the community's biggest GHGs and energy management challenges. The best performing neighbourhoods analyzed on a household basis are complete, compact and connected (to good transit and district energy). (See map, Figure 18)

**Table 6: Total Community-Wide & Per Capita $CO_2e$ Emissions by Sector and by Milestone**

| Sector & Sub-Sector | 2007 | | 2020 | | 2040 | |
|---|---|---|---|---|---|---|
| | Total | Per Capita | Total | Per Capita | Total | Per Capita |
| **Total Buildings** | **792,000** | **1.8** | **895,000 +13%** | **1.6 -11%** | **948,000 +20%** | **1.3 -28%** |
| • Residential Buildings | 565,000 | 1.3 | 626,000 | 1.1 | 641,000 | 0.9 |
| • ICI Buildings | 227,000 | 0.5 | 269,000 | 0.5 | 307,000 | 0.4 |
| **Total Transportation** | **1,287,000** | **3.0** | **1,184,000 -8%** | **2.1 -30%** | **930,000 -28** | **1.2 -60%** |
| • Personal Transportation | 828,000 | 1.9 | 763,000 | 1.4 | 511,000 | 0.7 |
| • Public Transit | 72,000 | 0.2 | 56,000 | 0.1 | 16,000 | 0.0 |
| • Commercial Transportation | 387,000 | 0.9 | 365,000 | 0.6 | 403,000 | 0.5 |
| **Total Waste** | **78,341** | **0.2** | **62,000 -21%** | **0.1 -30%** | **50,000 -37%** | **0.1 -59%** |
| **Total Community-Wide GHGs** | **2,158,000** | **4.9** | **2,038,000 -1%** | **3.8 -22%** | **1,878,000 -13%** | **2.6 -46%** |
| **Residential Community-Wide GHGs** [x] | **1,500,000** | **3.4** | **1,476,000 -2%** | **2.6 -23%** | **1,195,000 -20%** | **1.6 -52%** |

*N.B. Rounding results in minor discrepancies in values of some indicators when summed and multiplied.*

[x] *Community residential emissions comprise personal transportation, residential buildings and waste*




.

**Figure 19: Total Community-Wide $CO_2e$ Emissions:** Across the entire community, transportation GHGs drop most significantly (30%) due to growth in low carbon cars, transit use, walking and cycling, and more services closer to residents. Building GHGs grow 20% due to rapid residential and commercial growth. Waste GHGs shrink by a third.

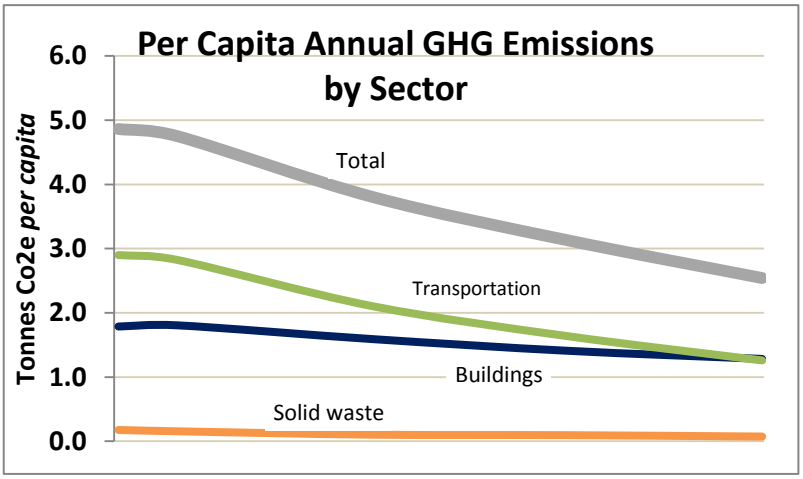



**Figure 20: Per Capita $CO_2e$ Reductions by Sector:** per capita GHG reductions are most dramatic in the transportation sector driven by a combination of smart land use, rapid transit, active transportation, local green car strategies, and very significantly strong senior government vehicle efficiency standards.

The Plan's forecasted emissions are compared relative to 2007, and a future *Business As Usual* scenario. BAU represents a future in which no further action would be taken to manage energy and GHGs beyond currently legislated senior government commitments – notably improvements to standards for vehicle efficiency and buildings. Relative to BAU, community wide emissions are cut 41% by 2040. (See Figure 20and Figure 23)

If the City took no action, GHGs would rise 5% relative to 2007. Local action, therefore, reduces GHGs 18% relative to the *No Local Action* future, or 13% below 2007 levels. (See Figure 21) These emission reductions happen during rapid growth of employment and residential growth, 100% and 65% respectively.

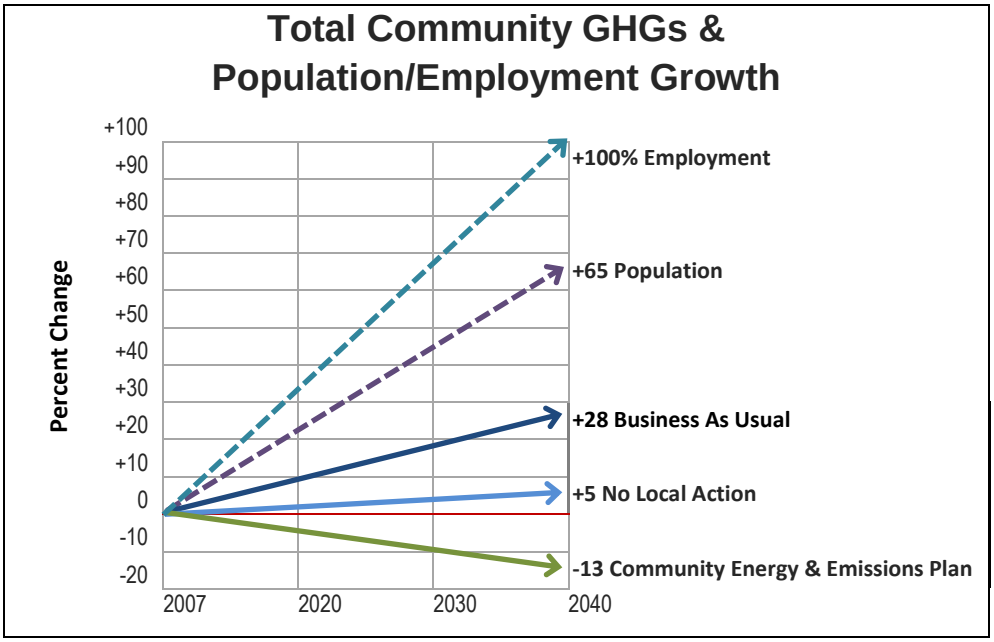



**Figure 21: Total Community $CO_2e$ & Population & Employment Growth:** The City makes sizeable community-wide emission reductions in the face of rapid employment and population and employment growth.

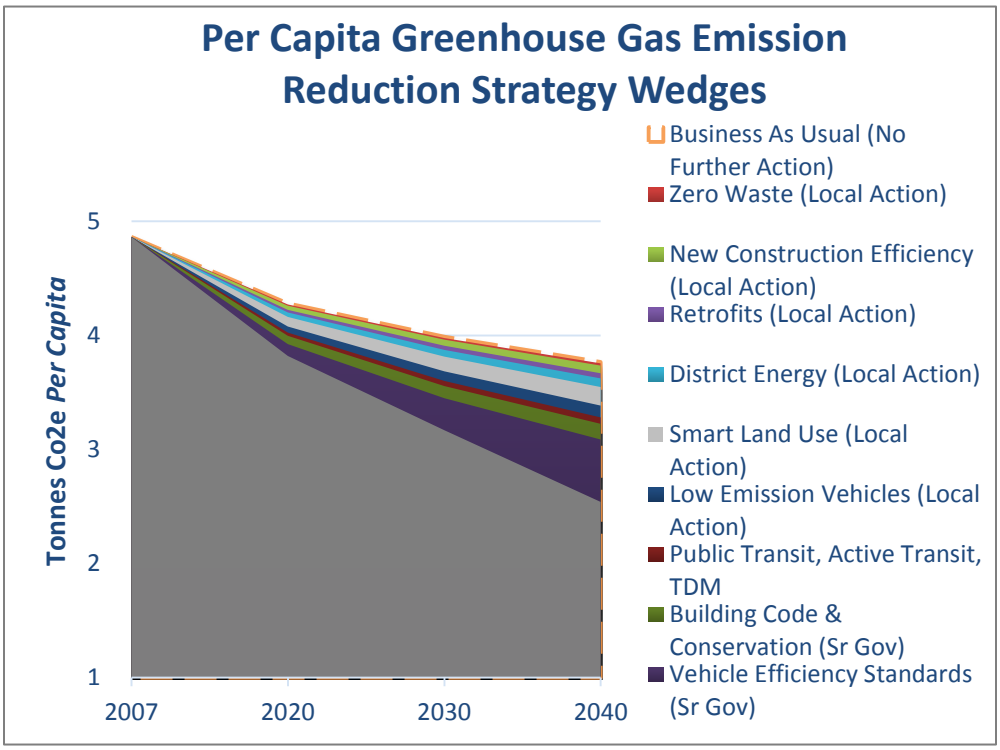



**Figure 22: Per Capita $CO_2e$ Emission Reduction Wedges**

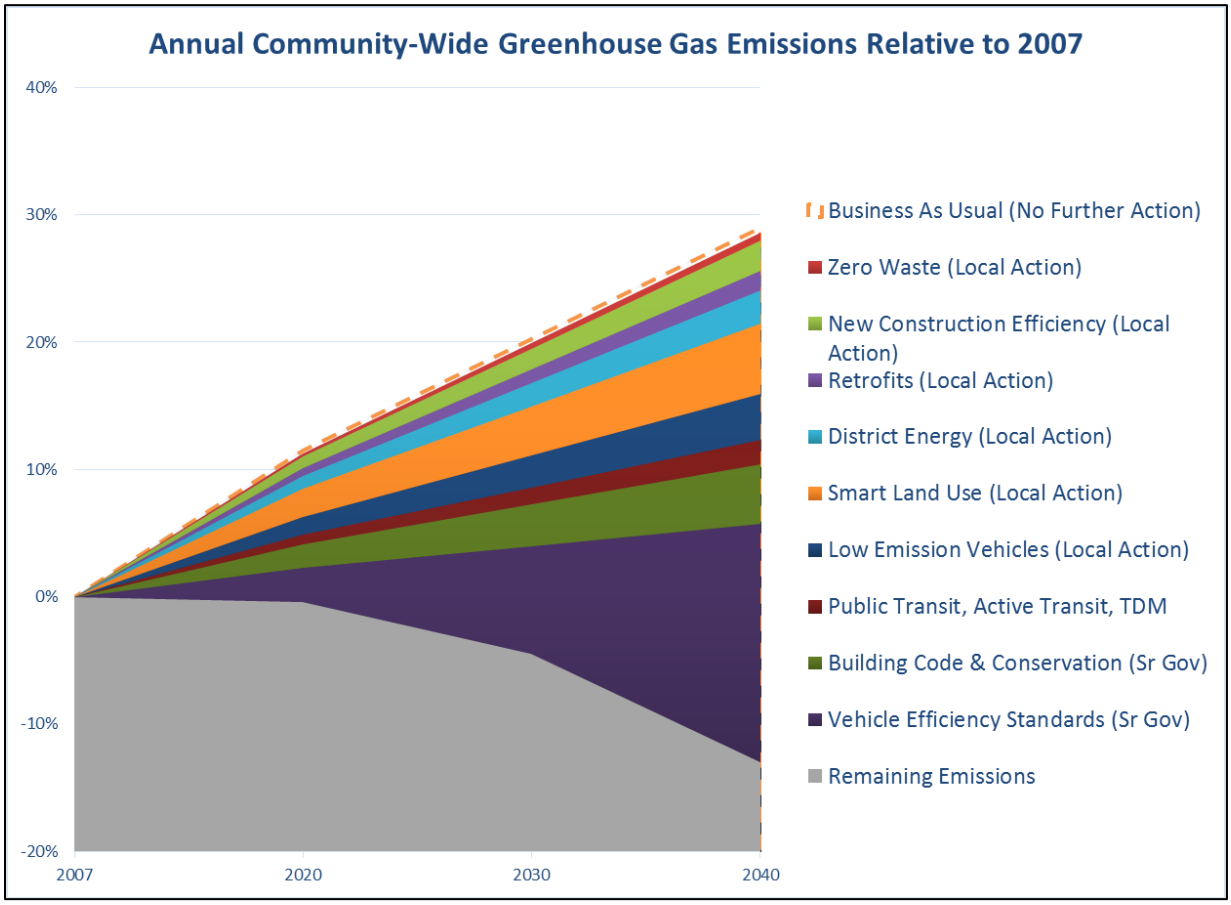



**Figure 23: Total Community Wide GHG Emission Reduction Wedges**

Per capita and community-wide strategy wedges show significant emission reductions from City-led (local) action, as well as senior government action. (See Figure 22, Figure 23 and Table 7) The magnitude of these emission reductions is shown relative to Business As Usual, i.e. No Further Action.

Combined City-driven GHG reduction wedges relative to BAU are almost 400,000 tonnes, roughly equivalent to cutting all of Chilliwack's current emissions (BC's 11th largest municipality). All local and senior government GHG reduction wedges combined relative to BAU are 899,000 tonnes, roughly equivalent to cutting all of Richmond's current emissions (BC's 4th largest municipality). (BC Ministry of Environment, 2013)

**Table 7: Emission Reductions by Wedge:** Per capita and total $CO_2e$ tonnes relative to BAU. These totals are reflected in the wedge charts (Figure 22 and Figure 23).

| Strategy Wedge | 2020 | | 2040 | |
|---|---|---|---|---|
| | Per Capita | Total | Per Capita | Total |
| **Local Action** | **0.28** | **155,000** | **0.55** | **394,000** |
| • Smart Land Use | 0.08 | 47,000 | 0.16 | 120,000 |
| • Transit, Active Transpo, TDM | 0.03 | 16,000 | 0.06 | 41,000 |
| • Low Emission Vehicles | 0.06 | 31,000 | 0.11 | 78,000 |
| • Retrofits | 0.02 | 13,000 | 0.05 | 34,000 |
| • New Construction Efficiency | 0.04 | 20,000 | 0.07 | 51,000 |
| • District Energy | 0.04 | 22,000 | 0.08 | 56,000 |
| • Zero Waste | 0.01 | 6,000 | 0.02 | 14,000 |
| **Senior Government Action** | **0.17** | **98,000** | **0.69** | **505,000** |
| • Vehicle Efficiency Standards | 0.10 | 58,000 | 0.55 | 403,000 |
| • Building Code & Conservation | 0.07 | 40,000 | 0.14 | 102,000 |
| **All Actions** | **0.45** | **253,000** | **1.24** | **899,000** |

Energy demand in the transportation sector drops considerably, -51% on a per capita basis and -17%on a total community wide basis by 2040. Despite a 25% improvement in per capita building energy demand, total building energy demand grows 50% due to significant growth in commercial floor area and new residential buildings.

**Table 8: Total Community-Wide & Per Capita Energy Demand (GJ) by Sector and Milestone**

| | 2007 | | 2020 | | 2040 | |
|---|---|---|---|---|---|---|
| **Sector & Sub-Sector** | **Total** | **Per Capita** | **Total** | **Per Capita** | **Total** | **Per Capita** |
| **Total Buildings** | **2007** | **2007** | **2020 +24%** | 52 +4% | **2040 +50%** | **48 +26%** |
| • Residential Buildings | 15,327,000 | 35 | 18,781,000 | 33 | 22,065,000 | 30 |
| • ICI Buildings | 8,290,000 | 19 | 10,419,000 | 19 | 13,245,000 | 18 |
| **Total Transportation** | **23,619,007** | **2061** | **29,200,000 -7%** | **52 -28%** | **35,310,000 -17%** | **48 51%** |
| • Personal Transportation | 12,209,000 | 28 | 11,325,000 | 20 | 8,641,000 | 12 |
| • Commercial Transportation | 5,568,000 | 13 | 5,260,000 | 9 | 5,888,000 | 8 |
| • Public Transportation | 1,038,000 | 2 | 985,000 | 2 | 1,040,000 | 1 |
| **Total Solid Waste** | n/a | n/a | n/a | n/a | n/a | n/a |
| **Total Community-Wide** | **42,433,000** | **96** | **46,770,000 -10%** | **83 -14%** | **50,879,000 -20%** | **69 -28%** |

**Excludes large industrial buildings*

## 1.2 Sub-Sector GHG Emission Forecast

Personal transportation is the largest share of all emissions. They are also reduced most dramatically by local and senior government action.

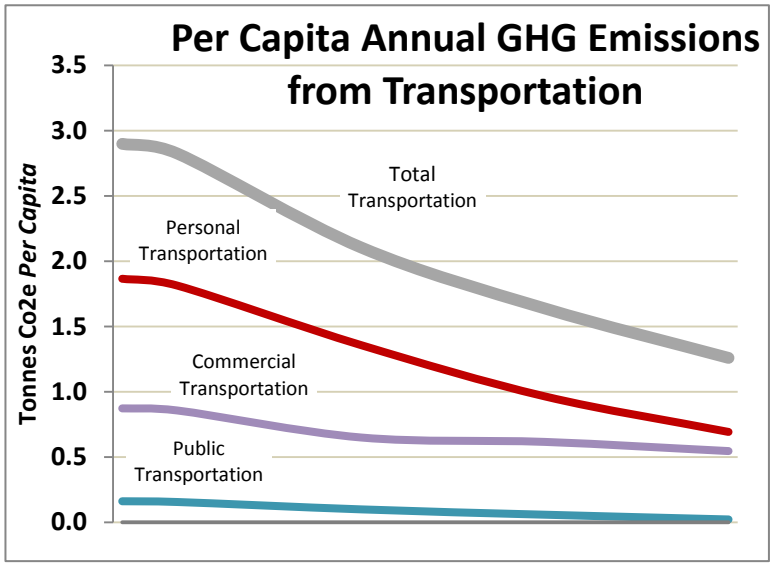



**Figure 24: Per Capita Annual Transportation GHGs**

Building GHGs are most concentrated in the residential sector. This is where the emission reductions are the greatest.

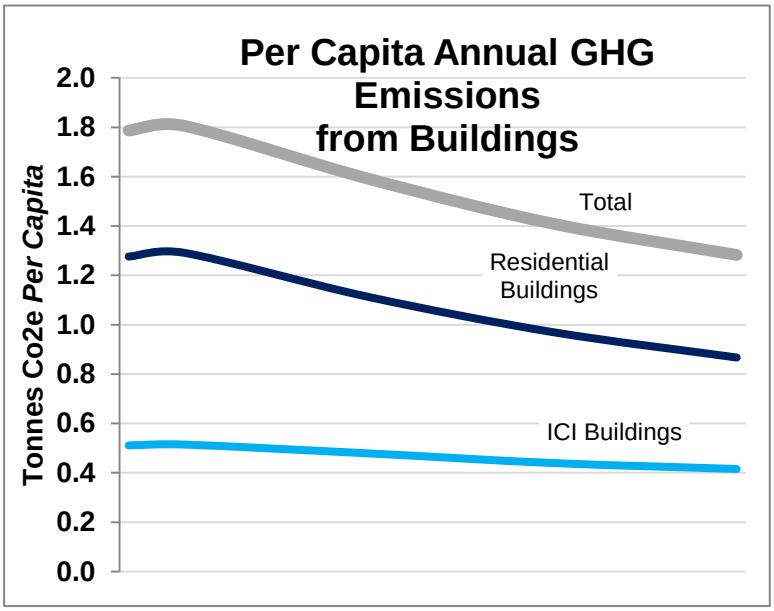



**Figure 25: Per Capita Annual Building GHGs**
(ICI: Institutional, Commercial, Industrial)

## 1.3 Energy Savings

Community-wide annual energy savings delivered by this Plan are concentrated in the transportation sector – 46% or $662 million by 2040 relative to Business As Usual (Table 9). Total community-wide energy savings are 30% relative to BAU or $736,389.

Table 9: Community Wide Annual Energy Savings Relative to Business as Usual

| | 2020 | | 2030 | | 2040 | |
|---|---|---|---|---|---|---|
| **Residential Buildings** | **$7,510,000** | **2%** | **$25,720,000** | **4%** | **$54,441,000** | **8%** |
| ICI Buildings | $7,418,000 | 3% | $10,700,000 | 4% | $20,385,000 | 5% |
| **Total Building Savings** | **$14,930,020.00** | **2%** | **$36,422,030.00** | **4%** | **$74,828,040.00** | **7%** |
| Personal Transportation | $43,740,000 | 8% | $118,203,000 | 21% | $216,196,000 | 34% |
| Public Transportation | $10,397,000 | 26% | $23,235,000 | 48% | $59,667,000 | 76% |
| Commercial Transportation | $117,429,000 | 38% | $181,153,000 | 45% | $385,700,000 | 60% |
| **Total Transportation Savings** | **$201,426,040.00** | **22%** | **$395,435,060.00** | **42%** | **$811,219,080.00** | **46%** |
| **Total Community-Wide Savings** | **$186,494,000** | **12%** | **$359,011,000** | **19%** | **$736,389,000** | **30%** |

## 1.4 Key Targets & Indicators

The following targets relative to the 2007 base year support the Plan's strategies:

- **Community Wide:** Reduce per capita residential GHGs 50% by 2040 and 20% by 2020
- **Community Wide:** Reduce per capita energy consumption 33% by 2040 and 20% by 2020
- **Land Use & Transportation:** Increase resident walking distance to transit 20% by 2040 and 10% by 2020
- **Land Use & Transportation:** Reduce personal vehicle driving distances 7% by 2040 and 4% by 2020 (vehicle kilometres travelled)
- **Land Use & Transportation:** Increase bicycle route kilometres 70% by 2040 and 33% by 2020.
- **Buildings:** Increase annual retrofit rate of existing buildings to 2% from 1%
- **Buildings:** Improve energy performance beyond typical new construction by 10% from 2015-2040
- **District Energy:** Targets in development
- **Solid Waste:** Divert 75% of solid waste to recycling and composting by 2020 and 85% by 2040

| Select Community Wide Indicators | 2020 | 2040 |
|---|---|---|
| Per Resident Tonnes of Personal GHGs (no institutional/commercial) | 2.6 \| -23% | 1.6 \| -52% |
| Per Capita Tonnes of Community GHGs (res, commercial, institutional) | 3.8 \| -22% | 2.6 \| -46% |
| Per Resident Personal Energy Use in Gigajoules (transpo, buildings) | 55 \| -14% | 43 \| -33% |
| Total Community Wide GHG Reductions Relative to 2007 | -1% | -13% |
| Total Community Wide Energy Savings Relative to BAU ($ millions) | 186.5 \| -12% | 736.5 \| -30% |

*Indicator values were generated by CEEMAP – the Community Energy and Emissions Modeling and Planning Tool.*

# 2 Land-Use

Relative to most other sectors where senior governments have significant authority, municipal authority and influence over urban land use is paramount. Land use planning has considerable influence carbon and energy activity for residents and businesses.

Land use planning determines where Surrey residents live, and to a certain extent where they and many others in the region work, shop, worship and recreate. The foundation of a transportation plan is a land use plan, profoundly influencing how people get to and from origins and destinations, with significant implications to energy and carbon. Carbon and energy in buildings is fundamentally influenced by building type, as well as design. The complete, compact nature of a neighbourhood, moreover, influences its potential for efficient, low carbon district energy.

Strategies in this section aim to maximize the location efficiency of growth, diversify the building stock, and contribute to the public realm with the aim of supporting higher efficiency buildings, transit, walking, cycling, and overall liveability.

| Key Indicators & Targets | 2020 | 2040 |
|---|---|---|
| Population | 562,400\| +25% | 739,000 \| +65% |
| Employment | 217,000 \| +52% | 280,000 \| +102% |
| Housing % Split at Milestone | 58\| 21\| 21 | 49\| 24\|26 |
| Resident Walking Distance (400 m) to Frequent Transit (5 min) ⊙ | 61% \| +10% | 72% \| +21% |
| Average Resident Distance to Employment in Region | 16.6km \| -0.05% | 15.5km \| -0.11 |

*-Annual performance relative to 2007 unless indicated.*
*-Indicator values were generated by CEEMAP – the Community Energy and Emissions Modeling and Planning Tool.*
*-⊙ Key Targets*

## Community Co-Benefits

As well as managing energy and carbon, land use strategies support broader community priorities.

Healthy Living | Affordability | Liveability | Smart Moblity

### Strategies

A. Focus Growth & Green Greenfields
B. Complete, Compact, Connected Corridors
C. Compact & Live/Work Housing
D. Low Carbon Development Permit Areas
E. Neighbourhood Sustainable Energy Pilot
F. Sustainable Development Checklist Update

## Focused Growth & Rapid Transit

Surrey's envisioned rapid transit network includes a Light Rail Transit system as well as a rapid bus line.

Under the preferred land use approach, some intensification of growth in key corridors would increase the benefits of Rapid Transit. This linkage is explored further in the Transportation strategies.

## Focused Growth and Walkability

Focusing residential growth in proximity to transit and other key destinations like grocery stores, parks and jobs will foster active transportation. This linkage is explored further in the Transportation strategies.

# A. Focus Growth & Green Greenfields

## Background

The thrust of this strategy is focusing growth in transportation corridors and mixed use nodes, thereby increasing accessibility to work, school and shopping. Best practices are applied in new neighbourhood development, curbing carbon and energy growth. The elements in this strategy reinforce directions in Surrey's Official Community Plan, the City's transportation plans, and the district energy agenda. They also complement housing affordability and healthy living by putting more affordable residential building types within walking and cycling distance of commercial and recreational destinations.

The land use plan focusses employment and residential growth in major nodes and corridors consistent with the City's emerging plans, as well as a greater proportion of infill in existing areas. This land use future is largely reflective of a shift in real estate demand that would accompany rapid transit deployment. This Plan assumes a full light rail and bus rapid transit network deployed by 2020. It is quite possible that more growth would locate in these corridors, taking advantage of attractive, convenient, fast rapid transit service, further reducing energy demand and GHGs.

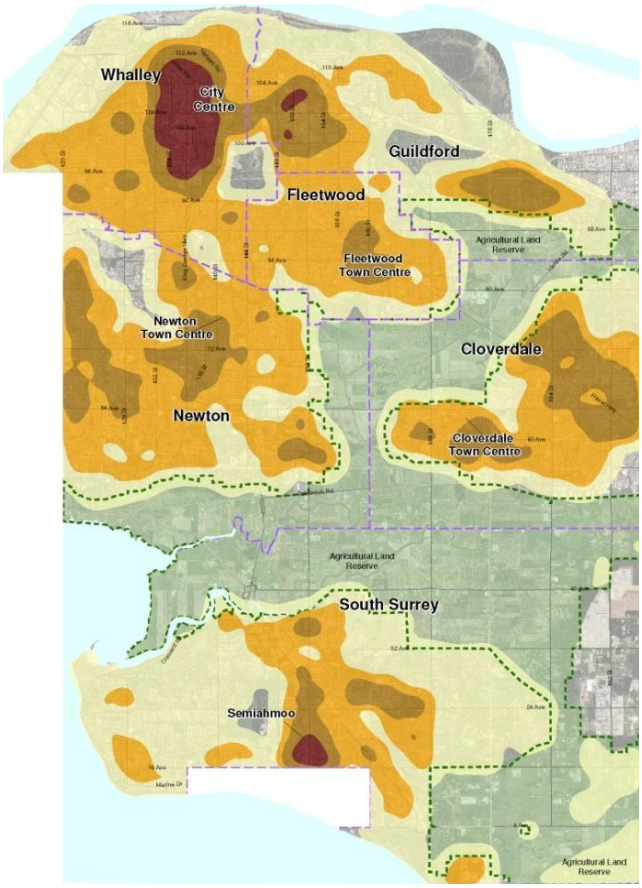



**Figure 26: 2040 Population Distribution:** Population will be focused in Surrey City Centre, first, then Town Centres, followed by corridors.

## Recommendations

Use the Official Community Plan and secondary plans to determine the type and nature of growth to support carbon and energy management in buildings and transportation.

1. Build on existing policies and plans to support City Centre as the region's second metropolitan centre.

   - Support high density, mixed use development and revitalization through redevelopment.
   - Encourage major institutional and commercial developments to locate in City Centre.

2. Build on existing policies and plans to focus residential and commercial growth in Town Centres, reinforcing the success of rapid transit infrastructure investment.

   - Transition single use commercial areas to mixed-use areas by residential development of large surface parking lots.

3. Focus growth in interconnected nodes and along transit corridors.

   - Use the Frequent Transit Development Area designation (see sidebar below) to support medium to high residential and commercial growth, strengthening transportation efficiency and successful rapid transit infrastructure investment.
   - Support medium density residential growth along secondary transit corridors.

4. Encourage gentle intensification of mature neighbourhoods. (This approach complements the *Compact and Live/Work Housing* strategy below).

   - Encourage intensification that maintains existing neighbourhood character through "invisible density" such as secondary suites, coach/laneway/garden houses, townhouses and ground-oriented multiplexes (2-5 units).

5. Build out existing Neighbourhood Concept Plans (NCP) with leading best practices.

   - Maintain the integrity of protected areas and the Agricultural Land Reserve.
   - Develop adequate commercial lands close to or within NCP areas to strengthen the job to resident ratio.
   - Ensure build out of existing NCPs prior to commencing new NCP.
   - Phase future NCPs to encourage a greater share of infill development relative to greenfield development.
   - Use the land use, transportation and building strategies of the *Community Energy & Emissions Plan* to continue to integrate best practices into the build out of existing NCPs.

6. Support commercial and industrial growth in areas that encourage transportation efficiency and rapid transit success.

   - Locate large institutional and commercial employers in City Centre, Town Centres or along Frequent Transit Development Areas.
   - Encourage large employers interested in business park/ industrial lands to locate in North West Surrey proximate to transit and higher residential populations. Encourage less employment intensive development in Southern business park/industrial lands.

### Secondary Land Use Plans

Surrey has a number of secondary land use plans supplementing the Official Community Plan, providing more detailed neighbourhood planning. They include General Land Use Plans (GLUP), Neighbourhood Concept Plans (NCP), Local Area Plans (LAP), Town Centre plans (TC) and the Surrey City Centre Plan.

The *Community Energy & Emissions Plan* reinforces build out of existing secondary land use plans with leading best practices, and locating growth in future NCPs adjacent to Town Centres and rapid transit corridors.

Table 10: Key Growth Assumptions by Major Land Use Type

| Planning Area | Indicator | Base Year 2007[4] | 2040 |
|---|---|---|---|
| Surrey City Centre | Density | 20 UPH / 20 EPH | 97 UPH / 92 EPH |
| | Share of new residential growth (dwellings/pop) | 5%/4% | 21%/18% |
| | Share of total residential pop | 6% | 10% |
| | New Building Mix | 100% MF | 100% MF |
| Town Centres | Density | 15 UPH / 21 EPH | 64 UPH / 65 EPH |
| | Share of new residential growth (dwellings/pop) | 12%/11% | 10%/8% |
| | Share of total residential pop | 9% | 8% |
| | New Building Mix | 96% MF 4% SF | 100% MF |
| Greenfield Neighbourhoods | Density | 5 UPH / 2 EPH | 21 UPH / 8 EPH |
| | Share of new residential growth (dwellings/pop) | 8%/11% | 17%/18% |
| | Share of total residential pop | 5% | 9% |
| | New Building Mix | 42% MF/58% SF | 63% MF / 37% SF |
| Frequent Transit Network Corridors | Density | 20 UPH / 21 EPH | 55 UPH / 33 EPH |
| | Share of new residential growth (dwellings/pop) | 7%/6% | 17%/15% |
| | Share of total residential pop | 16[5]% | 12% |
| | New Building Mix | 54%mf/46%sf | 100% MF |

UPH: Units per Hectare | EPH: Employees Per Hectare

## B. Complete, Compact, Connected Corridors

### Background

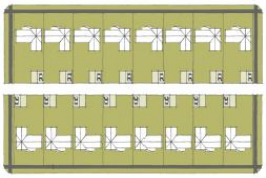
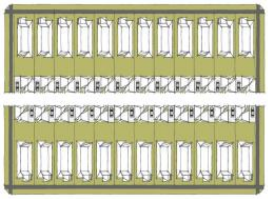
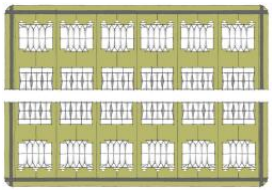
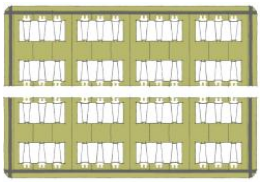
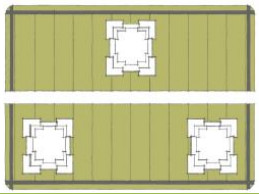
Reducing dependence on carbon-based transportation requires integration of land use, transportation, and infrastructure planning. High speed, convenient, low carbon mobility across large regions necessitates rapid transit. Rapid transit success is correlated to the quantity of jobs and residents within walking distance to transit (measured by metrics such as ridership, per capita cost, or cost per tonne of carbon). Attracting employers to a location in Metro Vancouver is strongly influenced by high quality transit. Office space within 500 metres of SkyTrain stations has a 3% vacancy rate in Surrey. Office space more than 500 metres from SkyTrain has a 25% vacancy rate (Jones Lang Lasalle, 2012).

A strong district energy network, and the resilience it affords users, also requires higher thermal energy density, typically associated with higher residential density, and ideally some diversity to distribute heating loads over the day.

Attracting residential density and diversity requires diverse housing tenures, types, sizes, costs, as well as access to safe places to meet and recreate such as parks, plazas, and community centres, and attractive neighbourhoods characterized by elements like thoughtfully designed streets and plazas. Aligning these factors requires significant collaboration amongst many actors such as the development community, TransLink, senior governments, and diverse community organizations. Physical land use and development planning, growth management, and urban design play critical roles. The City's leadership and success in Surrey City Centre is a solid foundation upon which to build.

[4] 2007 new dwellings is based 2001-2007 delta
[5] Signifies shitft from SF to mF ppn/hh goes down by 50%!!

**Table 11: Housing Form & Transit:** Secondary suites, laneway homes, and semi-detached houses can help focus growth. Rapid transit densities typically start in Townhouse/Rowhouse form. (Golder Sustainable Communities)

| Type | Description | UPH[X] | Distribution | Aesthetic | Transit Type[Y] |
|---|---|---|---|---|---|
| **Single Family** | -Single detached dwellings (1-2.5 stories) | 10-20 SF density |  |  | Basic Services |
| **"Hidden Density"** | -Compact single detached<br>-Singles with suites<br>-Laneway homes<br>-Larger with 3-4 units | 20-86 ~3x SF density |  |  | |
| **Semi-Detached** | -Duplex, Rowhouse, Townhouse | 40-125 ~5x SF density |  |  | Rapid Transit Services |
| **Low Rise Aptmnts** | -Low rise apartments of up to 4 stories<br>-Stacked townhouses | 40-300 ~10x SF density |  |  | |
| **Mid to High Rise Aptmnts** | -Mid and high rise apartments 5-50 stories | 250-800 ~25x SF density |  |  | *Typical continuum for service type by residential density* |

[X] Dwelling Units per Hectare
[Y] While important, density is one of many factors that determine appropriateness of transit type. Some highly used routes run to and through very low residential densities, e.g. Vancouver International Airport

## Recommendation

Encourage corridor intensification and revitalization. Adjust nature and intensity of development and design along corridors, providing appropriate transitions between Town Centres, and a hierarchy between the FTN and secondary corridors. Use diverse policies and tools to support revitalization, such as land use plans, incentives, real estate development and public investment tools.

1. Clearly define transit corridors for intensification using the Official Community Plan and its breadth of policy tools (e.g. development permit areas, zoning bylaws, arterial road intensification policy) to support effective design and development.
    - Integrate district energy policy and planning into land use and transportation planning, optimizing development patterns to strengthen the success of rapid transit and district energy.

## City Urban Design Leadership

The City can build on its leadership to enhance design along major transit corridors.

- The City has Development Permit Guidelines for neighbourhoods across the City that address safety, access, circulation, parking, and building form or character
- The City recently redesigned Holland Park to support festivals and events.
- The City has a Beautification Program to enhance neighbourhood aesthetics and build more vibrant communities.
- The Public Art Program contributes to creating vibrant public spaces.
- Neighbourhood Concept Plans incorporate place-making principles into new neighbourhood design.
- The City is a pioneer in Crime Prevention Through Environmental Design (CPTED), which aims to reduce or eliminate crime by creating spaces that people take ownership of, providing clear transitions between public and private space, maximizing visibility, controlling access, and maintaining appearance.

## Frequent Transit Development Area

This planning area designation is in Metro Vancouver's Regional Growth Strategy for higher density residential, commercial, mixed use locations along TransLink's Frequent Transit Network.

- Encourage complete, compact, connected development 400 metres either side of proposed rapid transit lines – cascading density out from stations. Consider initiating secondary plans to facilitate development and design along priority corridors.
- Minimally encourage gentle intensification densities along the Frequent Transit Network and secondary corridors.

2. Encourage a variety of housing types to attract diverse households (singles, couples, large families) within transit corridors.

- Encourage family-friendly housing with a mix of unit sizes (e.g. 2, 3 and 4 bedroom units) in multi-family developments; encourage diverse tenures (e.g. rental and fee simple); and support appropriate single-family-home-like amenities such as safe play areas and food growing opportunities within or nearby.
- Focus highest residential densities adjacent to transit stations, reducing densities as station distance grows. Provide for a diversity of housing types from low and high rise or smaller format MURBS such as townhouses, as well as multiplexes and duplexes, and then single-family character homes with suites.
- Encourage residential versus commercial, and medium vs. high density along secondary corridors, emphasizing housing formats that maintain single family and semi-detached character.
- Protect purpose-built rental stock in its present form or allow new development in its place with a requirement to replace an equivalent number of rental units.
- Consider interim parking measures to support higher density in areas where frequent transit is expected. Reduce parking requirements to promote housing affordability and transit.

3. Encourage major employers to locate in nodes and then corridors.

- Encourage mixed use buildings with retail, office and residential (inherently high efficiency building forms).

4. Ensure high quality urban design along rapid transit corridors to encourage walking, cycling, and access to transit.

- Continue City-led upgrades to street character and design, and public amenities (e.g. parks and community centres) along priority corridors in priority areas to strengthen the market signal to residents, businesses, developers and senior governments.
- Determine a long term approach for upgrading streets in key areas along priority corridors.
- Support urban design features such as: A) Sidewalks and street furniture scaled to the neighbourhood context with effective connections to private buildings; B) Interesting gathering spaces in private and public realm; C) Safe, well-connected walking and cycling access between origins and destinations, including transit stations; and D) Green space access.

## C. Compact & Live/Work Housing

### Background

Compact housing refers to dwelling smaller than conventional large-lot single detached houses including secondary or basement suites, garden suites, and coach houses. In multi-family buildings, policies would typically focus on less conventional, more affordable formats such as micro and lock-off suites.

Compact housing can increase buyer and renter affordability, maintain neighbourhood character, and contribute to transit accessibility and ridership. It can additionally help reverse the growth in housing size that has contributed to rising per capita building energy use.

Many compact homes can serve as offices. Home offices can reduce commuting and preserve neighbourhood character when they do not have high client or employee parking requirements. They are also cost effective job creation and start-up spaces.

### Recommendations

1. Review City policy to increase opportunities for gentle intensification of mature neighbourhoods in frequent and secondary transit corridors with townhouses and ground-oriented multiplexes, and small lot micro houses.

2. Evaluate opportunities for micro-suites and lock-off suites in apartments in market responsive, high density, mixed use, transit corridor neighbourhoods such as areas with a high percentage of single person households like students. Consider reducing parking requirements and unbundling parking. Integrate transportation carbon and energy management with building strategies, e.g. *Local Incentive* in the *New Buildings* sub-section, below.

3. Encourage live/work use appropriately across the community focusing on frequent and secondary transit corridors. Some restrictions should be placed on visitor and employee parking to discourage large volumes of non-local traffic.

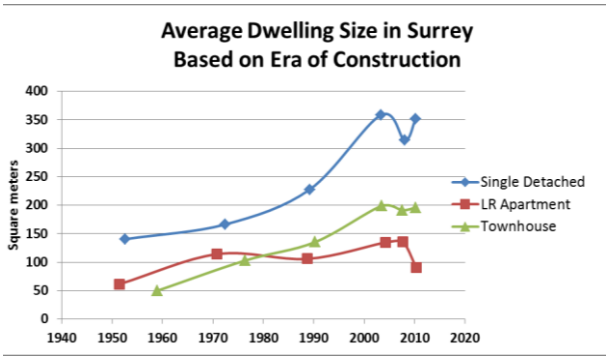



**Figure 28: Average Dwelling Size** in Surrey has risen since the 1950s, like most of Canada. Further driving energy demand has been a reduction in family size. Surrey's average family size has, stabilized over the last decade and is higher than the Canadian average.

### Secondary Suites

Since 2010 the City has permitted one secondary suite per single family home. This allows infill without changing neighbourhood character. Currently secondary suites are prohibited in semi-detached buildings and properties with a coach house.

### Coach Houses

Surrey has allowed coach houses in select areas for 10 years. Over 700 have been built, primarily in Clayton Heights and South Surrey. Many areas of the City do not have laneways, making coach house development impractical. Extending coach house development will involve resolving a number of issues including parking, multiple suites, lane design and landscaping.

### Micro Suites

In 2012 the City approved Balance, a 56 unit wood-frame building in City Centre. It will feature some of Canada's most compact suites – 90 to 200 square metres. The location reduces private vehicle dependency. Parking stalls are limited and sold separately. Car share services will be on site.

(Image: Tien Shier)

### Lock-Off Suites

Lock-off suites are secondary suites within an apartment. They provide flexibility for owners, allowing more space for a growing family, a semi-autonomous suite for an elderly parent, or a locked-off for a renter.

## Development Permit Areas

A Development Permit Area is an implementation tool pertaining to a specific area in a community.

DPAs lay out specific objectives and flexible guidelines to achieve them.

DPAs address a number of legislatively defined purposes such as safety, walkability, farmland protection. The *Local Government Act* has recently been amended to enable DPAs to cover energy and water conservation and GHG reduction. While they can apply to the exterior of a building, they cannot regulate what is inside the building.

DPAs are particularly effective in advancing passive design. Passive design strategies involve site selection, landscaping, insulation, window design, shading, non-mechanical ventilation, street and building orientation, massing and layout. Many passive design strategies are low to no cost and even cost saving measures.

DPAs can also be used to address important site level sustainable transportation opportunities such as pedestrian and bike infrastructure and network design considerations.

# D. Low Carbon Development Permit Areas

## Background

DPAs have significant potential for managing carbon and energy in buildings as well as important building and site-level considerations for transportation, waste and exterior lighting. As well as providing energy savings for owners, many measures are low to no construction cost.

## Recommendations

1. Create Low Carbon Development Permit Area Guidelines.

   - Develop passive guidelines to advance building efficiency (see sidebar).
   - Include guidelines to support, high efficiency exterior lighting for buildings, and private streets and parking areas.
   - Include sustainable transportation guidelines such as bike parking, bike/ pedestrian infrastructure, and electric bike and car charging stations.
   - Provide areas for recycling collection, composting and waste disposal that are appropriately sized, easily accessible and have capacity for future expansion, unless otherwise addressed by other bylaws.
   - Consider a neighbourhood typological approach to address unique opportunities. Focus on high growth neighbourhoods in creating Development Permit Area guidelines.

2. Amend the Terms of Reference for the City's Advisory Design Panel to ensure at least one member has expertise in applying the Low Carbon DPA guidelines. Liaise with BC Hydro for support in training.

3. Integrate Low Carbon Development Permit Area guidelines into the *Sustainable Development Checklist Update* (below in this section) and *Capacity Building* for builders, developers and key staff (in the *Buildings* section).

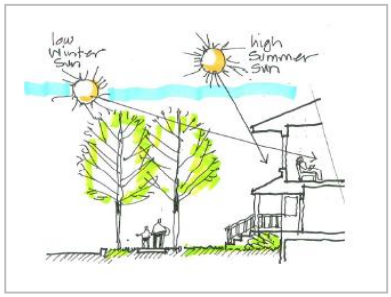



**Figure 29: Solar access:** Use shading and deciduous trees to maximize solar access for light and heat in winter and minimize in summer. (Illustration: Golder)

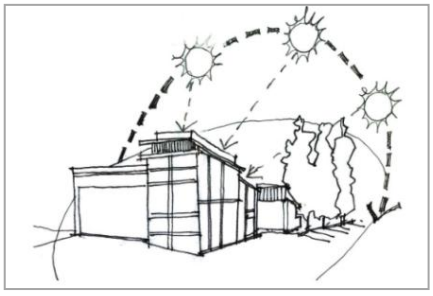


**Figure 30: Solar orientation:** Orient buildings to maximize solar access for heating and lighting. (Illustration: Golder)

## E. Neighbourhood Sustainable Energy Pilot

### Background

Neighbourhoods can be a good to scale to experiment with energy and carbon management. Many strategies outlined in this Plan are new for many City staff, builders, developers and current and prospective residents and businesses. Piloting strategies can permit some focused engagement, and additional support to help develop a level of comfort, refine strategies, and determine the extent and manner in which they are more broadly applied. Neighbourhoods with higher real estate demand can offer unique opportunities for innovation and monitoring. East Clayton was a neighbourhood-scale urban design pilot experimenting with new housing forms, street designs, and stormwater management. Many lessons were learned and have been adapted and integrated more broadly.

### Recommendations

1. Select, develop and roll out key pilot strategies in an appropriate neighbourhood, evaluate progress, strengthen strategies and potentially apply them more broadly. There are a range of candidate strategies that could be piloted in this from across various sectors of this Plan.
    - Collaborate with appropriate strategic partners to implement the pilot, such as builder/developer associations, financial institutions, utilities, non-profits.

| Neighbourhood Sustainable Energy Pilot Options | |
|---|---|
| Land Use | Complete, Compact, Connected Corridors |
| | Compact and Live/Work Housing |
| | Low Carbon Development Permit Area guidelines |
| | Sustainable Development Checklist Update |
| Transport | Select Integrated Active Transportation actions |
| | Select Bicycle Infrastructure Improvements actions |
| | Select Pedestrian Infrastructure Improvements actions |
| | Select Transportation Demand Management actions |
| Buildings | Third Party Incentive Promotion |
| | Local Incentive Program |
| | Basic Building Standards Strategy |
| District Energy | New Node & Corridor Evaluation |
| | Select DE Policy, Planning & Promotion actions |
| Solid Waste | Zero Waste Residents, Businesses, and Institutions |
| | Zero Waste Construction and Deconstruction |

### Surrey's Sustainable Development Checklist

Surrey's current Sustainable Development Checklist (SDC) was established to:

1. Support the Vision, Goals and Actions of the Surrey Sustainability Charter.

2. Encourage and highlight more sustainable land use and building design.

3. Provide a consistent "sustainability-focused" review of development applications.

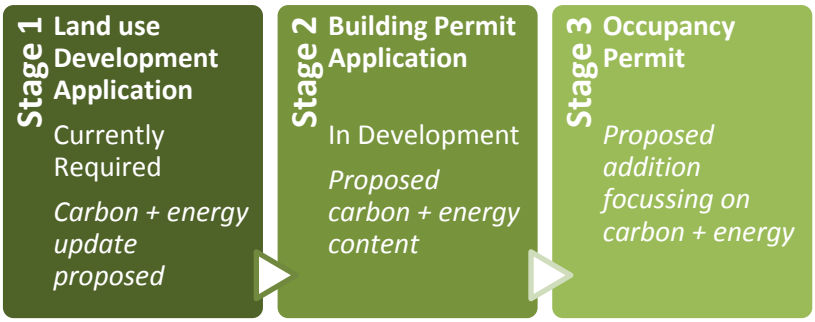
4. Raise awareness in the development industry of the benefits of applying sustainable "best management practices".

5. Explore and document how and to what extent new developments in Surrey are incorporating sustainable design and technology.

## F. Sustainable Development Checklist Update

### Background

Surrey's existing Sustainable Development Checklist (SDC) provides a solid foundation for guiding sustainable practices in land and building development in the private realm. Integrating capacity building, financial and regulatory strategies from the transportation, building and waste sectors into a future SDC update builds on this foundation to support clear and measureable carbon and energy management practices. The current SDC addresses broader social, environmental and economic considerations and these objectives should be maintained.




At present, the SDC is used during Development Applications during development applications to identify sustainability practices that could be considered, and provides staff and Council an opportunity to recommend additional measures. A second SDC stage focused on Building Permit applications is in development.

### Recommendations

The SDC could be used as a high level guidebook to assist developers and builders sequentially move through the entire development process and integrate the carbon and energy management strategies, and broader sustainability priorities. The checklist could follow the developer or builder through the development process and provide appropriate guidance by building types (e.g. wood frame buildings or large residential and commercial concrete buildings) and specific urban zones (e.g. Town Centre or greenfield).

Where possible, the SDC would incorporate and support achievement of quantifiable performance benchmarks. Performance benchmarks are critical for moving beyond business as usual development, setting realistic targets and tracking progress. The current SDC asks which standards are being pursued. An updated SDC would encourage development beyond business as usual and be able to quantify some actions to provide a performance based assessment of plans. This assessment can serve as a basis for discussing improvements for development performance, and provide tangible information to staff and Council that can be used in assessing applications.

To help prepare developers for the ongoing changes in the BC Building Code, the SDC should consider projected changes as part of its design. Key actions in the SDC update:

1. Consult with staff, developers, builders, Council and other key stakeholders in updating the Checklist content and process.

2. Consider phasing in a third Occupancy Permit Stage to confirm performance objectives and cover the full life-cycle of the construction process. Provide accurate and compelling information on the benefits of building commissioning. (ASHRAE, the standards organization for large buildings, explains commissioning as a comprehensive post construction inspection aimed at achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria. The inspection typically finds $4 of operational savings for $1 invested in the inspection.)

3. Update the SDC to include key performance benchmarks, guidance on suggested targets and certification programs to support them, and linkages to related strategies that will help builders and developers meet these targets, e.g. BC Hydro PowerSmart for New Homes incentive, and the *Green Loan Local Incentive Program*.

4. Evaluate the opportunity for developing Stage 2 (Building Permit Application) and Stage 3 (Occupancy Permit) of the SDC to provide guidance over the development life-cycle.

5. Train key City staff on emerging green building practices and targets and how they are integrated into the SDC.

6. Communicate the updated SDC through existing outreach channels like developer and builder associations.

7. Identify and integrate key resources such as training, information, and third party incentives. Establish a "living" list of resources including current capacity building and financing opportunities. Update these resources on an ongoing basis, at least once per year.

8. Include a line item in the SDC for submitting new development to the City Awards program for Clean Energy Leadership.

## Additional Land Use Opportunities

The following opportunity will be considered by the City in a later stage of CEEP implementation.

- **Growth Management Plan Continuous Optimization:** There is an opportunity for further strengthening GHG and energy management in building and transportation by further focusing residential and commercial growth.

  These opportunities could come in the form or real estate market shifts, gasoline price increases, or major rapid transit investment decisions. Assess on an ongoing basis, opportunities to re-direct residential growth from outside major corridors and nodes to inside corridors and nodes. Further focused growth can support other objectives, including transit ridership/congestion management, job creation, physical exercise, and transportation affordability.

# 3 Transportation

In 2007, transportation accounted for 62% of Surrey's GHGs and 47% of energy consumption. Transportation emissions from personal vehicles are the largest single source of GHGs. A history of spending by the region and senior governments on roads and bridges rather than high quality public transit has made the personal automobile the most attractive transportation mode, and has reduced market demand for complete, compact development – a precondition for successful transit and active transportation.

Surrey has a strong vision to reverse this trend in its Transportation Plan, Walking Plan, Cycling Plan, Rapid Transit vision, and long term, *complete, compact, connected corridor strategy* (above, under Land Use). The *Community Energy & Emissions Plan* strategies build on these existing plans and low emission vehicle strategies to reduce GHGs and avoid rapidly rising transportation fuel costs. These strategies, combined with good land use and design, will support a population that can walk to more destinations, and help curb growing health problems associated with sedentary lifestyles.

| Key Indicators & Targets | 2020 | 2040 |
|---|---|---|
| Per Resident Tonnes of Personal Transportation GHGs | 1.5 \| -29% | 0.7 \| -67% |
| Transportation Fuel Savings per Household Relative to Business As Usual | $230 \| -9% | $880 \| -34% |
| ⊙ Household Vehicle KM Travelled [X] | 20,000 \| -4% | 19,000 \| -7% |
| Household Transit KM Travelled [X] | 4,000 \| +8% | 5,000 \| +33% |
| Transit Route Network Length | 286 \| +33% | 382 \| +70% |
| Arterial Road Network Length | 624 \| +8% | 673 \| +14% |
| Average Intersection Density Per Road KM | 2.9 \|+17% | 3.6 \| +33% |
| ⊙ Bicycle Route Kilometres | 364 \| +33% | 485 \| +70% |
| Residential Population within 400 m of Bike Routes | 78% \| +16% | 97% \| +35% |
| Car Ownership Per Household | 1.19 \| -9% | 1.11 \| -15% |
| Per Resident Tonnes of Personal Transportation GHGs | 1.8 \| -3% | 1.4 \| -27% |

*-All % changes are annual performance relative to 2007.*

*[X]Despite a projected decrease, household size is held constant at current levels (3) in these calculations to compare relative change, and inform short to medium term decisions versus distant future ones.*

*-These indicator results were generated by CEEMAP – the Community Energy and Emissions Modeling and Planning Tool.*

*- ⊙ Key Targets*

## Community Co-Benefits

Economic Development | Energy Resilience | Healthy Living | Affordability | Liveability | Smart Mobility

## Strategies

***Transit***

A. Rapid Transit Development

B. Bus Service Improvements

***Active Transportation + Demand Management***

C. Integrated Active Transportation Infrastructure Improvements

D. Bicycle Infrastructure Improvements

E. Pedestrian Infrastructure Improvements

F. Transportation Demand Management

***Low Emission Vehicles***

G. Green Fleet Management and Vehicle Efficiency Support

H. Car Sharing Promotion

I. Low Emission Vehicle (LEV) Infrastructure Development

## Key Senior Government & Energy Utility Assumptions

Senior government, transit authority and energy utility action will have a significant impact on transportation emission reductions, and influence strategy development. Those key assumptions:

- Federal government raises vehicle emissions standards
- Senior governments and agencies invest in transit and electric vehicles
- Electricity prices steadily rise
- Carbon tax is maintained at current level

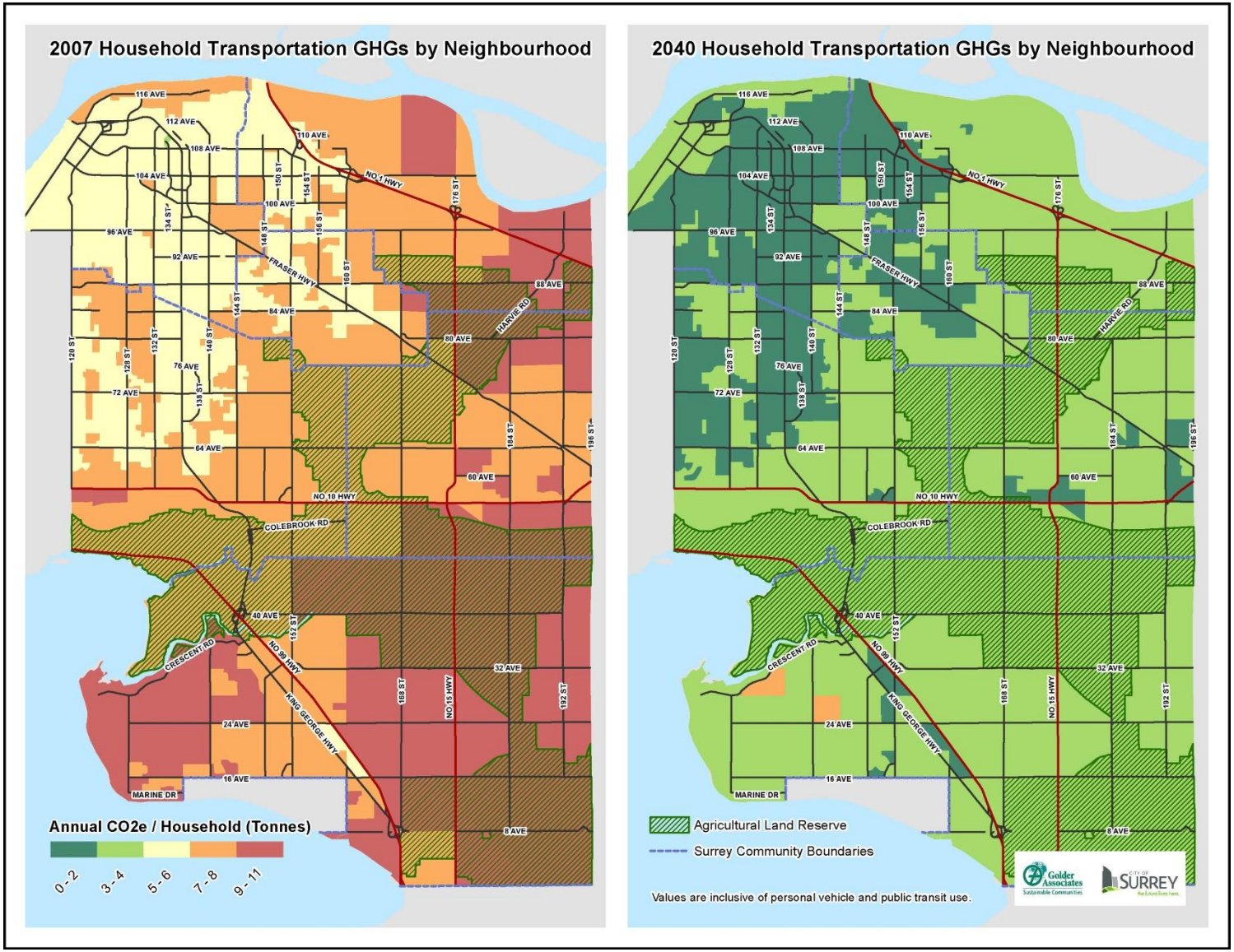



**Figure 31: Annual Household Transportation GHGs** drop 27% due to diverse changes driven by local and senior government activity. They result in increased vehicle efficiency and electrification, shifts to lower carbon transportation modes (transit, walking, cycling), more residential and commercial activity on good transit routes. The lowest emissions are in higher density areas well served by high quality transit and closer to employment in the region, and local services.

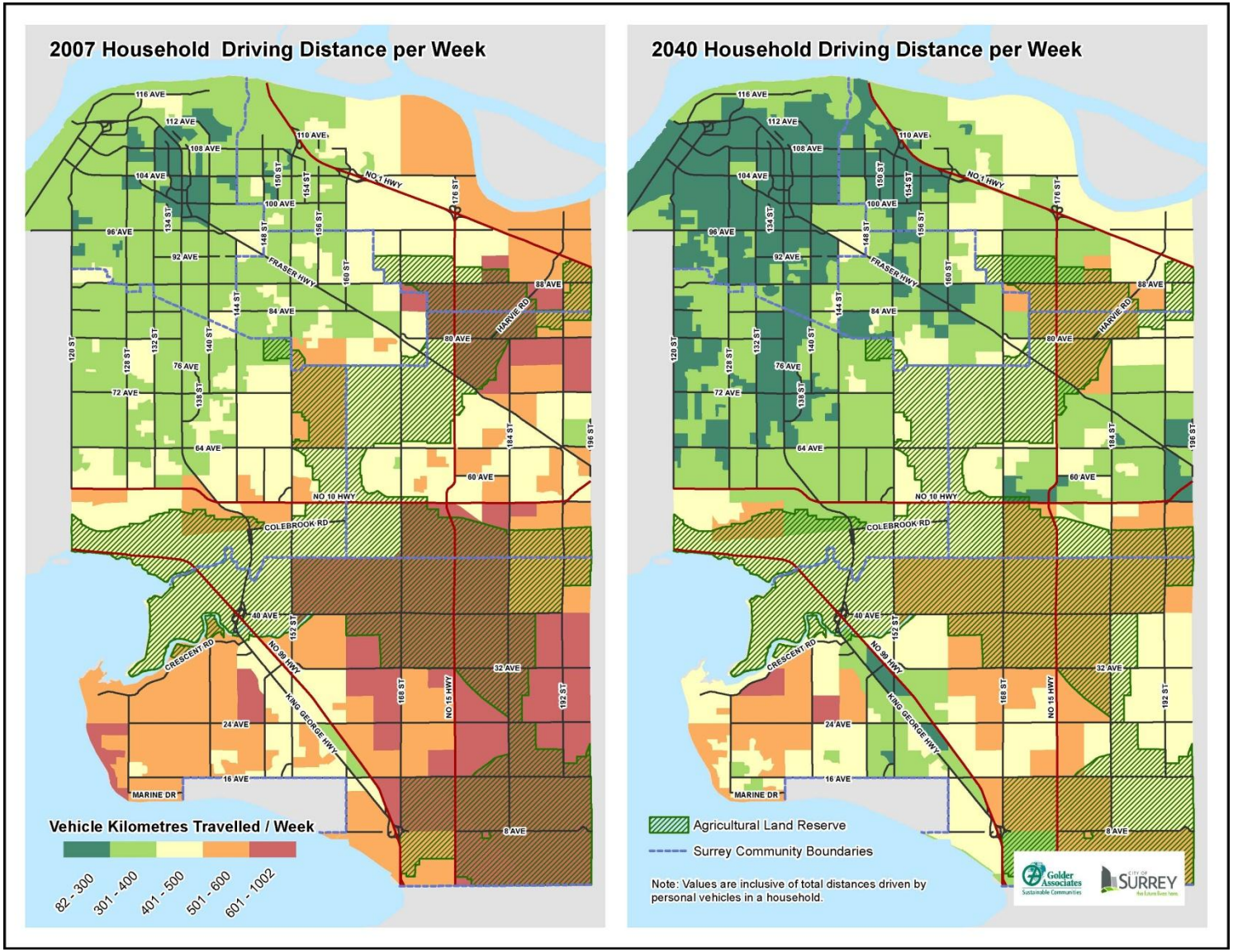



**Figure 32: Weekly Driving Distance Per Household** drops 7% due to shifts to transit as well as walking and cycling. The lowest emissions are in higher density areas well served by high quality transit and closer to employment in the region, and local services.


Surrey's preferred transit option – Light Rail – will help focus growth better than other rapid transit options. (Photo: City of Surrey)

### Rapid Transit & Development

Portland has gained around $8 billion in new development around light rail stations and a 69% increase in the rate of development in station areas, compared to areas along the rest of the corridor. There is a 3% vacancy rate for office space in Surrey close to rapid transit compared to a 25% vacancy rate for locations far from rapid transit (Jones Lang Lasalle, 2012).

### Transit & Household Spending

After housing, transportation is the highest household expense. An average BC household spends more than $10,000 annually. Gasoline prices are projected to increase **220%** from 2007-2020 (US Energy Information Administration, 2012), measureably impacting household budgets. Average Surrey households own more than one car. Access to high quality transit can eliminate one vehicle in many circumstances – an average savings of over $5,000 annually including insurance, purchasing/leasing cost, and maintenance.

Modeled average transportation savings in well transit served, complete, compact neighbourhoods are estimated at an average of $1400 – 1800 per household per year in Surrey. Savings rise with increased density.

## 3.1 Transit Strategies

In 2007, personal transportation was Surrey's largest source of GHGs, accounting for 38% of Surrey's GHGs. These strategies focus on shifting trips to transit mode. Success is linked to effective land use planning. As well as reducing GHGs, good quality transit can reduce steadily rising transportation spending.

### A. Rapid Transit Development

### Background

The City of Surrey is working with TransLink, regional, provincial and federal government bodies to consolidate support for a Light Rail Transit (LRT) network to better serve and link communities South of the Fraser. As well as provide high speed, convenient transportation, LRT will attract residential and commercial growth to corridors, and reduce rapidly rising transportation spending.


**Figure 33: Preferred Rapid Transit Future:** Surrey's preferred option within TransLink's option analysis is light rail from City Centre to three town centres: Guildford, Langley City and Newton; and Bus Rapid Transit from Newton to White Rock City Centre. (Map: TransLink / Ministry of Transportation and Infrastructure)

### Recommendations

1. To maximize ridership, focus complete, compact development along designated rapid transit corridors. Use the Frequent Transit Development Area (FTDA) designation and the complementary strategy, *Complete, Compact, and Connected Corridors* (in the *Land Use* section, above) to facilitate growth in these corridors and Town Centres, specifically:

   - King George Boulevard from City Centre to South Newton and extending to Highway 10.
   - 104 Avenue from City Centre connecting to Guildford Town Centre to 156 Street.
   - Fraser Highway from City Centre through Fleetwood Town Centre to Langley City.

2. To maximize potential for shaping growth and attracting ridership, work with TransLink, Metro Vancouver local governments, and senior governments to establish an LRT-oriented rapid transit network, specifically LRT from City Centre to three town centres: Guildford, Langley City and Newton; and Bus Rapid Transit from Newton to White Rock City Centre. (See Figure 33 *Preferred Rapid Transit Future*)

3. Work with TransLink, Metro Vancouver local governments, senior governments, and major employers and investors, to support rapid transit South of the Fraser through a combination of innovative local and senior government financial tools which could include one or more of the following options (See also *Carbon Pricing Revitalization & Clean Air and Healthy Communities Fund* in Cross Cutting *Strategies* section, below):

   - An equitable, regional road pricing regime;
   - An updated provincial carbon tax that would recycle revenue towards low carbon priorities, specifically public transit in Greater Vancouver;
   - Special transportation sales tax;
   - Vehicle registration surcharge;
   - Expanded regional parking tax to include parking spaces;
   - Balanced provincial/regional spending on public transit and active transportation relative to road, bridge and tunnel spending; and
   - "Prosperity" Fund for Low Carbon Community Development, establishing an envelope from Liquefied Natural Gas Royalties to invest in low carbon community projects.

## B. Bus Service Improvements

### Background

While rapid transit will provide significant benefits, improve the quality and extent of bus services is critical to enhancing mobility to serve residents and employers across the region, and reduce greenhouse gas emissions in the transportation sector.

### Recommendations

1. Work with TransLink to increase bus service outside rapid transit corridors with and enhance connectivity to rapid transit stations.

2. Continue to expand multi-modal linkages for transit such as Park-and-Ride, and Bike-and-Ride.

3. Use the designation of Frequent Transit Development Areas (FTDA) and Frequent Transit Network corridors to support increased transit mode share. (See rapid transit and secondary corridor recommendations in *Complete, Compact, Connected Corridor* strategy, in *Land Use* section, above.)

### Bus Service & Infrastructure in Surrey

As of the end of 2012, the City had 1332 bus stops and the following exchanges:

- Guildford Exchange (11 routes).
- Newton Exchange (9 routes).
- Scottsdale Exchange (11 routes).
- South Surrey Park-and-Ride (5 routes).
- Surrey Central Exchange (22 routes).
- White Rock Centre (10 routes).

Bus stop amenities and accessibility, including benches, shelters and sidewalks, are the City's responsibility. The City built 20 bus shelters in 2012 and is building 20 more in 2013.

### Frequent Transit Development Area (FTDA)

TransLink defines frequent transit as service running at least every 15 minutes in both directions, throughout the day and into the evening, every day of the week.

Identifying these areas can provide more certainty to residents and businesses that transit will be convenient, reliable, and effective. Identifying and "branding" a location as a FTDA may make new development more desirable and easier to market.

## Active Transportation and Affordability

The most cost effective modes to support the movement of people are foot and bike. It is estimated that over $5,000 a year can be saved by a household by owning one less vehicle. For households that purchase *new* vehicles, this figure jumps to between $11,000 and $14,000 annually (City of Surrey, 2012)


## Greenways Plan (2012)

Greenways are multi-use pathways for pedestrians, cyclists and other non-motorized users. They provide Surrey residents with an opportunity to walk or cycle to destinations within their community and throughout the city. They promote active living and encourage the transition to more sustainable methods of transportation.

## Regional Cycling Strategy

TransLink envisions a cycling-friendly region, where cycling is safe, convenient, comfortable, and fun for people of all ages and abilities.

The region's 2040 targets:

- 15% of all trips less than 8 km to be made by bicycle;
- 50% of all cycling trips made by females
- 50% fewer people killed or seriously injured while cycling

# 3.2 Active Transportation & Transportation Demand Management

Active transportation covers any form of human-powered transportation with a focus on walking and cycling. High quality active transportation can reduce greenhouse gas emissions associated with travel while also saving money and improving g physical health. Quality walking and cycling networks are also complementary to an effective public transit network as public transit users walk and – if there are safe, effective routes – cycle to transit stations.

While the major imperative of this Plan is carbon and energy management, public health is a key motivation for expanding active transportation. For each hour of driving per day, obesity increases 6 percent. Walking and cycling for transportation reduces obesity risk (Sugiyama T. a., 2012).

Table 12 shows selected health indicators for Surrey in 2010. While overall life expectancy in Surrey is similar to the BC average, some key health issues, including diabetes and cardiovascular disease, are higher. Street, neighbourhood design and infrastructure, as well as proximity to key destinations, that makes walking and cycling easy and safe leads to more exercise and help reduce the rates of these diseases.

**Table 12: Selected Health Indicators for Surrey** (Source: Population Health Profile 2010 - Surrey LHA, 2010)

| | Surrey | BC | Surrey relative to BC |
|---|---|---|---|
| **Diabetes Mellitus** | 8.9% | 6% | Higher |
| **Cardiovascular disease** | 4.8% | 4.2% | Higher |
| **History of Stroke** | 1.1% | 1.1% | Equal |
| **Hypertension** | 18.3% | 15.6% | Higher |
| **Depression** | 21.2% | 2 1% | Equal |
| **Dementia** | 5.4% | 7% | Lower |

Transportation Demand Management (TDM) measures involve reducing demand for single-occupant vehicle travel, especially during peak hours. TDM can refer to land use planning and active transportation strategies. Within the context of this Plan, however, TDM refers to education, parking, and pricing strategies that affect travel demand.

## C. Integrated Active Transportation Improvements

### Background

Active transportation has significant potential for greenhouse gas emissions reductions, protection from rising transportation prices, and health benefits. Good cycling and walking infrastructure makes supports access to public transportation, improves convenience, and increases use. Lastly, a greater walking and cycling share can makes an important contribution to congestion management.

### Recommendations

1. Build on existing Walking and Cycling Plan guidance for education and outreach to promote interest in and awareness of pedestrian and cycling networks, health and consumer benefits, and city spending benefits.

2. Build on existing Walking and Cycling Plan guidance to enhance pedestrian and bicycle connectivity through existing suburban loops and cul-de-sacs.

3. Increase active transportation connectivity in new greenfield developments through the use of grid pattern street networks, or residential quadrant-style streets.

4. Building on the City's Walking and Cycling Plan, ensure new neighbourhoods establish cycling and pedestrian plans that include strong connectivity, an appropriate variety of route types (neighbourhood routes, greenways where appropriate, and separated bike paths), intersection push buttons, and end-of-trip facilities for key destinations (commercial, institutional and transit).

5. Update the *Sustainable Development Checklist* to encourage pedestrian and bike routes and infrastructure in the private realm and connectivity to the public realm. (See *Low Carbon Development Permit Areas* under *Land Use*, above.)

6. Evaluate potential to invest in active transportation infrastructure through "cash-in-lieu" from developers in exchange for reduced parking.

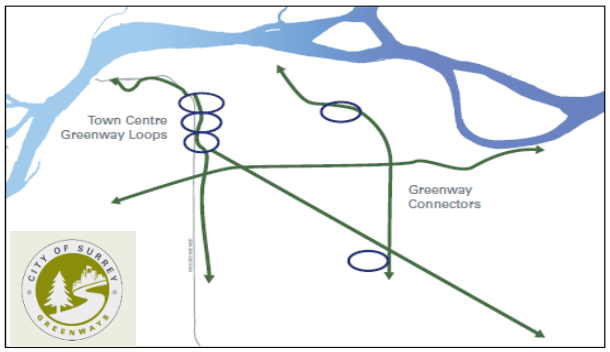



**Figure 34: Major Greenways** (Image: City of Surrey)

## D. Bicycle Infrastructure Improvements

### Background

To date, Surrey has over 450 kilometres of cycling routes, with approximately 12 kilometres added each year on streets, and 4 kilometres on greenways. A majority of residents live within 5 km of a Town Centre -- a 20 minute trip for average cyclists in average conditions (El-Geneidy, 2007).

For cycling to gain a larger share of overall trips, it must become an easier, safer and more enjoyable transportation choice. Realising this objective involves building on the City's efforts to establish an attractive, safe, high density bike route network with good connectivity, supported with good end of trip facilities. Integrating electric bike charging infrastructure into land use, transportation, and development policies and plans will remove a major barrier to a mode with significant growth projections in light of rising transportation costs. These recommendations reinforce the City's Cycling Plan which provides the essential framework for all these opportunities (see sidebar). This Plan aims to provide facilities for the "interested cyclist," representing 40% of the population, and the "regular cyclist," representing 25% of cyclists.


### Cycling Plan

The Plan **(2012)** has an ambitious vision for the City:

- That is well connected with bike routes, both on- and off-street.
- That is safe and convenient for cyclists of all ages and abilities.
- That has secure bicycle parking in both commercial and residential developments.
- That has easily identifiable and properly maintained bike routes.
- That supports cycling as a realistic transportation choice.
- Where more and more people are cycling.

There are 70 actions organized under four principles:

- **Making Connections:** Expand and improve the on- and off-street cycling network.
- **Providing Door-to-Door Service:** Increase the availability, quality, and variety of end-of-trip facilities.
- **Managing and Maintaining the Network:** Keep the network safe, visible, and in optimum condition.
- **Promoting Cycling:** Promote safe cycling as a healthy, fun and sustainable way to travel.

## Recommendations

1. Strengthen diversity, density and quality of the bicycle network, including a system and design to support Triple A (All Ages and Abilities) routes.

   - Increase and improve the bicycle network along all major corridors in City, including push buttons at major intersections.
   - Expand neighbourhood bike routes, and enhance connectivity through existing suburban areas.
   - Provide safe bicycle routes along key corridors leading to, from and in City Centre and Town Centres, prioritizing segregated facilities (separated bike paths, cycle tracks, and greenways).
   - Prioritize network and design improvements for accessing major destinations/clusters of destinations such as schools, grocery stores, and major employment nodes.
   - Explore viability of a regular maintenance program for the bike network to keep routes in good repair, clean and clear of debris.

2. Work with partners to improve quality and distribution of end-of-trip bike facilities (i.e. secure, weather-protected bike parking at origins and destinations, and additionally shower and change room facilities for employees in commercial buildings), and some access to basic 110 volt electrical outlets for E Bike charging.

   - Amend the zoning bylaw to require end-of-trip facilities in new multi-unit residential buildings for residents and visitors, and commercial buildings for employees and visitors, and some allocation of electrical outlets for E Bike charging.
   - Establish end-of-trip bike facilities in all public buildings for employees and visitors, where appropriate, and electrical outlets for E Bike charging.
   - Increase the density of safe, weather protected end-of-trip bike facilities in City Centre, Town Centres, transit hubs and nodes.
   - Continue to collaborate with the School District and TransLink to strengthen access to safe, weather protected, end-of-trip facilities for students and staff.
   - In collaboration with TransLink, improve multi-modal transportation by establishing safe network access and end-of-trip facilities at transit hubs, bike racks on all buses, and strong SkyTrain bike access.

3. Working with the School District, improve safe access to schools including intersection push buttons, separated bike lanes or neighbourhood bike routes, and student/staff end-of-trip, facilities.

4. Establish a consistent and clear bicycle way finding system, integrated with the public transit system and supported by digital tools and physical maps.

## E. Pedestrian Infrastructure Improvements

### Background

Walking improves community health and environmental sustainability, creates more civic pride and awareness, helps build cohesive communities, and reduces traffic congestion. Land use and transportation plans that focus people closer to key destinations and high quality transit, and establishes high quality transit and key destinations closer to more people creates a solid foundation to increase the number of trips and distances people walk. The City's *Walking Plan* lays out strategies to maximize this potential.

The City has made considerable progress in improving walkability. As of 2011, 70 km of a planned 270 km network of multi-use pathways have been constructed. In addition, 10-12 new traffic signals are implemented each year, providing improved road crossings. A costly but important challenge is incrementally redressing a major historical North American design oversight whereby many neighbourhoods were built without sidewalks or consideration for walking.

### Recommendations

1. Focus walking infrastructure improvements in higher density mixed use areas, specifically within the Frequent Transit Network.
   - Phase in sidewalk coverage within 200 m of key destinations.
   - Create more pedestrian crossings and signals in City Centre and Town Centres.
   - Enhance quality of sidewalk treatments within pedestrian precincts.
2. Update the *Sustainable Development Checklist* and use Development Permit Areas to promote active transportation and pedestrian infrastructure and network design in the private realm. (See *Sustainable Energy Development Permit Areas* under *Land Use*.)
3. Ensure new Area Plans effectively integrate pedestrian plans into their development.
4. Incrementally and opportunistically enhance pedestrian connectivity through suburban loops and cul-de-sacs.


### Walking Plan

The Walking Plan **(2011)** sets out the City's vision for the expansion of walking as a safe and convenient transportation choice for the citizens of and visitors to Surrey.

According to surveys conducted for the Walking Plan:

- 64% of the public say they would walk more if there were more walkways.
- 50% of the public are deterred from walking by a lack of sidewalks.
- 45% of the public say they would walk more if there were more marked crosswalks.
- 44% of the public say they would walk more if there were more mid-block crossings.
- 40% of arterial roads have two sidewalks and 25% have one sidewalk.
- Walking and cycling trails are the most used and most requested park features.
- Most people consider 3 km to be the greatest distance they would walk; 1 km is considered a comfortable walking distance.

## F. Transportation Demand Management

### Background

Transportation Demand Management involves reducing demand for single-occupant vehicle travel, especially during peak travel hours. This may occur through mode shift (more people walking, cycling, taking transit, or carpooling) or reduced driving (fewer trips to closer destinations).

Education is one of many strategies for reducing congestion and greenhouse gases. One of the reasons people drive is limited information or inexperience with alternatives. Amongst other strategies that increase convenience and reduce relative cost, better information can increase the use of transit, walking, cycling, and carpooling.

Price signals encourage sustainable transportation. For example, an average parking spot in Metro Vancouver costs between $10,000 (on-street parking) and $40,000 (for underground parking) to construct. In Surrey most on-street parking is free. When these hidden parking costs are revealed and optional, for example unbundling parking costs in developments, consumer decisions change. Measureable changes can only be expected when good alternatives are readily available.

### Recommendations

1. Work with TransLink and the City's active transportation initiatives (walking and cycling) to strengthen education and outreach:

   - Work with partners to provide resonant online and printed material for target constituencies on transportation costs and choices by mode and neighbourhood in Surrey to help residents and businesses make smart and sustainable decisions about transportation, and locations for new homes and businesses. Enhance TDM, anti-idling outreach, for example, into schools.
   - Encourage transportation demand management policies for large employers and explore how it could be required as a rezoning condition for new large employers or large employers moving to new locations. TDM plans should be comprehensive (e.g. transit, walking, cycling, and carpooling).
   - Collaborate with community organizations on outreach (e.g. trade associations, TransLink, Board of Trade, School Board).

2. Examine parking supply and price adjustments. Price signals and supply should be sensitive to cost effective, safe, convenient options.

   - Evaluate opportunities to adjust parking prices in City and Town Centres in a manner that does not undermine business. Explore parking supply reductions in exchange for more sustainable transportation in commercial and residential development.
   - Work with Metro Vancouver local governments, TransLink, and senior governments on regional/provincial price tools. (See the *Rapid Transit Development* strategy, above.)

### TravelSmart

TransLink's TravelSmart program offers tools, educational materials, and tips for residents, businesses, and schools to travel efficiently and effectively, saving money and reducing greenhouse gas emissions.

For businesses, TravelSmart offers site audits, company presentations, employee engagement, telework support, and discounted transit passes. (travelsmart.ca)

### Carpooling and Ride Sharing

Jack Bell Rideshare is a registered charity funded by TransLink and BC Transit, and designed to provide online ride-sharing services in BC. Anyone can log in to find ride-share matches. Businesses can also sign up to get their own ride-share website for employee use.

(https://online.ride-share.com for more information)

### Carpool Parking in Surrey

Scott Road and South Surrey Park-and-Ride offer free preferred parking for carpool groups (two or more passengers). Some employers also offer reserved or discounted carpool parking.

## 3.3 Low Emission Vehicle Strategies

While transit and active transportation opportunities will continue to grow in importance, Surrey's location within Metro Vancouver and the nature of existing residential and commercial development makes the car a part of the community's future. Low Emission Vehicle strategies address commercial and institutional vehicle fleets, car sharing opportunities, and diverse strategies for promoting low emission commercial, institutional and personal vehicles with emphasis on electric vehicles. These strategies build on the City's innovative requirement to offer alternative fuels at service stations, enabling lower carbon travel.

Residents and small businesses are likely to have between zero and five vehicles. Medium and large businesses may have hundreds and are more likely to have staff dedicated to vehicle fleet management and efficiency. Strategies in this section seek to address these groups' needs.

### G. Green Fleet Management and Efficiency Support

#### Background

Many organizations and businesses in Surrey have a fleet of vehicles to move staff and goods. These fleets may range in size from just a few vehicles to a few hundred. Regardless of size, there are existing programs to support more efficient vehicle fleets and driver behaviors.

In 2010, 300 taxis were registered in Surrey. Since 2007, the Province requires all new taxi vehicles meet a low emission vehicle standard and the City's business licensing places limits on the age of vehicles operating in Surrey. This has driven a major shift to low-emission vehicles. However, there are other gains the can be made: currently taxis require different licenses for different municipalities, and must therefore sometimes return to their origin empty even when they pass willing passengers.

Trucks are a significant source of greenhouse gas emissions and common air pollutants. Currently there are almost 6,000 registered tractor-trailer trucks in Surrey – more than a third of the regional total. Within the trucking sector, many businesses are small, owner-operated firms and fuel costs make up a significant share of their budget. There is a strong business case for retrofitting trucks with anti-idling technology. However, in many cases small trucking businesses also have narrow profit margins, constraints on capital to invest in upgrades, and limited knowledge of options. Surrey is uniquely positioned to support more efficient vehicle fleets that could have regionally significant implications.

#### Low Emission Vehicles

Low Emission Vehicles can include any vehicle that produces significantly less greenhouse gas emissions than a conventional one. LEVs include vehicles with lower carbon fuels, smaller or more efficient vehicles, and vehicles that are electric versus internal combustion.


Electric Car
(Photo: City of Surrey)


Natural Gas Heavy Duty Truck
(Photo: City of Surrey)

Low Emission Vehicles can also include retrofits to existing vehicles to make them run more efficiently and cleanly. For example, a refrigerated truck can be outfitted with an Auxiliary Power Unit (APU) that will keep refrigeration running while the main engine is off.


Auxiliary Power Unit on Heavy Duty Truck
(Photo: Transport Canada)

## Green Fleet Management and Training Programs

### FleetSmart

*FleetSmart*, a program offered by Natural Resources Canada, offers free advising and services on how energy-efficient vehicles and business practices can reduce operating costs, fuel consumption and GHG emissions.

Programs include free SmartDriver training for drivers, Fuel Management 101 workshops for fleet managers, educational materials, and general green fleet management advice.

A free workshop will be offered if at least 12 participants can be gathered together. Training sessions have been hosted in the past through the BC Trucking Association and through Port Metro Vancouver.

(http://fleetsmart.nrcan.gc.ca)

### E3 Fleets

The E3 program offers green fleet management services, including fleet efficiency benchmarking, fleet review, advising, and green fleet certification to its members. However, the costs of program participation may be high for small fleets (e.g. less than 5 vehicles).

E3 Fleets is managed by the Fraser Basin Council, a local non-profit society that advances sustainability in the Fraser River Basin and across BC. (www.e3fleet.com)


(Image: Fraser Basin Council)

## Recommendations

1. Convene FleetSmart driver training and Fuel Management 101 workshops in Surrey for commercial and institutional fleets. The City may play a role in workshop promotion, hosting, and even customization.

2. Consider requirements and incentives through business licensing, such as:

   - Business with fleets or a professional driver could be required to participate in basic training.
   - Incentives could be offered to businesses that join E3 Fleets, FleetSmart, Performance Innovative Transport for heavy haul trucking, or comparable green fleet and training program.
   - Incentives could be a rebate or time saver involving extending the period of a license. A fee reduction could be revenue neutral by modestly increasing other fees.

3. Work with the BC Trucking Association, Metro Vancouver, and the Port Authority to explore opportunities for a Surrey-based green loan and incentive program tailored for small trucking businesses. The program would focus on overcoming knowledge and capital barriers, and could be organized as a self-sustaining loan in partnership with a financial institution.

4. Explore through Metro Vancouver local governments the idea of integrated inter-municipal passenger vehicle licensing to improve driving optimization. This would allow taxis to return to their places of origin with passengers.

5. Working with other organizations and agencies to develop market-specific driver training and social marketing focusing on large sectors with high emissions and easier intervention like construction sites. Use leverage points such as site/project orientations to provide training and issuance of decals or tags that would allow entrance to sites.

6. Consider innovative opportunities for integrating freight into any road congestion charging or tolling system that would expedite regional freight traffic and contribute to public transit funding.

7. Consider further traffic signal synchronization alignment along major Surrey arteries, and extending permissible hours for truck loading, unloading and operation in appropriate locations.

## H. Car Sharing Promotion

### Background

Car sharing is an opportunity for some businesses and residents to reduce transportation costs as well as transportation GHGs. Car share users drive less than car owners, often eliminating one of the family cars. This reduces parking demand, which in turn can be used to reduce private and public sector costs to provide parking spaces.

### Recommendations

1. Continue to promote car-sharing to residents, businesses, developers, and public institutions, and facilitate discussions around the uptake of car sharing within the City.

2. Encourage car sharing by including dedicated on street parking in key neighbourhoods across the City, and protect car share parking in residential areas.

3. Evaluate opportunities to expand car sharing in residential developments through the Sustainable Development Checklist and parking variances.

    - Identify opportunities to reduce parking lot requirements to encourage car sharing and other vehicle reduction strategies in commercial and residential developments. This will require a comprehensive update to parking requirements in the Zoning Bylaw.

### What is Car Sharing?

Car sharing refers to business models that rent cars for short periods, charge by distance driven, time used, or both.

As car sharing involves paying based on usage, there is a significant incentive to drive only when necessary; the opposite is true of owning a vehicle, where ownership and insurance costs account for a majority of annual vehicle expenses, so the marginal cost of driving encourages lots of trips and long distances by car.

Modo Car Coop already has vehicles in City Centre. As population density and public transit options increase, so will the business case for other car share companies to establish themselves and new locations across the City.

### Car Sharing & Parking Demand

Recently, two developers in Surrey have integrated co-op cars into their developments. The City supported these initiatives by relaxing parking requirements, passing cost savings on to the developer, and condo owners.

One of two co-op cars at Quattro (Whalley Boulevard and 108 Avenue)

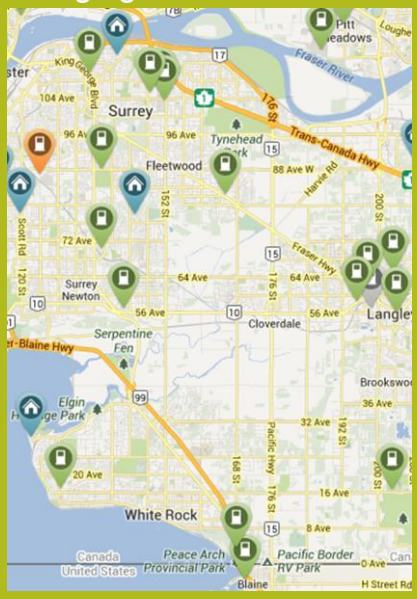
The upcoming Tien Shier micro-loft project pictured above is slated to include a co-op car and dedicated parking space.

## Surrey LEV Promotion

The City has passed a bylaw requiring new gas stations and major gas station renovations to include alternative fuel sources, such as a level-three electric vehicle charging station, compressed natural gas, hydrogen or propane.

Surrey was also the first major city in Canada to host a free, publically accessible EV charging station at City Hall. There are also 14 new charging stations across the community.

## Charging Station Network




(Map: PlugShare.com)

Surrey has a growing network of level 2 charging stations installed by the City, service stations and other businesses, as well as residents making theirs available. PlugShare.com has the most up to date locations.

## Charging Station Incentives

To facilitate market transformation, the BC Government has provided significant rebates for purchasing level 2 (fast charge) electric vehicle charging stations for residential, commercial and institutional use.

# I. Low Emission Vehicle (LEV) Infrastructure Development

## Background

Strategies that reduce automobile dependence in terms of trips, kilometres travelled and ownership are higher on the sustainable transportation hierarchy, however, the significant reductions in GHGs and air pollutants associated with new Low Emission Vehicles affords them a place in a GHG reduction effort. Low Emission Vehicles can include any vehicle that produces significantly less GHGs than a conventional one. Key examples include vehicles powered by electricity, biofuels from recycled feedstock, and natural gas.

For LEVs, convenient and accessible charging or fueling stations are highly important. High quality electric vehicle charging infrastructure is already being deployed by progressive real-estate developers as a result of market demand.

1. Expand opportunities for all low emission vehicles:

   - Continue to require new fuel service stations and major renovations to existing stations to offer alternative fuels.
   - Reduce parking rates and offer premium locations for low emission vehicles for both on-street and off-street parking lots, and encourage similar treatment by businesses and developers.
   - Evaluate the opportunity for adjusting business licensing fees in a revenue neutral manner so that companies with fleets using LEVs receive discounted rates.

2. Expand opportunities for electric vehicle charging infrastructure:

   - Conduct outreach to businesses and institutions located in strategic public locations for electric vehicle charging infrastructure based on high turnover rates, consistent demand and for 1-4 hour parking periods.
   - Require large new commercial and mixed used developments with significant projected vehicle volume to install Level 2 electric vehicle charging infrastructure (as well as the provision of some Level 1 outlets for electric bike parking). Provisions can be made for a combination of rough-in conduits as well as chargers.
   - Negotiate with optimally-located large companies to include charging equipment in their operations for staff, visitors, and patrons.
   - Require new multi-unit residential developments to have a combination of Level 1 charging outlets, and conduit ready Level 1 charging outlets, which have relatively minor cost implications. Include requirements for a minimum percentage (e.g. 15%) of parking spots to have potential access as well some accommodation for electric bike charging. These requirements could be met through an update to Zoning Bylaw

## Electric Vehicles (EVs)

While they do not reduce congestion and the cost of supporting automobile transportation, vehicle electrification (e.g. plug-in hybrid electric – PHEV – and full electric vehicles—EVs) can improve transportation energy efficiency, reduce greenhouse gases and other air pollutants, decrease oil demand, and reduce operation and maintenance costs. In the short-term, higher purchase prices and range limitations compared to internal-combustion-engine (ICE) vehicles will make EVs a niche market. Increasingly over the next ten years, a combination of technological innovation, policy evolution and market forces will result in EVs becoming more common. Local government engagement can significantly accelerate this market transformation process.

### Efficiency and Emissions

EVs—especially those charged using low carbon, high efficiency power sources such as hydroelectricity—use energy more efficiently and are responsible for significantly fewer air pollutants than their conventional ICE counterparts.

A typical EV uses 0.0828 gigajoules (GJ) per 100 km traveled. [A] An average passenger vehicle on the road today uses 0.348 GJ per 100 km traveled. One of the primary reasons for this is that EVs have much higher energy utilization rates, i.e. converting electricity to the drive train, rather than to heat or braking friction.

In British Columbia, a typical EV emits 6 grams $CO_2e$ per kilometre; the average ICE passenger vehicle in Surrey emits 288 grams $CO_2e$ per kilometre.

### Charging Station Location Optimization


Optimal EV Charging Station locations are mapped based on priority destinations, traffic volumes and employment density.

### EV Charging Infrastructure Types

In anticipation of new EVs and PHEVs, local and national authorities in coordination with vehicle manufacturers and utility companies have developed guidelines and codes for charging infrastructure. The BC government, through the Clean Energy Vehicle Program, is currently working towards the installation of more than 1000 charge points across the province by the end of 2013, offering residential rebates for Level 1 and 2 stations, funding incentives for publically accessible Level 2 stations and direct install of Level 3 rapid charging stations.

**Table 13: Charging Infrastructure Types**

| Charger Level | Rate (range per hr of charging)* | Electrical Requirements | Unit Cost | Electricity Cost per hr |
|---|---|---|---|---|
| 1 | 3 – 8 km | Standard wall plug (110V AC, 15-20amp) | $400 | $0.08 |
| 2 | 15 – 30 km | 220V AC, 20-80amp plug (e.g. oven or dryer) | $3,000-$10,000 | $0.16 |
| 3 | 290 – 380 km | Specialized equipment (400-500V DC, 125-200amp) | $50,000+ | $2.00-4.00 |

Sources:, (US Department of Energy, 2013) [A] According to the United States Environmental Protection Agency (US EPA), the 2011 Nissan Leaf (full electric vehicle) uses 0.23 kW-h of electricity per kilometre traveled. 1 kW-h is equivalent to 0.0036 GJ.

## Additional Transportation Opportunities

The following opportunities will be considered by the City in a later stage of CEEP implementation.

- **Expanded access to alternative fuel infrastructure:** There is a significant amount of compressed or liquefied natural gas fueling infrastructure held by private companies. The City should explore opportunities for expanding access to these fueling stations for other fleets and commercial vehicles with appropriate compensation. FortisBC has expressed a willingness to play a role facilitating access to existing fueling stations, and creating opportunities for broader access at new facilities.
- **Anti-idling initiatives:** Explore development of a community-based social marketing campaign for which there are municipal precedents. Idling is a significant waste a fuel. Reducing idling is a win-win scenario reducing energy use, local air pollution, global greenhouse gases, and saving money.

  Focus on major opportunities where there is significant idling and high potential to engage with target audiences with partners and efforts can be enforced such as construction sites and school drop off and pick up areas. Construction sites can involve and schools can engage schools and school boards as well as youth ambassadors and parents.

# 4 Buildings Sector

In 2007, buildings were responsible for approximately 35% of Surrey's total greenhouse gas emissions and 55% of energy use. Most GHG emissions from buildings are from natural gas combustion for space and water heating. As well as contributing to a more secure provincial energy system, and cutting carbon to support climate protection, more efficient buildings reduce energy spending for residents and businesses.

With appropriate policy and program design, energy retrofits in rental and social housing, moreover, can make an important contribution to safeguarding affordable housing and managing household energy costs for families with increasingly constrained incomes. Building energy retrofits, additionally, have the potential to create diverse job opportunities. Finally, building higher efficiency new buildings enables local developers and builders to meet the growing demand for higher standards driven by senior governments, utilities, technological innovations, competition and consumer demand.

| Key Indicators & Targets | 2020 | 2040 |
|---|---|---|
| Avg Per Resident Tonnes of Personal Building GHGs | 1.1 \| -13%[X] | 0.9 \| -32%[X] |
| Avg Per Resident Gigajoules of Building Energy Use | 33 \| -3%[X] | 30 \| -14%[X] |
| Avg Household Building Energy Savings Relative to Business As Usual | $40 \| -2%[X] | $200 \| -13%[X] |
| Community Wide Building Power Conservation Relative to Business As Usual ⊙ | 73 GWh \| 2% | 270 GWh \| 5% |
| Local Action Building Energy Retrofit Rate ⊙ | 1.00%[Y] | 1.00%[Y] |
| Energy Performance Beyond Typical New Construction at Milestone Year | 10% | 10% |

[X] *Annual performance relative to 2007.*

[Y] *Local action doubles retrofit rate driven by market, senior government and utility action from 1 to 2% per annum of existing buildings.*

*-Indicator values were generated through CEEMAP – the Community Energy and Emissions Modeling and Planning Tool.*

*-⊙ Key Targets*

## Community Co-Benefits

Economic Development | Energy Resilience | Healthy Living | Affordability | Liveability

## Strategies

***Cross-Cutting Building Strategies***

A. Capacity Building for Low Carbon, High Efficiency Buildings

***Existing Building Strategies***

B. Third Party Retrofit Program Integration
C. Affordable Housing Energy Retrofit Strategy

***New Construction Strategies***

D. Third Party Incentive Promotion
E. Local Incentive Program Development
F. Basics Building Standards Strategy

***Building Related Strategies in Land Use Sector***

- Sustainable Development Checklist Update
- Pilot Sustainable Energy Neighbourhood
- Low Carbon Development Permit Areas
- Compact & Live/Work Housing

## Key Senior Government & Energy Utility Assumptions

Senior government and energy utility actions will have a significant impact on GHGs and energy in buildings, and influence local strategies. Key assumptions:

- Steadily rising BC Building Code
- BC Hydro and FortisBC continue to provide incentives for energy efficiency and renewable energy, including community energy management
- Rising electricity prices and modest growth in natural gas prices

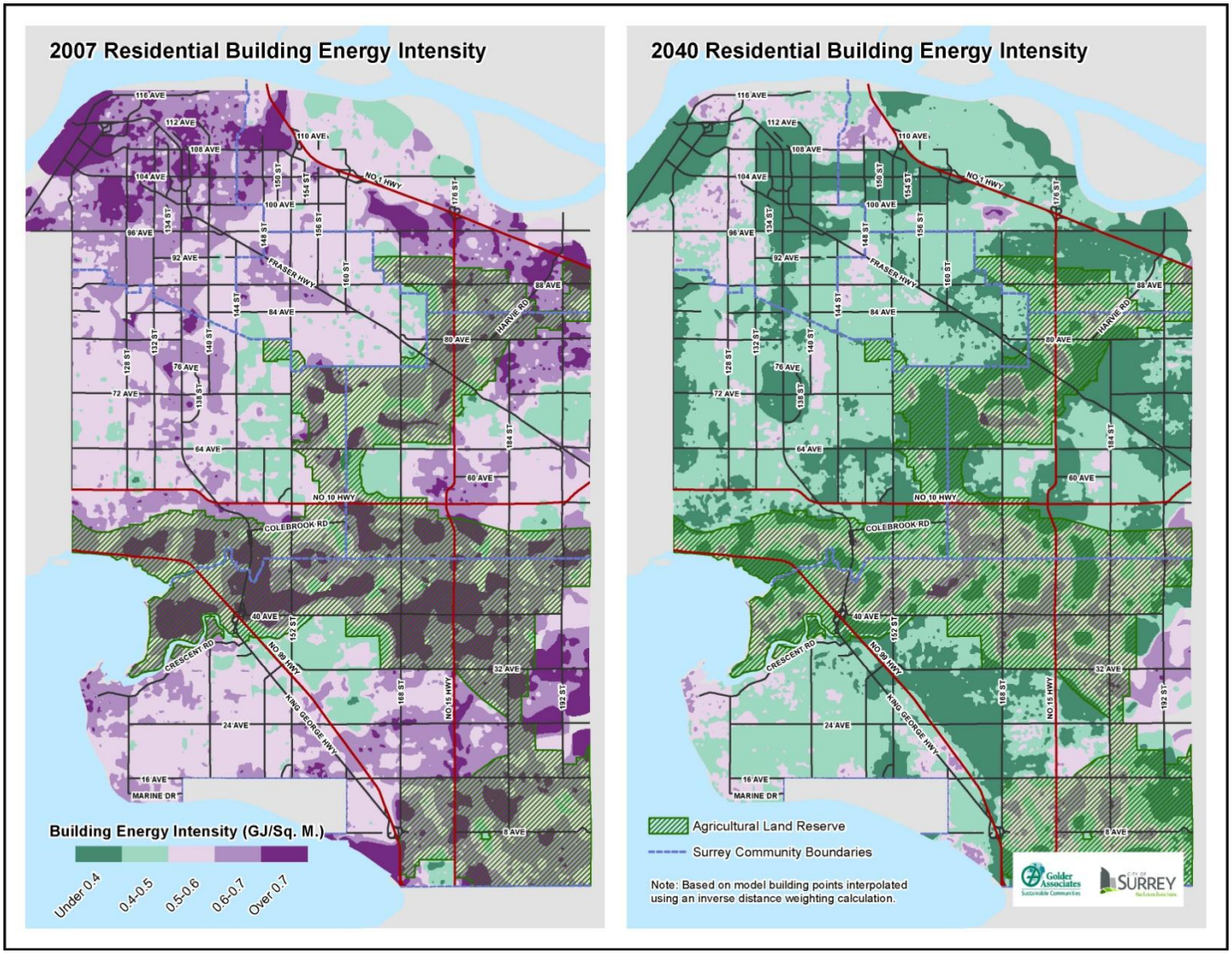



**Figure 35: Building Energy Intensity:** Intensity (measured in gigajoules per square metre of floor area) drops by 1/3 due to higher senior government building code, capacity building for new and existing buildings, local building retrofit programs, and incentives.

## 4.1 Cross-Cutting Building Strategies

### A. Capacity Building for Low Carbon, High Efficiency Buildings

There are many barriers to high efficiency, low carbon buildings – knowledge is an important one. Capacity building is aimed at strengthening information, knowledge, and skills. Capacity building is a cross-cutting strategy, supporting the success of other strategies. A capacity building program would tailor efforts to different audiences, and take advantage of existing programs. The City is exploring the delivery of training courses for builders with the Canadian Home Builders Association (CHBA) and other partners. The Homeowner Protection Office (HPO) is also developing new standards and requirements for tradespeople and builders. These programs should address key carbon and energy management priorities.

#### Recommendations

1. Awareness, training and institution building for new and existing buildings:

| Primary Audiences |
|---|
| ■ Builders, Developers and Design Teams<br>■ City Staff |
| **Secondary Audiences** |
| ■ Residential and Commercial Building Owners, Prospective Buyers and Renters, and Building Managers<br>■ Realtors (Residential and Commercial) |

   - Builder, developers, trades, and design teams: Collaborate with utilities, and construction/developer/builder associations to deliver programs. Fill key skill and knowledge gaps for improving energy and carbon management opportunities with a particular focus complementing strategies in this Plan. Cooperate at the regional scale with Metro Vancouver could economize efforts. Consider diverse players such architects and engineers and entry-level, sub trades such the crew installing air barriers and insulation in program design. Delivery can include workshops, info sessions, and promotion of third party educational programs, and information in applications. Pay particular attention to small and medium-sized builders, and sub-trades, who often do not have the resources to stay on top of innovations.
   - City staff: coordinate with utilities, key construction/developer/builder association and department heads to develop internal training for select staff groups on specific practice knowledge, and foster awareness of broader educational programs to promote to builders, developers, trades and design teams.
   - Job creation: Evaluate the potential of working in partnerships with social organizations and job creation agencies to develop a local job and skills development program for unemployed, underemployed, entry level, and/or young people interested in the construction industry. Such a program could focus on building retrofits, new construction or both.
2. Sustainable Energy Leadership Recognition: Integrate sustainable energy leadership recognition into the existing City Awards program, including the Clean Energy Award. This recognition would acknowledge the small constituency of leading builders, developers, architects, engineers as well as business, home owners and the public sector. The exercise would be intended to normalize these best practices.

## 4.2 Existing Building Strategies

In spite of Surrey's rapid growth, the existing building stock is expected to be the source of around 70% of total building GHG emissions even by the year 2040. Meeting the City's climate action objectives, and reducing building energy spending for most Surrey households, thus, depends on taking action on retrofitting the existing building stock.

Retrofits also create local jobs, a major City priority. These jobs are in construction and building materials retail sector. Furthermore, insulation upgrades and window replacements, which reduce drafts and water leaks, can improve health, safety and quality of life in residential and commercial buildings.

Any City led efforts would be designed to dovetail existing senior government and utility incentive programs. The scale and unpredictability of senior government and utility programs, nevertheless, is such that only in tandem with the City can these diverse social, economic and environmental benefits be met.

**Figure 36:** (Source: Golder Sustainable Communities)

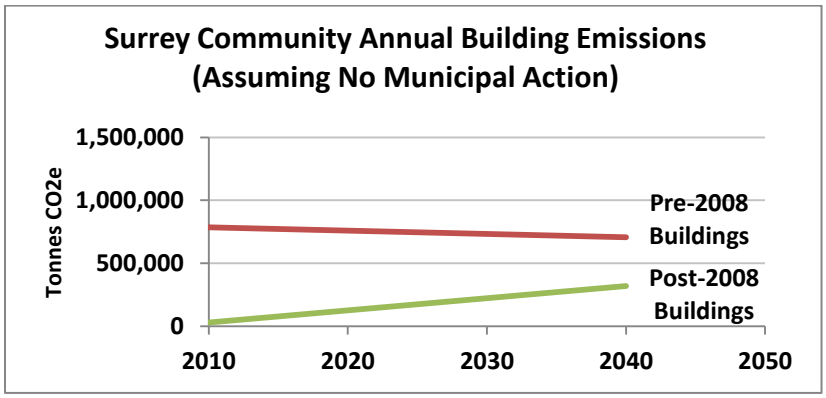
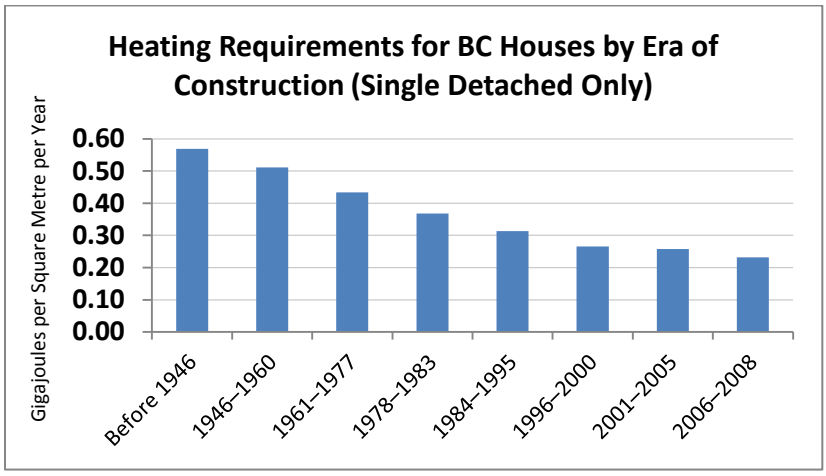



**Figure 37:** (Source: Natural Resources Canada)




### Current Retrofit Programs

*Utility On-Bill Financing Retrofit Programs:*

The Province is requiring utilities to develop on-bill financing programs for energy efficiency retrofits. The program roll out is phased, starting with Single Family homes, program design consultations for rental and strata units in 2013 and for commercial buildings in 2014/15. The exact nature of these programs has not been determined. Local governments may be able to take advantage of these programs by promoting them, piloting new ones for distinct sectors (e.g. purpose built rental), or collaborating with utilities to develop one that will generate significant savings and meet a community's unique needs.

LiveSmart BC brings together incentives from BC Hydro, FortisBC, and the Province.

The Efficiency Incentive Program offers incentives for audits and efficient or renewable energy equipment. The program applies to detached and attached houses (single, townhouse, or row-house).

LiveSmart BC Small Business Program currently provides free energy efficiency audits and advice, free or discounted energy efficiency products, and a recognition program (LiveSmart Champion) to small businesses.

*Livesmart BC* brings together incentives from BC Hydro, FortisBC, and the Province. They operate programs targeting both homes and small businesses.

## B. Third Party Retrofit Program Integration

### Background

Numerous efficiency retrofits programs are currently available and some are under development. The City has significant potential to increase the uptake of existing programs due to low awareness in many markets, taking advantage of the City's unique access to builders and developers, and home and business owners through the building permit office.

For many business and home owners, contractors may be their first and only point of contact when repairing or retrofitting a building. In many cases the contractor will advise, design, apply for permits, and carry out construction and repair. It is, therefore, good business practice for contractors to gain awareness of incentive programs and pass this information on to building owners.

### Recommendations

1. Work through the Building Permit Division to promote retrofits. Enable clerks and front-counter staff to connect applicants with appropriate energy efficiency retrofit information and programs, optimizing efforts based on knowledge of building type and use and planned renovations. Engage BC Hydro and FortisBC in training sessions. Integrate incentives into online and hard copy application processes.

2. Actively promote retrofits for local businesses. Work with business associations (e.g. BIA, Surrey Board of Trade, Chamber of Commerce and other key organizations) to develop workshops, lunch and learns, and "BIA Blitzes" with third-party organizations providing funding and training opportunities.

3. Consider using business licenses to target retrofit program promotion for more energy intensive sectors (e.g. grocery, small industry, food services). This data could be used to target marketing. It is also possible to consider revenue neutral shifts in business licensing to reward companies that improver energy efficiency.

4. Evaluate collaboration with the Condo Homeowner's Association (CHOA), the Building Owners and Managers Association (BOMA), and various property management companies to promote existing and emerging retrofit financing programs, including training for building managers.

### Commercial and Industrial Building Efficiency Incentives

BC Hydro and FortisBC offer programs for businesses ranging from small commercial to large industrial. A series of online tools can help with benchmarking, and funding is available for capacity building, training, auditing and implementation of more efficient technologies.

BC Hydro's
Business Program Eligibility Tool:
bchydro.com/program_eligibility

FortisBC Rebates:
fortisbc.com/Rebates

### Business Area Blitz

A pilot project is underway to assess the effectiveness of focusing on a single area and conducting door-to-door canvassing for incentive programs. The project, conducted in partnership between BC Hydro, FortisBC, and LiveSmart BC, may present a good model for localized engagement with businesses to improve energy efficiency.

## C. Affordable Housing Energy Retrofit Strategy

### Background

Affordable housing is critical for retaining and attracting a workforce vital to the entire region's economy. As well as reducing energy spending, energy retrofits can improve comfort, health, and safety and play a role in safeguarding the existence of this housing stock.

Affordable housing also has less extensive program offerings for energy improvements compared with single family homes and a typically lower retrofit rate. Third party promotion and modest capacity building, addressed in the strategies above, can further augment single family retrofit rates. Multi-unit rental buildings have unique retrofit challenges including contrasting tenant-landlord incentives, multiple decision makers, and greater building technology complexity. Focused efforts can help overcome these barriers, improve carbon and energy performance, and safeguard the community's affordable housing stock.

While comprising only 12 percent of the City's total dwelling units, purpose built rental and nonprofit housing are strategically important for protecting housing affordability – a key City priority.

**Purpose-Built Rental Housing**

Metro Vancouver considers purpose-built rental the largest single source of affordable market housing in the region. Surrey's has a much larger share than most municipalities – 9,000 units in 150 buildings. A large share is estimated to be at significant risk of redevelopment, meaning the potential value if redeveloped is much higher than the current value. Four hundred units have been lost in the last 10 years due to redevelopment.

**Non–Profit Housing**

After the City of Vancouver, Surrey has the largest number of nonprofit housing units in Metro Vancouver – 6,500 units. While third party financing for energy retrofits of this stock is cyclical, it is often available and frequently not fully taken advantage of, nor fully subscribed. Fostering awareness of senior government or utility programs, and providing support for applications, including high level screening of opportunities, can increase the take up rate.

**Figure 38: Rental Costs in Surrey (Fall, 2010)**

| | | Bachelor | 1 Bed | 2 Bed | 3 + Bed | Total |
|---|---|---|---|---|---|---|
| Average Rent | Surrey | $589 | $724 | $881 | $1,106 | $832 |
| | Vancouver Census Area | $811 | $940 | $1,202 | $1,410 | $1,006 |

### Energy Conservation Assistance Program

BC Hydro provides free audits and basic efficiency upgrades to low-income households for renters, owners, and housing providers. The City could integrate ECAP promotion into existing service programs targeting low-income households.

ECAP delivery in Surrey as of 2012:

- Over 4,000 basic take-home energy savings kits
- Around 700 ECAP retrofits (free energy audits with retrofits carried out by a contractor)
- Over 130 Energy Star fridges

Most of this conservation activity was delivered to multi-unit residential buildings. Key partners included:

- Spruce Housing Co-Op
- SOS Children's Village
- Valley Village Housing Co-Op
- Surrey Christmas Bureau

This outreach is a solid foundation for extending to other households.

Energy conservation is particularly valuable for working families that are not classified as low income, but spend a growing majority of their income on basic needs (e.g. transportation, housing, food, and clothing).


(Image: BC Hydro)

### Potential Energy Retrofit Program Collaborators

- BC Hydro
- FortisBC
- Condo Homeowners Association
- Business Improvement Associations
- Building Owners and Managers Association
- Vancouver Regional Construction Association
- Canadian Homebuilders Association
- BC Non-Profit Housing Association
- Community service organizations (faith-based groups, Scouts, etc.)
- Surrey Board of Trade
- Surrey Homelessness and Housing Society
- Vibrant Surrey Poverty Reduction Society,
- Canadian Federation of Independent Businesses
- Council of Manufacturers and Exporters

## Recommendations

1. Develop a framework to support purpose-built rental housing retrofits.

   - To help focus support, the City should better characterize energy performance of these buildings and potential energy retrofit measures and savings with superior data and analysis, including random audits. Consider broader building deficiencies with high energy implications such as moisture ingress.
   - Enhance building characterization, integrating typical energy consumption estimates with building type and age, size, redevelopment risk, common area, and location proximate to frequent transit network.
   - Engage key constituencies to shape the framework, including landlord barriers and motivations, building energy performance and retrofit opportunities, effective financing, tenant participation opportunities and administrative support for landlords. Key energy expert knowledge can be procured through local energy service sector, renters, other municipalities developing similar programs, e.g. City of Vancouver and City of North Vancouver, BC Hydro, FortisBC, and Metro Vancouver.
   - Consider how existing programs can be optimized within such a framework, notably with BC Hydro and FortisBC, as well as emerging programs like the BC government-required MURB on-bill financing system to capitalize and payback retrofits through utilities. Identify other support. Consider how the ECAP program (see sidebar above) targeting low or fixed income households can be effectively integrated into the framework.
   - Establish a purpose built rental MURB retrofit pilot to test development of the opportunity, make a Go/No Go decision on fuller program development, and prepare for refinements.
   - Explore partnerships with utilities and community organizations for delivery. Evaluate the opportunity of involving faith-based groups, and other service organizations with social service programs in delivering basic retrofit services.
   - Ensure the design of a retrofit framework is complemented with a communications and outreach strategy.

2. Support outreach to non– profit housing to deepen retrofit rates:

   - Develop an outreach strategy to support non-profit housing energy retrofits taking advantage of third party incentive programs and BC Non Profit Housing Association's energy management program.
   - Provide support to non-profits for incentive program applications.
   - Where strategic, integrate ECAP promotion targeting low or fixed income households into the outreach strategy.
   - Develop program in tandem with and informed by the purpose built rental housing support program.

## 4.3 New Construction Strategies

As the life-span of a building is often between 50 and 100 years, small improvements at the time of construction can have large impacts over the life of the building and make significant contributions to improving the overall building stock. The need to get new buildings right is particularly important in Surrey due to the rapid rate of growth.

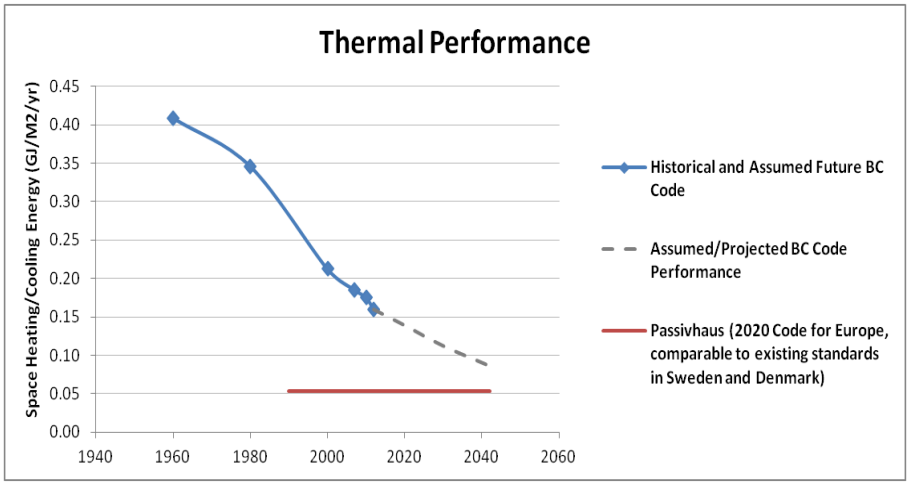
Building efficiency has gradually improved over time due to technological innovation, regulation, and market demand. A dynamic tension, however, is that evidence shows energy performance in new buildings across BC are not as high as originally assumed. For some, building thermal performance hasn't changed in four decades. (See *Building Code Capacity Building* below for evidence.)

This is partially as a result of inferior energy-related construction practices such curtain walls (comprised largely of windows), un-metered gas fireplaces, and improperly designed common area heating and ventilation systems. Additionally, a large percentage of buildings need to do more to meet code.

As well as reducing residential and commercial energy spending and GHGs, stronger efficiency performance will prepare builders and developers to meet rising standards driven by the province, consumer demand and technological innovation, and a clamp down on meeting code.

The following strategies are voluntary, educational and incentive-oriented with some modest regulatory elements. While the individual strategies are mutually reinforcing, they can be phased in separately.

**Figure 39: Space Heating and Cooling Requirements for Single Detached Homes**



## Third Party Incentives and Training for New Construction

### Houses

*Power Smart New Home Program* provides incentives for new houses to be constructed to be more efficient than Code requirements (currently an EnerGuide Rating of 80 or higher) or include Energy Star certified products. Single detached houses, duplexes, and row houses are eligible. At least ten buildings in Surrey representing dozens of homes have participated.

### Apartments and Commercial Buildings

For large buildings, the *Whole Building Design Program* provides subsidies for an Energy Study that explores the cost effectiveness of different energy efficiency measures.

The *Lighting Efficiency Study* incentive is available for lighting designs that exceed Building Code requirements by 10%. This program is suited to smaller MURB's and commercial buildings. Completed studies often lead to significant implementation capital incentives from BC Hydro and FortisBC.

# D. Third Party Incentive Promotion

## Background

BC Hydro, FortisBC, and other Provincial and Federal agencies have numerous incentive programs to encourage more efficient new construction for residential, commercial, and industrial buildings. BC Hydro offers the most comprehensive programs as they cover design, capacity building, and implementation incentives. While some developers are already well aware of these programs, both utilities have indicated that many more are not. The City is in a strong position to integrate third-party incentives into the development process.

## Recommendations

5. Increase awareness of incentives by hosting workshops and info sessions from utilities, building associations, LiveSmart and other third-parties. Host workshops through the Sustainability Office &/or Building Division. Education on key best practices can be integrated into these processes.

    - Pay particular attention to small and medium-sized builders and developers who may not have the resources to stay on top of incentives.

6. Integrate third party incentives into the permitting process and the *Sustainable Development Checklist* (see the *SDC Update Strategy* above under Land Use).

7. Facilitate involvement in BC Hydro or FortisBC programs during rezoning, notably for large buildings.

## E. Local Incentive Program Development

### Background

BC consumers pay electricity and natural gas at prices most of the world would consider a bargain. These low prices make paybacks on some efficiency and renewable measures quite long. Without major regulatory intervention, a major financial instrument is needed to achieve significant improvements beyond typical construction.

Incentives for new construction can come in many forms. Potential approaches include:

- Density Bonusing could provide density beyond the existing zoning permits in exchange for higher energy performance. While not universal, density bonusing is typically applied in neighbourhoods where there is clear demand for larger/taller (higher density) buildings. Rapid transit would improve demand for density bonusing.
- A Green Loan program could be established with one or more financial institutions. The loan would be transferred to the building buyer (which may be the strata), rather than remain with the developer. Installments would be approximately equal to the energy savings enjoyed by building occupants relative to a standard development. The loan could be marketed as a valuable feature that increases the building's value at no or marginal extra cost to owners. Upon paying back the loan, there would be a measureable drop in monthly strata fees.

  *The City* would facilitate financial institution interest in the opportunity and then, ostensibly, encourage the market to take advantage of the opportunity.

  An alternative to a financial institution, it may be possible to arrange financing through BC Hydro or FortisBC. Customers would pay back the loan through an energy efficiency installment on each energy bill. The financial instrument would be similar to the emerging on bill financing system being required for building energy retrofits.

- A Community Energy Fund could be established to provide financial incentives for reducing the incremental cost of energy efficiency and renewable energy, or for building neighbourhood-scale (district) renewable energy systems.

  Money for the fund could come from a Community Amenity Contribution for Energy (see sidebar below). The Fund could be structured to provide an opportunity for developers to contribute to the fund in lieu of on-site green building features, meet basic requirements, or receive incentives for cutting-edge building techniques or technologies.

### City of North Vancouver Density Bonusing for Green Buildings

The City of North Vancouver's unique density bonusing policy and particular real estate market ensure virtually all new buildings – large and small, residential and commercial – achieve greater energy performance than the BC Building Code.

For large (Part 3) buildings, additional floor area over a base threshold up to the Official Community Plan maximum density is granted in exchange for achieving higher energy performance. For wood frame construction (Part 9 buildings) maximum floor space calculations now exclude the cellar unless higher energy efficiency is met. All buildings post a one percent performance bond that is remitted upon proof of higher efficiency.

### Green Loans for New Construction

The award-winning Verdant apartment building in Burnaby financed energy efficient equipment and a renewable energy system through a second VanCity green mortgage. This mortgage transferred to the strata at time of sale - residents pay the cost of energy for a conventional building, with operational savings paying down the mortgage.

## Density Bonusing

Density, the size of a building relative to the lot on which it is built, can be increased in exchange for community amenities. Density bonusing is an excellent tool for areas where there is significant demand for development and high land prices as it is voluntary and incentive-based. However, the tool is not typically ass effective in areas where there is low demand for higher density buildings.

Surrey currently has an interim Density Bonusing bylaw that applies to City Centre and Guildford Town Centre. The current focus is placed on affordable housing and other amenities. Density bonusing has been used by other communities to increase energy efficiency.

## Climate Protection: A Community Amenity

Neighbourhood Concept Plans address funding arrangements for the provision of community facilities, amenities and services such as park development, police, and transportation infrastructure. Specific contribution requirements are laid out for each neighbourhood in Surrey. The preservation of a stable climate is a community contribution that could be explored to support higher building efficiency.

## Recommendations

Develop a local financial instrument to incentivize performance significantly beyond code to supplement existing programs offered by utilities and senior governments. Instrument selection would require further research and analysis. Next steps:

1. Determine applicability and design of an energy efficiency density bonusing policy for appropriate zones and building types across the City.

2. Evaluate the relative merits of a more broad-based financial instrument such as a community amenity contribution financed Community Energy Fund or Green Loan.

    - Meet with prospective partners (local financial institutions or utilities) to examine the potential and design for a green loan.
    - Consult with staff, developers, builders, Council and other key stakeholders in developing the financial instrument(s) as part of the broader new construction efficiency strategy framework.
    - Select appropriate performance thresholds beyond which new developments will be eligible and encouraged to achieve with the incentive. These targets should be aligned with an existing certification or incentive program that leads to significant energy and carbon savings, and consistent with the existing BC Building Code. Proof of certification from another organization would reduce the administrative burden on the City (e.g. Built Green, PowerSmart).
    - Select and design the preferred financial instrument(s). Consider piloting in an appropriate neighbourhood (see Neighbourhood Energy Pilot strategy below) to evaluate its broader application.

3. Integrate financial instruments into the Development Checklist and permitting process.

## F. Basics Building Standards Strategy

### Background

There is considerable variability in new construction. Many builders and developers exceed Building Code for diverse reasons: sustainability, commitment to excellence, or marketing. There is a large share that must perform better to meet basic code with implications to energy spending, GHGs, as well as occupant health, safety, comfort and building durability.

Code non-compliance is prevalent across BC and more broadly in North America (see sidebar). Compliance can be improved through capacity building for key municipal staff, builders, developers, trades and sub-trades, as well as adjustments to the permitting and inspection process.

In many cases, modest labour and material costs and some basic training will enable new construction to meet basic standards. Proper mechanical insulation has a 1-4 year payback, cutting demand 1-14% (HB Lanarc, 2010). Improving air barriers can cost several hundred dollars (Proskiw, 2011), constraining energy demand, reducing heating and cooling system size requirements, and increasing heat recovery ventilator effectiveness.

**Figure 40: Survey on Code Deficiencies in BC** (Province of BC, 2012). Many health and safety standards have energy efficiency implications.

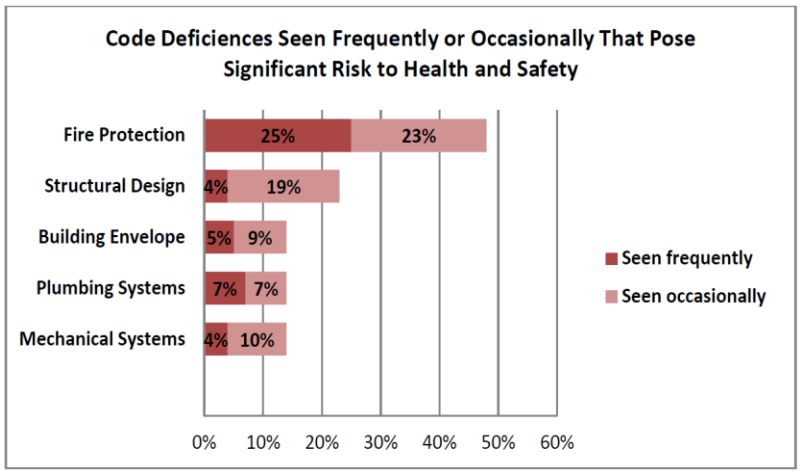
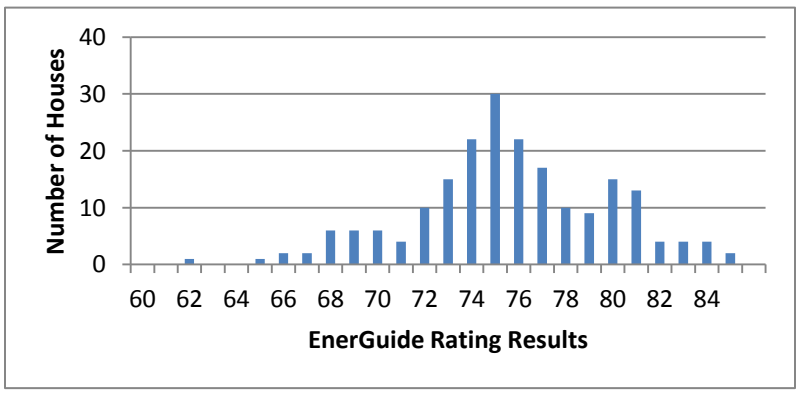



**Figure 41:** Measured Home Performance Targeting EnerGuide 80 in a Metro municipality




### Non Compliance Analysis

There is growing evidence many new buildings perform below code.

- A random survey by the BC Government found a large share of buildings is not meeting basic health and safety requirements (see Figure 40). There are energy implications to many of these code deficiencies.
- Spot-checks around BC's Lower Mainland found most new buildings do not have properly installed insulation on pipes and mechanical equipment, an issue which has deteriorated since the 1980s. (HB Lanarc, 2010)
- Energy evaluations in one BC municipality for homes aiming to meet EnerGuide 80 found they were performing even lower than code (~EG 77). (see Figure 41).
- Research for Natural Resources Canada shows air tightness in BC homes is the lowest in the country.
- US Studies show code compliance rates from 0%-73% for new buildings, with significant variability by jurisdiction and research methodology. (Harper, 2012) (Yang, 2005)
- Audits of new wood-frame, residential buildings in BC since 2008 have found one-third did not attic insulation requirements. (BC_Hydro_Staff, 2013)
- Industry professionals and building officials estimate 42 percent compliance with ASHRAE 90.1 2004 Part 10 focussing on energy (the latest

## Recommendations

Improve code compliance in new construction through a combination of training with builders, developers and City staff, and fine tuning the permitting and inspection process. Key steps:

1. Offer capacity building opportunities on key practices for improving building energy performance, focusing on low cost, high impact, easily enforceable opportunities. Adjust training by audience, including staff, builders, developers and construction trades. Use workshops, pamphlets, info sessions, site briefings, and collaborate with other interested parties (e.g. utilities, and construction/developer/builder associations) on program delivery. (See Capacity Building under Cross-Cutting Building Strategies for more information.)

2. Identify and implement practical opportunities for enhancing code compliance, including:

   - Update specific inspection checklist items, e.g. air barrier at pre-dry wall inspection, and mechanical insulation at occupancy permit stage.
   - Identify practical opportunities for updating requirements for Letters of Assurance for energy-related construction. There may be funding available from BC Hydro to pilot this.
   - For Part 10 of the Building Code (Energy Efficiency) set a minimum target for spot checking/auditing compliance documentation (e.g. 10%). Track the trends in compliance pathway choice and energy over time, especially modeled energy performance (energy intensity) and EnerGuide ratings. This is valuable data for tracking progress.

3. Evaluate the opportunity of testing compliance with minimum energy performance ratings:

   - Require or reserve the right to randomly require Part 9 (wood frame) buildings to have a blower door energy performance evaluation. Reduce costs in townhouses and row houses by testing a small sample of units.
   - Require a modest energy performance bond of 1% or less of construction costs that would be remitted upon successful completion of the enhanced building inspection and permitting process, including the blower door test.

4. Integrate capacity building resources and amendments to permitting and inspection process into the Sustainable Development Checklist.

# Additional Building Opportunities

The following opportunities will be considered by the City in a later stage of CEEP implementation.

## Existing Buildings

- **Strata Housing Retrofit Outreach**: Approximately one quarter of Surrey dwelling units are in strata buildings which require unique considerations for program design, delivery, communications and outreach. Small strata complexes (<25 units) need significant support, and there are lots of these buildings in Surrey

  Build on the foundation of the purpose built rental support and non-profit housing outreach strategies to inform design of a strata strategy.

  In addition to stakeholders identified under the purpose-built rental support (above), BOMA (Building Owners and Managers Association) and CHOA (Condominium Home Owners Association) are key stakeholders.

- **Energy Retrofit Renovation Standard**: Evaluate potential for establishing a value threshold (or thresholds) that would require energy upgrades for building permits for existing buildings over certain values.
- **Building Recommissioning**: Recommissioning (RCx) is a re-optimization process that ensures existing equipment and systems operate efficiently. It is often combined with education and training. On average, RCx leads to energy savings of 16%, with a typical payback of just over one year (Natural Resources Canada).

  Evaluate the potential of using business licenses or renovation building permit values to require building recommissioning on large buildings.

- **Energy & Water Conservation Training Integration**: Evaluate the efficacy of integrating energy conservation training with the City's successful Operation Save H2O. The youth teams can be provided with material and guidance to match several dominant building types with appropriate conservation opportunities. Youth teams could provide literature on incentives and tips, and potentially supplement this with coaching support. Building owners who have successfully made significant changes to water consumption are strong candidates for taking action on energy conservation. Follow up visits or mailings to these building owners can be considered.

The following opportunities will be communicated to senior governments and utilities.

- **Senior Government & Utility Policy & Program Development:** Extend and enhance incentives and capacity building for energy and carbon management in existing buildings with a particular focus on enabling permitting offices to facilitate retrofits.

### Building Commissioning

"Building commissioning benefits owners' through improved energy efficiency, improved workplace performance due to higher quality environments, reduced risk from threats, and prevention of business losses. Organizations that have researched commissioning claim that owners can achieve savings in operations of $4 over the first five years of occupancy as a direct result of every $1 invested in commissioning—an excellent return on investment. Meanwhile, the cost of not commissioning is equal to the costs of correcting deficiencies plus the costs of inefficient operations. For mission-critical facilities, the cost of not commissioning can be measured by the cost of downtime and lack of appropriate facility use. " (National Institute of Building Sciences (US))

## New Construction

The following opportunities will be considered by the City in a later stage of CEEP implementation.

- **Building Commissioning:** Evaluate requiring or encouraging building commissioning for large (part 3) buildings over a certain size threshold. Explore opportunities to link building commissioning to performance bonds. This would complement the strategy, outlined above under code compliance capacity building for part 9 (wood frame) buildings involving blower door testing and the posting of a performance bond.

The City will encourage senior governments and utilities to address the following opportunities:

- **Senior Government & Utility Policy & Program Development:** The following priorities would support improved carbon and energy performance in new construction:

  -Extend and enhance incentives for energy and carbon management in new construction;

  -Extend the use of on-bill financing by utilities for new construction;

  -Work with municipalities and builder/developer associations (including sub-trades) to support audience-specific capacity building aimed at increasing compliance with the BC Building Code;

  -Investigate through third party audits code non-compliance as it pertains to energy efficiency as well as broader health, safety and material durability.

## Building Strategies in Land Use Sector

The following building-efficiency strategies are more fully addressed in the Land Use sector.

- **Sustainable Development Checklist Update:** Surrey's Sustainable Development Checklist provides a coherent foundation for advancing sustainability in real estate development. Integrating capacity building, financial and regulatory strategies from the land use, transportation, building, and waste sectors into a future SD Checklist update builds on this foundation to support measureable carbon and energy management practices. (See Sustainable Development Checklist under Land Use Strategies.)
- **Pilot Sustainable Energy Neighbourhood:** The neighbourhood can be a good to scale to innovate with high efficiency, low carbon strategies in buildings as well as in land use and transportation. Additional support can be focused and strategies can be refined in a low risk manner. (See Pilot Sustainable Energy Neighbourhood under Buildings Strategies.)
- **Low Carbon Development Permit Areas:** Development Permit Area Guidelines are a soft regulatory tool that can be used effectively to support low carbon, energy efficient buildings, and site level transportation and land use. Passive building design opportunities are particularly significant under a DPA. (See Sustainable Energy Development Permit Area under Land Use Strategies.)
- **Compact and Live/Work Housing:** A major contributor to rising per capita energy consumption over the last three decades is housing size. Small format housing options can help reduce energy consumption and focus growth in transit corridors. (See Small Format housing under Land Use Strategies.)

# 5 District Energy

District energy can provide efficient, cost effective, low carbon energy to higher density areas. The City has recently established a district energy utility and commenced construction of its first district energy service area in Central Surrey. The City is well positioned to expand DE across City Centre and beyond for several reasons:

1. **Rapid, focused growth** in rapid transit corridors complements district energy development.
2. **Well-coordinated departments and divisions** are already collaborating on agendas like transportation and land use planning can build on this foundation to support district energy.
3. **Strategic, methodical approach** to district energy development thus far, including policy development and utility design, is laying a foundation of trust with real estate developers – central players in successful community district energy systems.

These strategies reinforce the City's work in City Centre and provide guidance for evaluating and extending district energy in key across the community. These strategies are supported by preliminary screening based on this Plan's preferred land use future, summarized in this section. See *District Energy Technical Memorandum* in the appendix for more comprehensive analysis and assumptions.

| Key Indicators & Targets | 2020 | 2040 |
|---|---|---|
| Targets under development | | |

## Community Co-Benefits

As well as managing energy and carbon, district energy strategies support broader community priorities.

Economic Development

Energy Resilience

Healthy Living

Affordability

### Strategies

A. City Centre District Energy Extension
B. New Node & Corridor Evaluation
C. Detailed DE Policy, Planning & Promotion

### Key Senior Government & Energy Utility Assumptions

Senior government and energy utility actions will have a significant impact on GHGs and energy in building efficiency and energy supply, and influence local strategies. Key assumptions:

- Steadily rising BC Building Code
- BC Hydro and FortisBC provide incentives for energy efficiency and renewable energy, including community energy management
- Rising electricity prices and modest growth in natural gas prices

## DE Thermal Demand Opportunity Assessment Summary [x]

Projected commercial and residential growth and building types provide a basic thermal demand profile to begin screening opportunities. While many considerations determine feasibility including building mix, extent of new build, speed of build out, anchor loads, and supply opportunities, the most basic requirement is sufficient thermal energy demand density based on space heating and hot water loads. Generally areas with a minimum of 50,000 GJ of heat demand per year per square kilometre begin to meet the DE threshold. This map series shows growth in thermal demand from residential, commercial and institutional development over 30 years.

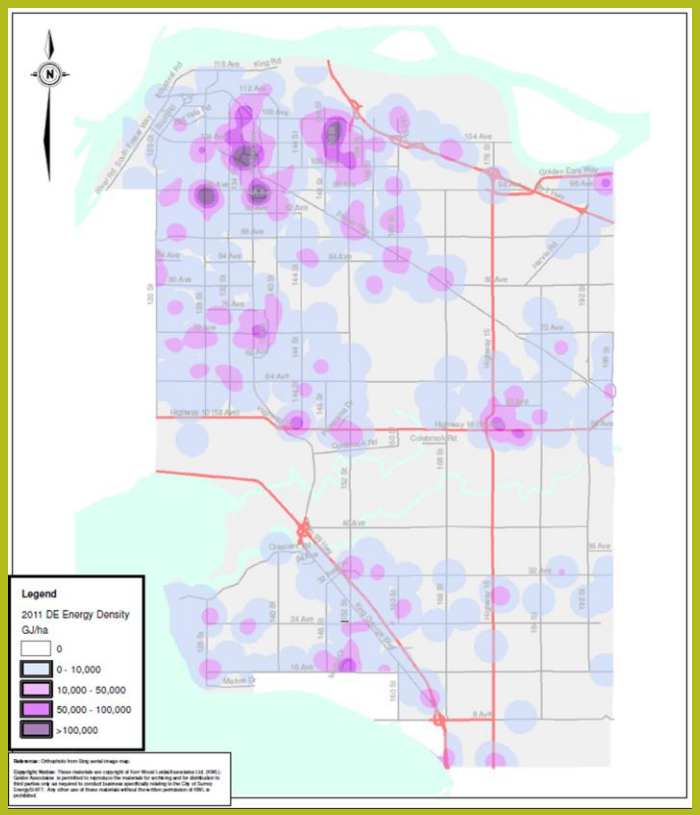



**Figure 42: 2011 Thermal Energy Density** (Map: Kerr Wood Leidal)

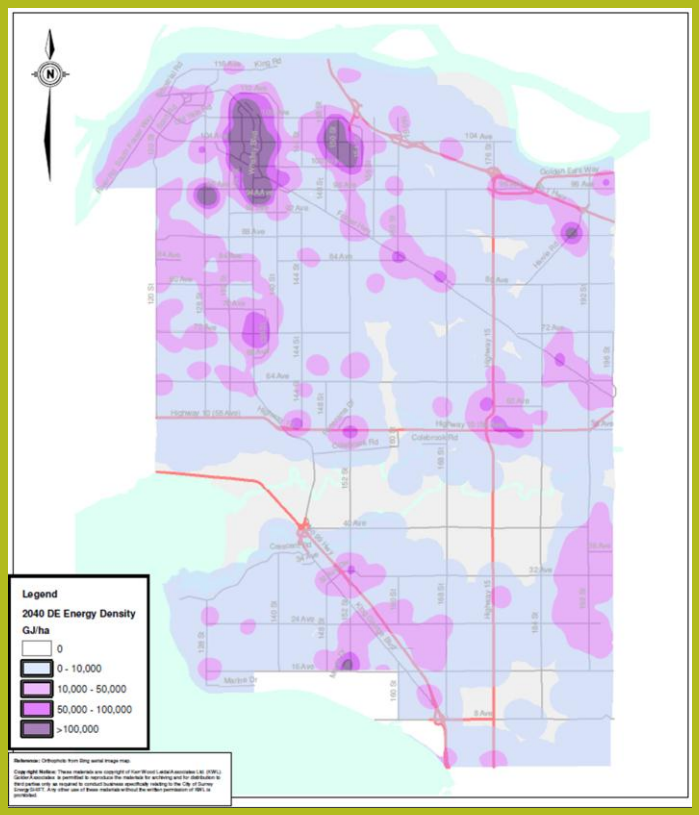



**Figure 43: 2040 Thermal Energy Density** (Map: Kerr Wood Leidal)

[x] See *District Energy Technical Memorandum* in appendix for more detailed analysis and assumptions

### Table 14: Summary of District Energy Supply Opportunity Assessment [x]

| | Natural Gas | Wood Biomass | MSW for Heat | Combined Heat & Power | Sewage Influent | Geo-Exchange | Solar |
|---|---|---|---|---|---|---|---|
| **Type** | Natural gas combustion for heat | Wood combustion for heat | Residual waste combustion for heat | Natural gas, wood, or MSW for heat&power | Heat recovery from sewage pipes | Heat pumps recover heat from ground | Solar hot water |
| **Capacity** | Easily scaled to location | Easily scaled to location | Likely large | Likely large | Low | Low | Low |
| **Precedent** | Lonsdale | Revelstoke, Dockside Green | Vienna | Copenhagen, Paris, Burnaby WTE | Vancouver Olympic Village | Surrey Civic Centre, Richmond | Vancouver Olympic Village, Lonsdale |
| **GHG Reduction Relative to BAU** | Low Increase to Low Reduction | Moderate to High Reduction | Moderate to High Reduction | Low Increase to High Reduction | Moderate Reduction | High | High |
| **Electricity Reduction** | High | High | High | High | Moderate[y] | Low[y] | Moderate |
| **Cost** | Low | Moderate | Varies by design and location | Varies by design and location | High | Moderate to High | Very High |
| **Comments** | Commonly transition technology to other District Energy technologies. GHGs depend on BAU heat supply system efficiency and gas or electric supply. | Many DE systems in SW BC are planning to use wood biomass. Break point between between large custom and small off-the-shelf systems. GHGs and feasibility depend on transportation. | If a Metro Van facility is sited in or near an industrial area and proximate to DE service area it may be possible to access heat. GHGs depend on plastic and recyclable content in feedstock. | This is a combustion-technology add-on. The business case depends on future electricity prices, feedstock costs, scale and industrial opportunities. GHGs depend on feedstock. | Rare and potentially complex as this can interfere with the operations of sewage treatment plant if too much heat is removed. | Cost depends on site-specific conditions, and technology type (open or closed loop). Highly variable across community.<br>Drilling required to assess feasibility. | Prohibitive capital cost as base load. May be used in moderation as educational tool. |
| **Further Analysis by Location** | City Centre<br>WR/Semiahmoo<br>Guildford TC<br>104th Ave<br>Newton TC<br>Cloverdale TC<br>Panorama Village<br>Claytons<br>Scott Road | City Centre-Lrg<br>WR/Semiahmoo-Sm<br>Guildford TC-Lrg<br>104th Ave-Sm<br>Newton TC-Sm<br>Cloverdale TC-Sm<br>Panorama Village-Sm<br>Claytons-Sm<br>Scott Road-Sm | City Centre<br>104th Ave<br>Newton TC<br>Scott Road | City Centre<br>Guildford TC<br>104th<br>Newton TC<br>Scott Road | City Centre<br>WR/Semiahmoo<br>Newton TC<br>Cloverdale TC<br>E Panorama TC | City Centre (Civic Only)<br>WR/Semiahmoo<br>104th Ave<br>Newton TC<br>Cloverdale TC<br>Panorama Village<br>Claytons<br>Scott Road | No – except for educational purposes |

[x] See *District Energy Technical Memorandum* in appendix for more comprehensive analysis and assumptions.

## Potential District Energy Service Areas[X]

A screening-level modeling exercise was used to evaluate potential for district energy in 20 high thermal energy density areas. Using the annual energy estimated from projected growth, key criteria for estimating system capital and operating costs were determined. The system capital and operating costs were then translated into lifecycle cost estimates and a lifecycle unit energy cost was estimated for each area at 2020 and 2040. Each DE area was assigned a renewable energy component, which varied depending upon size and availability of energy sources.

A "Business as Usual" comparative case was developed for each area based on the full building stock that could be eligible for district energy. District energy potential areas driven by renewables, typically with peaking natural gas boilers, were ranked as *High* if their costs were better than Business as Usual, *Moderate* if they were within 10% of BAU, and *Low* within 20% of BAU. Although the most important factors were incorporated into this analysis, the future can change dramatically such as location and speed of growth due to the real estate market or rapid transit project, or energy commodity changes due to changes in global demand, altering this assessment.

| Service Area | 2020 DE Type | 2040 DES | Potential |
|---|---|---|---|
| **City Centre** | | | |
| Surrey Central | Biomass | Biomass | High |
| Gateway | Biomass | Biomass | |
| King George | Biomass | Biomass | |
| **Outside City Centre** | | | |
| Semiahmoo TC | Natural Gas | Nat Gas or ASHP | High |
| Guildford TC | Biomass | Biomass | |
| 104th Avenue | Natural Gas | Biomass | |
| Cloverdale TC | Natural Gas | Sewer | Moderate |
| Clayton Village | > 20% of BAU | AS Heat Pump | |
| Panorama Village | > 20% of BAU | AS Heat Pump | Low to Moderate |
| Clayton Village South | > 20% of BAU | AS Heat Pump | |
| Scott Road | > 20% of BAU | AS Heat Pump | |

Table 15: 2040 DE Potential Areas & Technologies

Legend
ASHP=Air Source Heat Pump

| DE Cost Relative to BAU |
|---|
| Better than BAU |
| Within 10% of BAU |
| Within 20% of BAU |
| 20% Greater than BAU |

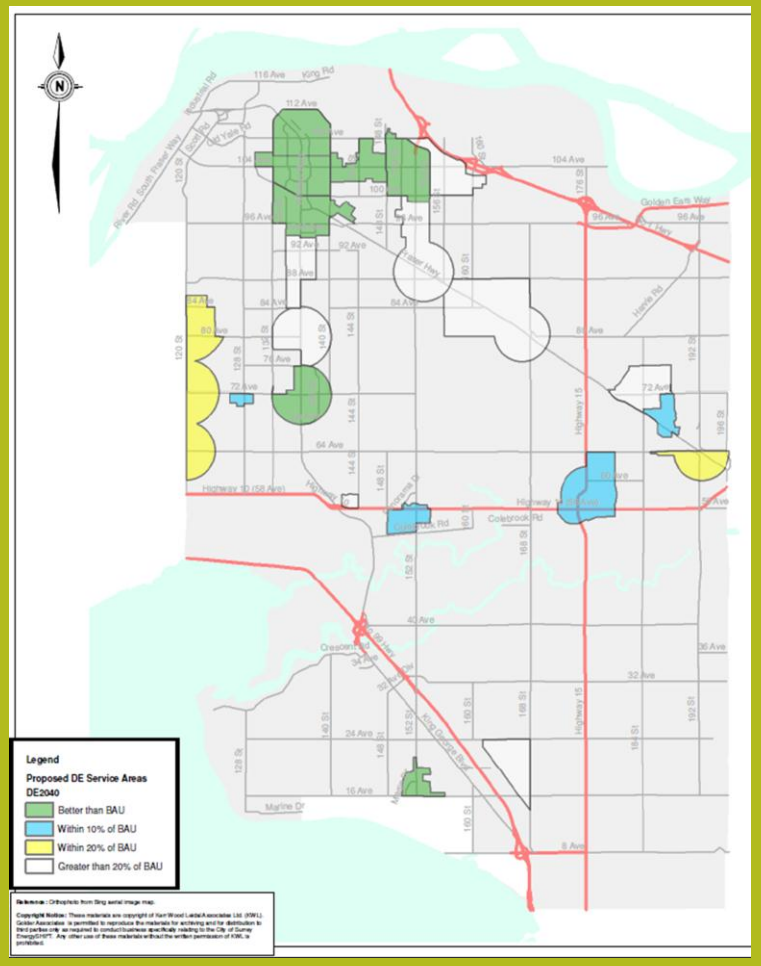



Figure 44: 2040 District Energy Potential Areas
(Map: Kerr Wood Leidal)

XSee *District Energy Technical Memorandum* in Appendix for more detailed analysis and assumptions.

### District Energy System Technology

District energy systems (DES) use centralized energy plants to generate heat for hot water and space heating, and sometimes cooling, through a network of pipes to buildings. Heat exchangers separate the DE system from building mechanical systems. Generally buildings require a hydronic (water-based) system to distribute heating and/or cooling vs electric baseboard.

Systems can use different feed stocks including natural gas, ground source heat, sewage heat, solar thermal, industrial or commercial waste heat, or wood. They may accommodate more than one energy source, or transition from one to another. This flexibility means district energy can be more resilient to changes in energy commodity prices – an adaptive capacity not afforded conventional individual boilers or baseboard electric heating.

(image: City of Surrey)

## Strategies

### A. City Centre District Energy Extension

### Background

The City has carried out extensive policy, utility design, developer engagement, and area feasibility analysis to assess district energy potential. Recently, the City established a district energy utility in its fastest growth area, Surrey City Centre. The new system will initially serve the new city hall and library, extending to adjacent mixed use development over time.

The initial Surrey Centre district energy service area uses geo-exchange – i.e. ground source heat – with natural gas to meet peak demand. As this system extends it will initially be natural gas with the expectation that a biomass system will be phased around 2020.

The City is requiring large buildings in City Centre to connect and providing an incentive ($1.50 per square foot) for early adopters through a dedicated property tax. Building type and proximity to the hub determine energy services to be delivered, e.g. all space and hot water for nearby areas, or hot water for the building and common area space heat for buildings beyond Central area.

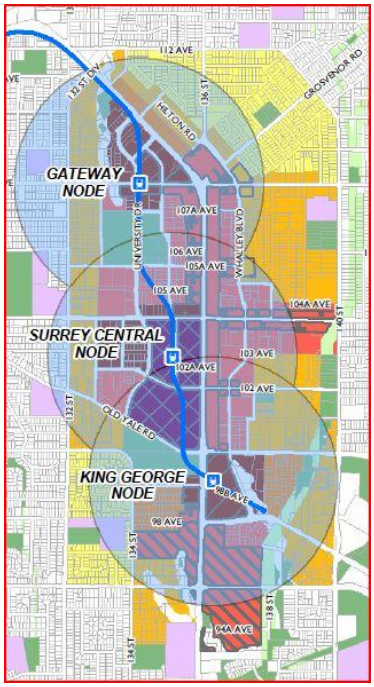



**Figure 45: City Centre DE Nodes**
(Map: City of Surrey)

A second node will be developed around King George Station, where population is projected to double by 2030. This system is currently planned to be natural gas driven and phase into biomass. Gateway SkyTrain station area is the proposed following node. The City's methodical approach, developer engagement, clarity, incentives, and competitive business model provide a solid foundation for success.

## Recommendations

1. Continue current plans for establishing and extending district energy nodes in City Centre, focusing on Surrey Central, King George, and Gateway.

   - Refine renewable energy transition plan to replace district energy natural gas base loads by 2020.
   - Continue to build support for ongoing district energy development with developers, building owners, major employers and key City institutions like the Development Advisory Committee.

2. Evaluate the opportunity to extend district energy from the three City Centre nodes into adjacent planning areas with high DE potential to establish a large, contiguous service area, specifically consider 104th Avenue Corridor and Guildford Town Centre.

   - Examine the rate and scale of development, and consider opportunity for adjustment to strengthen the business case.
   - Integrate DE policy and planning in these areas into broader land use, transportation and infrastructure planning activity, acknowledging in particular the opportunity for rapid transit stations and major hubs along the frequent transit network. (See complementary D*istrict Energy - Detailed Policy, Planning & Promotion* strategy below.)

# B. New District Energy Node & Corridor Evaluation

## Background

For district energy to be extended beyond City Centre, further analysis, and policy and planning is necessary to determine specific locational feasibility, governance and business model. A strategic pathway is outlined and shown below (Figure 47). Figure 44 and Table 15 identify higher potential areas.

### District Energy Technologies: Electricity & Carbon Trade Offs

Different DE technologies have different electricity and GHG intensities. Conscientious planning will be necessary to transition to renewable energy from the natural gas systems that will be used to establish many service areas.

Natural gas DE systems ostensibly eliminate power demand, but they are still GHG intensive.

Heat pump technologies rely on power, moderating electricity conservation. However, they are relatively efficient in delivering heat and given the nature of BC's power grid they are relatively low GHG intensity.

Biomass combustion systems can have the lowest GHG and electricity intensity, largely contingent on transportation (shipping) distances.

This study assumes DE systems use peaking natural gas boilers, accounting for 25% of heat.

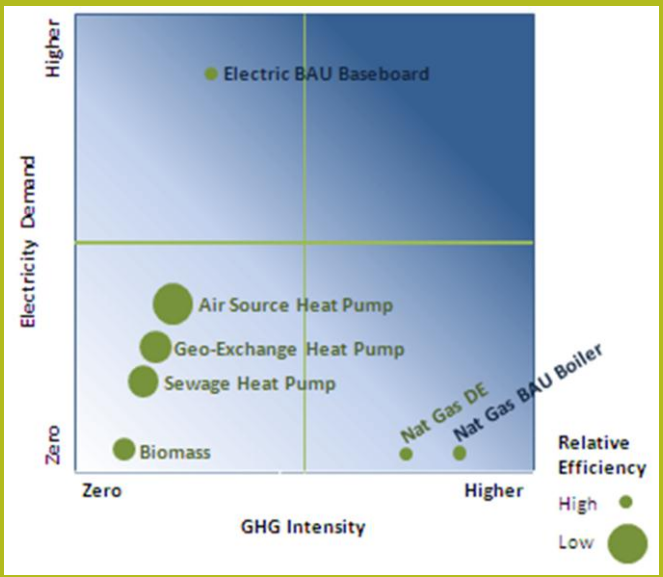



**Figure 46:DE Electricity & Carbon Trade Offs:** Analysis assumes BC's relatively low carbon grid (Golder Sustainable Communities)

## Recommendations

1. Conduct planning area district energy opportunity assessments. Use screening analysis from this Plan (see *District Energy Technical Memorandum* in Appendix), and more detailed area-level plans to further screen potential. Confirm potential, or opportunity to further adjust policies and plans to strengthen business case.
   - Where Neighbourhood Concept Plans have not been developed, this analysis should be integrated into this process.
2. Evaluate governance/ownership options for the specific location. If there is high potential, make a decision about whether system ownership would be best developed and operated by the municipal utility or by a private utility or a hybrid. This will influence whether a Request for Expressions of Interest is issued to utility providers or if the City secures financing to carry out detailed feasibility analysis. Consult key stakeholders to inform this decision.
3. Conduct detailed feasibility analysis. Determine the basic technical and financial viability of a project, including detailed heating and cooling load projections, supply options analysis, phasing, net present value calculation or other internal financial tests, carbon, power and energy savings, and district energy plant siting and network mapping. Engage internal and external stakeholders. Execute technical Go/No Go.

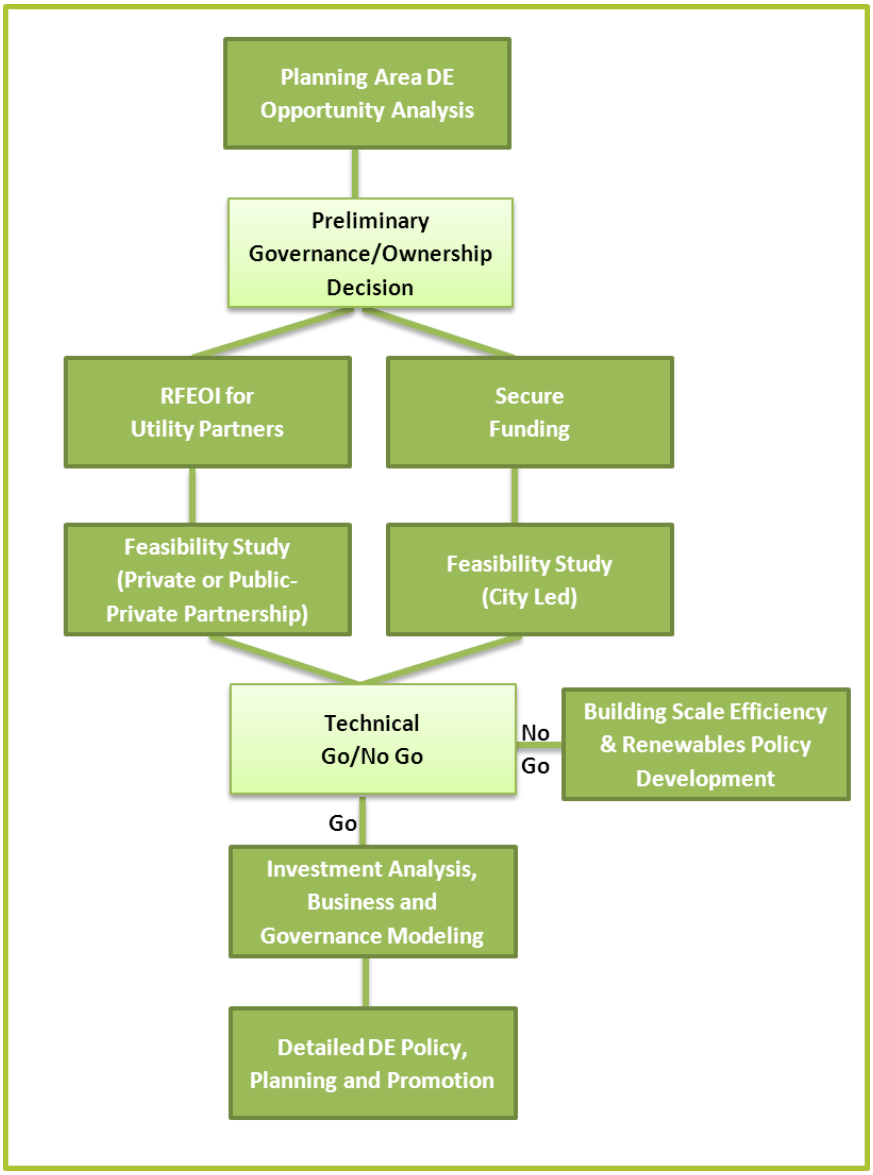



**Figure 47: DE Policy, Planning & Governance Pathway** (Flow Chart: Golder Sustainable Communities)

### DE Study Areas

The City should continue to establish district energy under its own utility in the high potential City Centre areas, and consider extending to the contiguous higher potential areas of 104th Corridor and Guildford Town Centre. Further governance/ownership decisions and feasibility analysis is required in other areas.

| |
|---|
| **High Potential** |
| Surrey Central City Centre |
| Gateway City Centre |
| King George City Centre |
| Semiahmoo Town Centre |
| Guildford Town Centre |
| 104th Avenue Corridor |
| **Moderate Potential** |
| Cloverdale Town Centre |
| Clayton Village |
| **Low to Moderate Potential** |
| Panorama Village |
| Clayton Village South |
| Scott Road Corridor |
| **No Potential** |
| 152 Street Corridor |
| Bear Creek Village |
| Fleetwood Town Centre |
| Grandview #2 |
| Guildford East |
| King George Corridor |
| Kwantlen |
| Old Civic Centre |
| West Clayton |

### Development Approval Information Areas

Section 920.01 of the Local Government Act provides authority for local governments to designate areas and/or specify circumstances in which development approval information can be required. This information could include projected energy demand or greenhouse gas emissions which could be useful to support district energy planning.

5. If it is *No Go*, consider other low carbon, sustainable energy solutions. If it is a *Go*, conduct detailed investment analysis and business and governance modeling. Build on the technical and financial feasibility, identify actions to support the business case including securing customers, adjusting land use plans, attracting anchor tenants, developing a phasing strategy, and determine the optimal business and governance model for the unique development and area, outlining specific financing, ownership elements, and operation details. Situations that may be more conducive to private or hybrid models include a large public or private owner/developer with a large site, small district energy service areas, or a large industrial heat generator.

   - Continue to monitor the BC Utilities Commission Regulatory Framework for Thermal Energy System Utilities to determine if opportunities may change for different types of utilities and different sizes of systems. (If the regulatory framework is relaxed for small systems, for example, this may alter the optimal governance/ business model.)

6. Carry out detailed policy, planning and promotion. Building on the actions to support the business case outlined above, flesh out policies, plans, and promotional activities. (See *Detailed Policy, Planning & Promotion* strategy below.)

## C. Detailed DE Policy, Planning & Promotion

### Background

Detailed policy, planning and promotion builds on business case development in the *Node and Corridor Evaluation* strategy under the *District Energy* strategy. It also aims to strengthen integration amongst big planning agendas, and diverse departments and divisions.

### Recommendations

1. Deeply integrate district energy and rapid transit agendas. Use both to help focus growth, and reinforce the success of each of these important initiatives. (See *Complete, Compact, Connected Corridor Strategy* in the *Land Use* section, above)

   - Strengthen Departmental and Division efforts on planning and engineering, such as road and traditional utility infrastructure development, building development and building permitting, transit planning, and neighbourhood and rapid transit corridor policy, as well district energy.
   - Phase and reinforce growth rates and scales around proposed transit stations to support district energy where DE potential thresholds can be justified from a market perspective.

- Coordinate street and utility upgrades and rapid transit infrastructure deployment with district energy development.

- Use the innovation factor of the twin agenda of rapid transit/district energy to attract senior government interest to these opportunities.

3. Integrate district energy development into broader land use and infrastructure planning.

   - Coordinate with public agencies and City of Surrey facilities on new developments and upgrades to serve as anchors in district energy development, e.g. recreation and senior's centres, libraries, Peace Arch Hospital/Fraser Health Authority, City of White Rock, retirement homes, senior government agencies.
   - Coordinate, attract and focus large private sector anchors (large employers, commercial and industrial heat users/generators, retirement homes) around potential district energy nodes.
   - Consider establishing *Development Approval Information Areas* where there is high district energy potential to require an energy study for developments over a certain size, e.g. two acres, that minimally provides energy demand projections over build out. (Under the Local Government Act section 920, local governments have the authority to designate areas and/or specify circumstances in which development approval information can be required.) Considering using this tool in tandem with promoting or requiring programs like BC Hydro's *Whole Building Design Program*.
   - If there is sufficient demand to establish cost effective district energy systems in an area, develop a Service Area Bylaw to require connection, and compatible building design. being constructed
   - Require large, new developments (e.g. 2,000 square meters or greater) within feasible service areas but prior to DES development to use hydronic heating. Consider using financial incentives discussed above for residential developments.
   - Integrate district energy promotion and planning in the *Sustainable Development Checklist* in a manner that is sensitive to the zone.
   - Coordinate with appropriate departments and divisions to identify existing and new applications for light industrial and commercial businesses with high heat demand and/or waste heat proximate to other potential district energy areas; and/or an aggregation of light industrial and commercial activity in focused areas. (High heat users and generators (e.g. food processing, refrigeration, data centres, and retirement homes) could be identified through business licensing by industry type.
   - As well as Planning and Engineering, Economic Development should be integrated into district energy planning to help attract and identify anchors and large new system loads.
   - Coordinate, attract and focus large private sector anchors (large employers, commercial and industrial heat users/generators, retirement homes) around potential district energy nodes.

4. Establish a building retrofit policy and program framework to support district energy expansion.

   - Develop a strategy that includes characterization of appropriate building types, estimated costs, optimal building lifecycle retrofit points, connection requirements, and a survey of potential incentives and regulations.

5. Protect rights of way for district energy distribution networks.

   - Develop a right-of-way framework involving mapping and securing access to planned and potential district energy rights of way for distribution networks and plants in new developments and road reconstruction, and formalizing this system into policy, planning and development.

6. Establish policies and plans to guide the City and private sector to transition out of natural gas and into renewables to reduce the carbon intensity of buildings on DE systems.

# 6 Solid Waste

In 2007, solid waste was responsible for 4% of total GHGs in Surrey. In contrast to most community GHGs, solid waste is primarily a non-energy source of GHGs and results from the anaerobic decomposition (i.e. without oxygen.) of organic waste in landfills

Reducing waste GHGs is mainly oriented towards diverting solid waste from landfills. Reducing, reusing, and recycling inorganic waste, nevertheless, can avoid significant GHGs by reducing demand for raw resources, processing and transportation.

The City of Surrey is already implementing a number of organic waste management best practices, including pickup of organic waste from single detached homes and development of a biofuel facility to process organic waste. The strategies outlined below continue with existing policies/programs with the intention of increasing recycling rates and virtually eliminating organics from landfill by 2015. These strategies are aligned with Metro Vancouver's Integrated Solid Waste and Materials Management Plan.

| Key Indicators & Targets | 2020 | 2040 |
|---|---|---|
| Share of Waste diverted to recycling and composting ⊙ | 75% | 85% |
| Total Tonnes Waste Per Capita (including recyclables + compost) | 0.86 \| 30% | 0.80 \| 59 |
| Per Capita GHG Tonnes of Waste | 0.1 \|-42% | 0.07 \| -58% |

[X] *The 2020 value is ambitious, yet below Metro Vancouver's aspirational target given the enourmity of the challenge and level of plans.*
[Y] *Annual performance relative to 2007.*

⊙*Key Target*

## Community Co Benefits

Economic Development

Energy Resilience

Zero Waste

## Strategies

A. Zero Waste Residents, Businesses, & Institutions

B. Zero Waste Construction & Deconstruction

C. Senior Government Sustainable Packaging & Extended Producer Responsibility

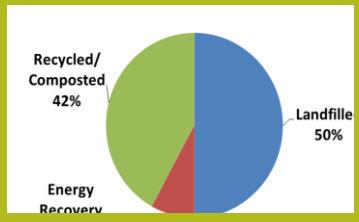
Sustainable Planning & Design for Energy Recovery from Waste

## Senior Government Assumptions

- Metro Vancouver bans compostable organics and wood waste from landfills by 2015 in accordance with the regional solid waste plan.
- Expansion of Extended Production Responsibility to include new waste/packaging types.
- 75% landfill gas capture rate achieved by 2016 in accordance with Provincial Landfill Gas Management Regulation.

## 2007 Waste Profile

In 2007 – this Plan's base year for analysis – around 50% of Surrey's waste went to a landfill (215,000 tonnes). 42% was diverted to recycling or composting. The remainder (8%) was combusted at the regional Energy Recovery from Waste facility in Burnaby. These 2007 figures predate municipal organic waste pickup for single family homes.



## The GHGs of Waste Management

Different waste management practices change the type and quantity of GHGs which, in turn, varies by material type. Generally, the primary GHG of interest is methane which is generated in landfills when organic waste anaerobically decomposes. Methane is 25 times more potent than carbon dioxide. Other waste management practices result in emission increases or decreases, depending on waste type, transportation mode and distance, and other factors. While not part of a traditional inventory, there are also emissions embedded in waste from extraction, processing and transportation. A strong waste management plan will consider GHG profiles of different management practices and product lifecycles to inform optimal management practices.

### Waste & Embodied GHGs

Embodied CO2e per tonne of waste differs significantly by material type.

**Table 16: GHGs by Material Type**

| Embodied $CO_2e$ per Tonne of Waste by Material Type[X] | | | | |
|---|---|---|---|---|
| Plastic | Milled Lumber | Aluminum | Office Paper | Computer |
| 2 t | 2 t | 8 t | 8 t | 56 t |

Some waste types have relatively low material and GHG inputs, e.g. wood. There are also waste types that are “valuable” due to immense embedded material inputs and GHGs and higher order management practice options, i.e. reuse and recycling potential versus landfilling or combustion.

### Management Practices & GHGs

GHGs vary significantly by management practice and waste type.

**Table 17: GHGs by Waste Management Practice**

| Tonnes of $CO_2e$ by Waste Management Practice Per Tonne of Waste[X] | | | |
|---|---|---|---|
| | Recycling | Landfilling | Combustion |
| **Office paper** | -3 t | +2 t | 0 t |
| **Milled lumber** | -2.5 t | +1 t | 0 t |
| **Plastic** | -1.5 t | +0.1 t | +1 t |

Recycling and reduction result in avoided virgin material inputs and emissions from extraction, processing and transportation. Combusting biogenic carbon (e.g. paper, wood) avoids potent landfill methane emissions and the emitted carbon is assumed to be re-absorbed by new trees – a fair assumption for North American fibre. Combusting plastic is more GHG-intensive than landfilling.

[X] US EPA: WARM Tool (Numbers are rounded and include generic assumptions which are not specific to Surrey’s context. They remain useful for relative comparisons across different waste management practices. )

## Strategies

### A. Zero Waste Residents, Businesses & Institutions

### Background

The City of Surrey is transforming waste collection to reduce emissions and divert waste from the landfill. The City directly manages waste, recycling, and organics pickup for single family homes and recycling pickup for multi-family homes. The City also plays a broad role in public education regarding waste management. This creates opportunities for the City to work with all sectors to increase waste reduction, separation, diversion, and recycling rates for residents, businesses, and institutions.

Diversion of waste from landfill differs significantly by sector and building type. Some of the challenges and opportunities in each sector are described below. The Metro Vancouver ban on organics, to take effect in 2015, is expected to help to drive increased diversion, recycling, and reuse rates of organic materials.

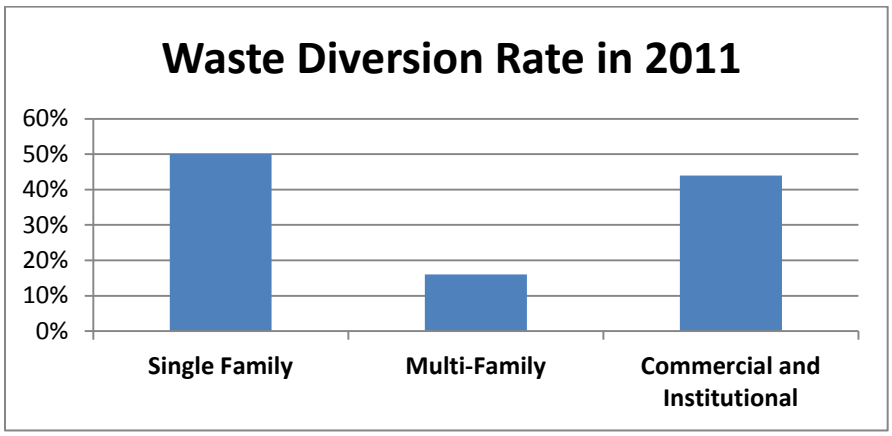



**Figure 48: Waste Diversion Rate 2011:** (Single data City of Surrey; Multi-family and commercial/institutional data: Metro Vancouver, 2011)


**Figure 49: Social Marketing:** The City runs education and outreach that continue to be strengthened. *Rethink Waste* is the current program.

### City of Surrey Biofuels Facility


The City of Surrey will build a new organics biofuel facility through a public private partnership. The facility will process residential and commercial kitchen and yard waste into a renewable fuel. It will be located on City-owned land in Port Kells adjacent to the Surrey Transfer Station.

Once the facility is operating, Surrey will be home to the only fully-integrated organics waste management system in North America. The system includes curbside organics collection, an entire fleet of compressed natural gas waste collection trucks, and a facility to process organics into "green gas". The 80,000 metric tonne per year facility will help the City and Metro Vancouver achieve the regional 70 per cent waste diversion target by 2015.

## Waste Management Situational Analysis by Sector

### Single Family

Since October 2012, City waste trucks have been picking up organic waste at curbside for single family homes each week. This has helped to increase the single family diversion rate from 40% in 2007 to around 60% in 2012. The major challenge is continuing to educate residents in single family homes about what types of waste can be placed in the organics bin and what cannot.

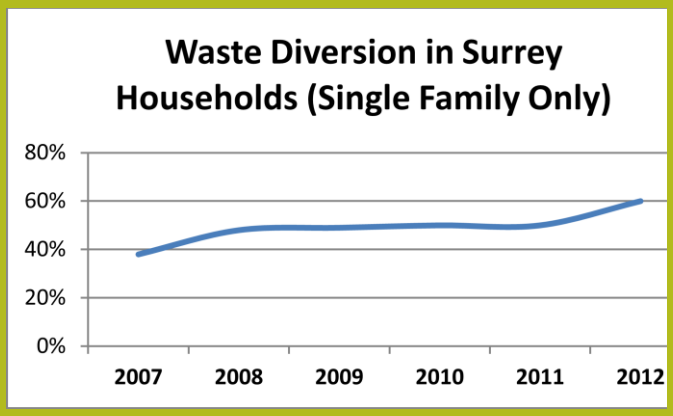


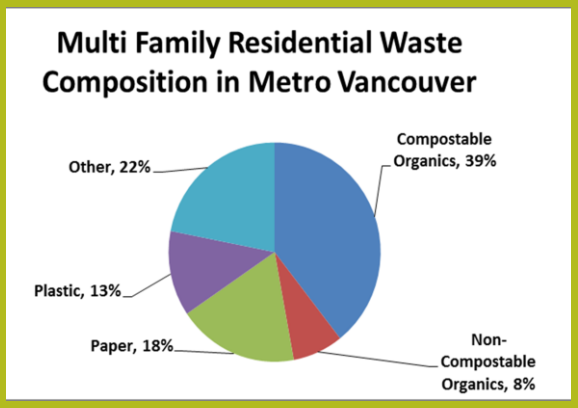

**Figure 50: Waste Diversion in Single Family (City of Surrey)**

### Multi-Family

While Surrey has achieved significant success in diverting waste from landfills in single-family homes, the diversion rate in multi-family homes is much lower, a consistent challenge across Metro Vancouver. Data specific to Surrey is not available, but for the region multi-family diversion is around 16%, less than 1/3$^{rd}$ the rate for single family homes. The largest fraction of waste from this sector is compostable organics at 39%, followed by paper and plastic. For existing multi-family buildings, in many cases, appropriate designed space for organic and waste bins was not designed at the time of construction. This can present a barrier in some buildings to increased diversion.

### Commercial/Institutional

For commercial (businesses) and institutions, diversion rates are nearly as high as single family buildings at around 44%. However, this sector has a high share of compostable and recyclable material remaining in their waste that could be diverted and is therefore considered a regional priority. The largest fraction of waste from this sector is compostable organics at 34%, followed by paper and plastic. Key sub-sectors to focus on include hospitality (restaurants, hotels and events), offices, schools and healthcare, and manufacturers of food and paper products (Metro Vancouver, 2011). Commercial and institutional waste collection services are contracted directly with the Private sector, making it more challenging for the City to directly sstrengthen compliance.



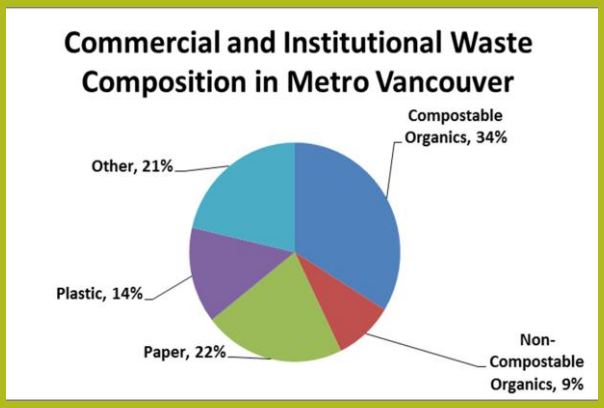




**Figure 51: Waste Composition in Multi-Family and Commercial/Institutional Buildings (TRI, 2012)**

## Recommendation

1. Continue to extend outreach on organics pickup in single detached homes.

    - Continue to deliver, evaluate and refine the City's social marketing.
    - Provide translated educational materials on organic waste pickup systems in languages appropriate to the community, e.g. Chinese, Hindi, Korean, Punjabi, and Tagalog.

2. Work with partners to develop targeted outreach for multi-family residential buildings for organics and recyclables.

    - Partner with Metro Vancouver, key large stratas, landlords, the Condo Homeowners Association, the Strata Property Agents of BC, and/or the Real Estate Council of BC's Rental Property Manager Licensing program to develop appropriate training, education, and capacity building programs for multi-family residences.

3. Support Metro Vancouver's outreach with key business and institutional sub-sectors, such as restaurants, grocery stores and food processors on organic diversion and offices for paper diversion.

    - Partner with Metro Vancouver, local Business Improvement Associations, Surrey Board of Trade, BC Food Processers Association, and other trade associations to deliver programs.

4. Evaluate and address key barriers to organics and recycling diversion in multi-unit residential buildings, and large commercial/institutional buildings, considering the unique opportunities in new and existing buildings.

    - Examine the need to update the City bylaw to require more (space) requirement for all building types (residential, commercial and institutional). Use Metro Vancouver's sample bylaw to inform development.

5. Update bylaw to require organic and recycling separation and transportation to appropriate facilities (with exemptions for on-site management systems) using Metro Vancouver's sample bylaw as a basis.

# B. Zero Waste Construction & Deconstruction

## Background

By weight, construction and demolition waste is the most significant waste stream across the region. Wood is a primary construction sector waste material, comprising15% of the total regional waste stream. Given its rate of growth, a measureable share of Surrey's waste is likely from the construction sector.

Increasing the processing capacity for large quantities of mixed materials and establishing convenient collection facilities for small loads of source

### Deconstruction & Demolition

Deconstruction is the practice of systematically disassembling a building in order to maximize the reuse, recycling or recovery of building materials. It is possible to achieve diversion rates over 90%.

Deconstruction is not common: it takes longer and is more labour intensive than conventional demolition, which can result in higher initial costs. Deconstruction can take two to six weeks, as compared to one to two days for conventional demolition

Pilot deconstruction projects carried out in the Lower Mainland have resulted in high diversion rates (over 80%). Where reported in one case study, the cost premium over conventional demolition increased overall project costs by around 1%. These costs are sensitive to the price of labour and tipping fees at landfills. The ban on wood waste could significantly reduce the cost premium as this material will need to be separated out regardless of whether buildings are deconstructed or demolished.

Overall, it appears that deconstruction can provide significant environmental benefits at a marginal cost premium. The City can play a key role in enabling and supporting an increased uptake of deconstruction practices.

Sources: (City of Vancouver, 2011) and (Casavant, 2012)

### Extended Producer Responsibility

"To achieve the aggressive waste reduction and diversion targets and reduce waste management costs, changes of an entirely different magnitude will be required. As long as products are made that are difficult to reuse or recycle, municipalities and society will be burdened by the significant efforts and high costs needed to manage waste. As we approach the limits of what can be practically and economically recycled, society will likely face diminishing returns in efforts to reach the 80% diversion level and the 10% per-capita reduction in waste generation.

To overcome these limits, products and their packaging will need to be designed with "cradle-to cradle" principles, so that at the end of their useful life, they can be repurposed or economically recycled into similar products. With those changes, the volume of waste that becomes the responsibility of local governments would be reduced, and local recycling initiatives would be more effective. However, those responsible for product design and manufacturing currently have little or no responsibility for designing products that minimize waste. Product development, marketing and distribution are global businesses, largely beyond the direct control of local governments and citizens… Manufacturers, distributors, retailers and consumers must become engaged in the process of reducing waste at its source."

Source: Metro Vancouver Zero Waste Challenge Strategy (2011)

separated wood could significantly boost diversion rates. Metro Vancouver has announced a ban on the disposal of wood waste in landfills by 2015. This is expected to drive increases in the convenience and ease of recycling wood waste.

From the municipal and construction industry perspective, managing time and reducing visual impact favours demolition and discourages deconstruction.

### Recommendation

1. Develop a construction and deconstruction policy framework to support resource recovery and zero waste:

   - Work with Metro Vancouver, and the regional/local construction industry, builders and developers to develop a cost effective, shared framework.
   - Review the current City and regional waste management process for opportunities to strengthen resource recovery and eliminate waste in construction and deconstruction. Consider diverse tools to support this framework (education, program development, partnerships, regulation, fiscal, and enforcement).

## C. Senior Government Sustainable Packaging & Extended Producer Responsibility

### Background

A large amount of residuals and costly recycling measures are due to poor product design and excessive packaging. The associated GHGs are significant at the community level, and even more so from a lifecycle perspective. Addressing these problems is beyond the influence of local governments, and requires senior government engagement.

Extended Producer Responsibility (EPR) aims to shift responsibility for managing products at end-of-life from taxpayers and municipalities to producers. In theory, this provides incentives to redesign products to minimize waste.

In practice, EPR in BC has focused on collection and recycling. The current approach allows producers to collectively manage an entire category of products and pass the cost to customers. For example, when buying a television, the purchaser pays a fee to handle its end-of-life management. The fee is the same for all brands, regardless of their design and the degree to which each product can be recycled. The policy framework has not incentivized companies to redesign products. Companies designing better products will have the same fees attached to their products as companies with poor design.

Metro Vancouver has offered staff support to the Provincial government to deepen EPR. They are also participating in Federal initiatives and

advocating for the reduction of packaging, phase out of non-recyclable packaging, and development of national sustainable packaging guidelines.

### Recommendation

1. Encourage senior governments to establish stronger policies on packaging and extended producer responsibility.

2. Support and engage with the national zero waste marketing council initiated by Metro Vancouver.

## D. Sustainable Planning & Design for Energy Recovery From Waste

### Background

Metro Vancouver / regional municipalities will use energy recovery from waste combustion as one of many strategies to help achieve its ambitious zero waste goals. While energy recovery is near the bottom of the waste management hierarchy, lower still is industrial-scale landfilling where the remaining resource value is discarded and GHGs are high. There are, nevertheless, wide ranging energy recovery combustion options with diverse performance on GHGs, waste management, energy sustainability, and air quality.

If Metro Vancouver choses to locate an energy recovery from waste facility in Surrey, the City should help shape a low carbon and high energy value option. Strong planning and design principles are necessary to ensure energy recovery from waste is a high sustainability solution.

To maximize sustainability objectives and alignment with Metro's, the City's, and the Province's climate, energy and waste goals, energy recovery from waste combustion is ideally not a short-term oriented, rigid power system. To maximize energy value and minimize GHGs, the system should generate useable heat and power. Feedstocks should be part of a flexible, resilient system that can accommodate planned reductions in waste volumes, changes in traditional and renewable energy feedstock prices, and other renewable feedstocks.

### Recommendation

1. If Surrey becomes a favoured location for an energy recovery from waste plant, the City should advocate a solution that is district energy-based and maximizes energy and waste management sustainability, and minimizes GHGs and criteria air contaminants.
2. The City should ensure a clear set of planning and design principles for energy recovery from waste underpin a district energy system that would be located in its community:

   - **GHG Lifecycle Sensitive:** ensure upstream and downstream GHG life cycle analysis is used to optimize a system that reduces overall GHGs from the region`s waste, including the transport emissions associated with a plant. Such analysis would also identify waste types appropriate to immediately include or exclude, and inform an adaptive management strategy to phase in or out over time (**Table 16** and **Table 17**)
   - **Maximize Energy Potential:** ensuring biomass combustion uses heat energy, and potentially heat and power.
   - **Adaptive Management:** systems should be engineered to accommodate changes in energy commodity markets and changing waste management practices, permitting diverse feedstocks.
   - **Air Quality Excellence:** ensure a system exceeds regulatory standards.

# 7 Cross Cutting Strategies

These measures cut across traditional energy and emission sectors and municipal line departments and extend out into the community. They are designed to foster alignment within the municipality, and consolidate support for the Plan within the City, community stakeholders, and the public. These measures also help ensure a municipality's daily business activity and the immense community-wide activity shaped by City business supports a future that is increasingly low carbon and energy resilient.

## A. Low Carbon Sustainability Lens

### Background

Taking comprehensive, coherent action on novel agendas like climate change, energy security and sustainability is challenging. Low carbon community development requires a major course correction to the traditional municipal approach. Managing greenhouse gas emissions across a community's buildings or transportation systems has implications horizontally across and vertically through many municipal departments.

Making headway on discreet, one-off projects can help support holistic thinking, municipal alignment, and award winning recognition. Systemic change that drives low carbon development across buildings, transportation and waste requires more fundamental adjustments. Systemic change can be supported through a decision making lens with the aim of managing carbon and costs, and maximizing energy resilience for residents, businesses, and the city, currently and in the future.

Crafting such a lens can be done specifically to address carbon and energy management, or address broader sustainability priorities. Carbon and energy management should, nevertheless, be linked to other critical community priorities like affordability, mobility and job creation.

### Recommendation

1. Develop a decision making lens to support staff, council, and potentially private, public and social sector players in the community to evaluate impact and provide guidance for managing GHGs and energy, and, if desired, broader sustainability policy. A straightforward, qualitative scoring tool could situate and optimize key decisions.
    - Engage council and staff and broader community stakeholders in developing the sustainability lens to increase potential for its application inside the City and in the broader community.
    - Specifically, use the tool during the annual budget process to qualitatively understand and manage the long term GHG and energy and cost implications of decisions, including the reduction or increase in energy spending for residents and businesses.
    - Use the tool to support and strengthen major land use and infrastructure decisions.

### Strategies

A. Low Carbon Sustainability Lens

B. Carbon Pricing Revitalization & Clean Air and Healthy Communities Fund

C. Community & Corporate Carbon Management Integration

### Energy, Emissions & Finance

Different capital investments options have different long term cost implications for operation, maintenance and replacement. They can also drive or constrain greenhouse gas emission growth. Capital investments that are highly energy efficient or use renewable energy are often more costly than conventional investments but can be less expensive to operate and maintain. When life cycle costing analysis is integrated into financial decisions, it often leads to lower long term costs and lower emissions. Incorporating life cycle costing and carbon quantification into municipal finance allows richer decision-making. Key opportunities for such analysis include:

- Annual budget
- Capital planning
- Procurement

- Consider integrating into the procurement process a qualitative discussion of the carbon and energy impact and management implications.
- Consider promoting tool application by other community private, public, social sector organizations.

## B. Carbon Pricing Revitalization & Clean Air and Healthy Communities Fund

### Background

There are two significant opportunities to renew and revitalize provincial fiscal policy to support a legacy for community investment and deep carbon reduction. Either or both of these opportunities could be used to seed a *Clean Air and Healthy Communities Fund*.

1. **Carbon Tax Renewal:** The Carbon Tax requires comprehensive renewal after its initial five year design. While the minor commitments made by the current provincial Government would be maintained such as the $30/tonne freeze, redesign opportunities include:

   - Phase in a portion of revenue to be recycled into a *Clean Air and Healthy Communities Fund* to invest in priorities that improve air quality, physical fitness and reduce GHGs such as transit, active transportation, control over large point sources of GHGs and air pollution;
   - Formally engage local governments in determining investments with advisory input from key players such as public health officers and major community emitters;
   - Amend carbon tax coverage to increase equity and fairness from demographic and sectoral perspectives.
   - Consider extending carbon tax coverage to include other air pollutants generated from fossil fuel combustion to manage these pollutants, too.

2. **Prosperity Fund for Low Carbon Community Development:** The provincial government has announced development of a Prosperity Fund that will be financed through liquefied natural gas (LNG) exports. Little is confirmed about this Fund. If LNG exports are as significant as the Province expects, pressure will grow to effectively mitigate the environmental and human health risks, and notably manage the growth of provincial greenhouse gas emissions.

   - Establish a *Clean Air and Healthy Communities Fund* envelope through the Prosperity Fund financed by LNG exports.

Support for these initiatives, will be strongly influenced by the nature of the investments and beneficiaries. Projects with significant community co-benefits would tend to have higher support such physical health (e.g. walk/bike to school programs), congestion management (e.g. transit), air quality (e.g. heavy duty trucking fuel economy), job creation (e.g. community building retrofit project for homes and businesses), affordability (e.g. energy/location efficient affordable housing).

### Recommendation

1. Create a dialogue with the Provincial Government to establish a *Clean Air and Healthy Community Fund* to build a legacy of deep carbon reduction/community development projects financed through a constructively renewed provincial carbon tax and LNG-financed prosperity fund for low carbon community development.

2. Work through and/or with Metro Vancouver and other key stakeholder to advance these opportunities.

## Community Carbon Offsets

The City of Surrey is a signatory to the BC Climate Action Charter, which includes a voluntary carbon neutral commitment for government operations. As administrator of the Charter, the provincial Green Communities Committee (GCC) has identified several GHG reduction projects that could be developed by local governments to offset the carbon liability of local government operations – with a lesser emphasis on quantification and verification of emission reductions, reporting and monitoring. These *Community Carbon Offsets* are an alternative to purchasing carbon credits through the Pacific Carbon Trust or another vendor. This should be an attractive opportunity for the City of Surrey and many other communities because it would allow them to:

- Leverage spending for community emission reductions projects with significant community co-benefits.
- Help achieve carbon neutrality in municipal operations while keeping expenditures local.
- Contribute to emission reduction efforts provincially and specifically for BC municipalities.

## Project Requirements

To be considered eligible, emissions reductions must be:

- *Additional* to those that would be possible without the financial / technical / coordination contributions of the City.
- *Real and Permanent:* the reductions need to meet minimum standards that prevent against leakage (activities shifting to a different locale or to occur in the future) and safeguards should be put in place to ensure carbon emissions avoided or sequestered are not released during and after completion of the project.
- *Measureable* and documented according to approved methodologies or methodology guidelines.
- *Clear City Ownership* established through documentation, particularly on multi-party projects.

## Project Types

A number of projects developed in this Plan have potential to become community carbon offset projects, including:

- District energy;
- Residential and commercial building retrofits;
- Rapid transit and low carbon land use;
- Low emission vehicle strategies;
- Building code compliance; and
- Centralized organic waste composting, as well biofuel production.

The BC Climate Action Secretariat has developed methodologies for some of these project types. Given the voluntary nature of the Charter, the City may be interested in developing its own project methodologies conforming to the Province's project requirements; and remaining aware of the criticism business as usual projects.

## Public-Sector, Scope-Three Offset Projects

Public sector organizations (PSOs) must offset emissions from scope 1 (e.g. direct GHGs from gasoline combustion in fleet vehicles or natural gas combustion for heating buildings), and scope 2 (e.g. indirect GHGs from power purchased from BC Hydro generated from a natural gas power plant). PSOs do not have to offset scope 3 emissions (e.g. emissions from employee/student travel to and from work/school). Many PSOs have significant influence over some scope three emissions and could contribute to project development by financial contributions from offset spending.

## Costs and Benefits

The costs associated with developing many offset projects with high community value are greater than the cost of purchasing carbon credits from other vendors. When there are significant co-benefits, the comparatively greater costs —versus purchasing carbon credits— may be justified because of the value they provide to the community.

## C. Community & Corporate Carbon Management Integration

### Background

The provincial carbon neutral agenda has come been criticized by many outside and inside the provincial government, including the Auditor General, for failing to cost effectively incentivize emission reductions inside government, subsidizing emission reduction projects that would have happened anyway, as well as subsidizing private sector projects with scarce public fiscal resources. This criticism has been focussed more at the carbon neutral regime for public sector organizations (PSOs) legislatively-bound to be carbon neutral vs local governments with a voluntary commitment.

If the carbon neutral agenda continues, there are opportunities to support high integrity offset projects that provide high benefit to the broader community in terms of job creation, genuine innovation, congestion management, and public health. These projects could be developed by the City, or in partnership with other PSOs, e.g. Health Authority, TransLink, School Board, or a Post-Secondary institution.

Activity on this Framework should be advanced only when there is greater certainty on the continuation of the carbon neutral agenda by the BC government.

(For further context, see *Community Carbon Offsets* discussion box, above).

### Recommendation

3. If BC's Carbon Neutral Agenda continues and the City aims to achieve carbon neutrality, the City should establish a Community Carbon Offset Framework to help meet a corporate carbon neutral commitment and support high value community emission reduction projects that offset City or PSO carbon liability.

   - Screen the community for high integrity carbon offset-type projects (see *Community Carbon Offsets* discussion box, below). Use existing Green Communities Committee project methodologies/protocols for calculating the value of these projects, or develop new methodologies/protocols that address the province's project requirement principles and some basic accounting requirements for local government projects. Liaise with the Climate Action Secretariat and Ministry of Community Development in project development.
   - Work with key PSOs to identify carbon-offset projects within *their* scope three emissions that are of high community value. Public schools/school boards, secondary schools, hospitals and TransLink may have beyond business as usual carbon reduction opportunities that could be partially financed by offsets. This could include projects such as low carbon real estate development, walk/bike to school programs, employee/student travel demand management, and innovative transit. The broader community benefit derived from these programs may justify active City involvement. Emission reductions/offsets could be used either to reduce corporate carbon liability for these institutions or the City. Liaise with the Climate Action Secretariat and Pacific Carbon Trust in project development.

# III Implementation & Monitoring

Please see *Implementation, Monitoring and Prioritization* excel document. Select content will be form the basis of some tables that are included here. Modeling results will help inform the prioritization matrix.

# IV Appendices

## A. References


*Population Health Profile 2010 - Surrey LHA.* (2010). Retrieved from http://www.fraserhealth.ca/media/Surrey_LHA_Profile_2010_FINAL.pdf

BC Hydro. (2012). *2012 Integrated Resource Plan, Chapter 4, Market Price Forecasts.*

BC Ministry of Environment. (2011). *Coastal Floodplain Mapping Guidelines and Coastal Flood Hazard Areas, Coastal Flood Hazard Area Maps.*

BC Ministry of Environment. (2013). *2010 Community Energy and Emissions Inventory Reports.* Victoria.

BC_Hydro_Staff. (2013, June). BC Hydro Code Compliance Analysis. (A. Boston, Interviewer)

Casavant, T. (2012, April 12th ). *Dematerialization and Buildings.* Retrieved from http://www.metrovancouver.org/region/breakfasts/Presentations/TracyCasavantDematerializationAndBuildings.pdf

City of Surrey. (2008). *Sustainability Charter.* Retrieved from https://www.surrey.ca/files/Sustainability_Charter.pdf

City of Surrey. (2012). *Cycling Plan.* Retrieved from http://www.surrey.ca/files/Surrey_Cycling_Plan_2012.pdf

City of Vancouver. (2011, July 26). *Advancing Deconstruction in Vancouver and Supporting By-Law.* Retrieved from http://vancouver.ca/files/cov/deconstruction-policy.pdf

CMHC. (2002, July). *Residential Street Pattern Design.* Retrieved November 2012, from Socio-economic Series 75: http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/socio75.html

El-Geneidy, A. a. (2007). Predicting Bicyle Travel Speeds Along Different Facilities Using GPS Data: A Proof of Concept Model. *Transportation Research Board 86th Annual Meeting* (p. 13). Transportation Research Board Business Office.

Harper, B. a. (2012). *Improved Code Enforcement: A Powerful Policy Tool - Lessons Learned from New York State, Vermont Energy Investment Corporation.* American Council on an Energy Efficient Economy.

HB Lanarc. (2010, December). *Pipes Need Jackets Too: Improving performance of BC Buildings through mechanical insulation practice and standards - a white paper.* Retrieved from http://www.energyconservationspecialists.org/wordpress/wp-content/uploads/2011/02/White-Paper_Pipes-need-jackets-too.pdf

HM Treasury. (2009). *Stern Review on the Economics of Climate Change. .* Retrieved from http://www.hm-treasury.gov.uk/sternreview_index.htm

Insurance Bureau of Canada. (2003, May 4th ). *Hurricane Juan insurance tab tops $113 million: points to need for preventative measures.*

Intergovernmental Panel on Climate Change. (2007). *Fourth Assessment Report. Working Four-Economic and Social Dimensions of Climate Change.* United Nations.

IPCC. (2007). *Climate Change 2007: The Physical Science Basis.* New York. : Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on CLimate Change.

Jones Lang Lasalle. (2012). *Rapid Transit Office Index.* Retrieved from http://www.joneslanglasalle.ca/ResearchLevel1/Rapid-Transit-Index.pdf

Knowles, W. a. (2012). *Compliance with Part 10 of BCBC Memo Regarding Survey Results.* Office of Housing and Construction Standards, BC Ministry of Energy and Mines.

MCD. (2011, November). *Development Permit Areas for Climate Action: A guide for energy conservation, water conservation, and GHG emissions reduction.* Retrieved from Ministry of Community, Sport and Cultural Development: http://www.cscd.gov.bc.ca/lgd/library/dpa_guide/dpa_guide.pdf

Metro Vancouver. (2011, February). *Zero Waste Challenge Strategy.* Retrieved from http://www.metrovancouver.org/region/ZeroWasteConference/Documents/ZWCStrategy.pdf

National Institute of Building Sciences (US). (n.d.). *Building Commissioning*. Retrieved May 2013, from Whole Building Design Guide: http://www.wbdg.org/project/buildingcomm.php

Proskiw, G. (2011). *Cost and Benefit Analysis of Proposed changes for energy efficiency in housing and small buildings in the National Building Code.* Canadian Codes Centre Institute for Research in Construction, National Research Council.

Province of BC. (2012, February ). *Modern Building Regulatory System White Paper.* Retrieved from Office of Housing and Construction Standards: http://housing.gov.bc.ca/mod/WhitePaper_Building_Regulatory_System.pdf

Sugiyama, T. (2012). Prolonged sitting in cars: Prevalence, socio-demographic variations, and trends. *Preventive Medicine*.

Sugiyama, T. a. (2012, October). Prolonged sitting in cars: Prevalence, socio-demographic variations, and trends. *Preventive Medicine, Volume 55, Issue 4*, pp. 315-318.

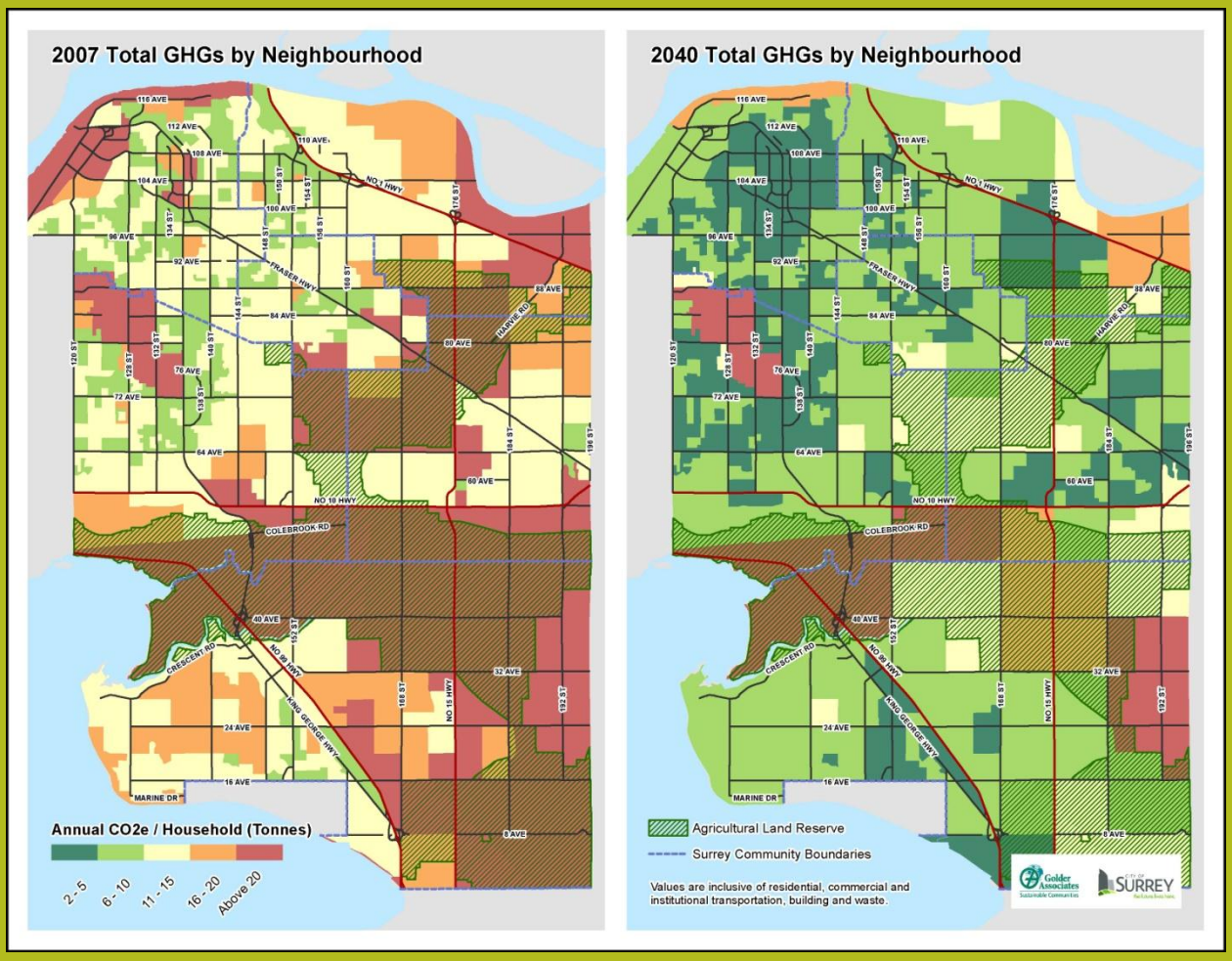
TRI. (2012, May 11). *Metro Vancouver 2011 Solid Waste Composition Monitoring Report.* Retrieved from TRI Environmental Consulting Inc.: http://www.metrovancouver.org/about/publications/Publications/2011_Waste_Composition_Report.pdf

US Department of Energy/Energy Information Administration. (2013). *Annual Energy Outlook 2013.*

US Energy Information Administration. (2012, June). *Annual Energy Outlook 2012 with Projections to 2035.* Retrieved from http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf

World Bank. (2012). *Climate Change and the World Bank.*

Yang, B. (2005). *Residential Energy Code Evaluations: review and future directions. Building Codes Assistance Project.*


2007 Total GHGs by Neighbourhood
2040 Total GHGs by Neighbourhood
Annual CO2e / Household (Tonnes)
2 - 5
6 - 10
11 - 15
16 - 20
Above 20
Agricultural Land Reserve
Surrey Community Boundaries
Values are inclusive of residential, commercial and institutional transportation, building and waste.
Golder Associates
SURREY
116 AVE
112 AVE
108 AVE
110 AVE
104 AVE
100 AVE
96 AVE
92 AVE
88 AVE
84 AVE
80 AVE
76 AVE
72 AVE
64 AVE
60 AVE
40 AVE
32 AVE
24 AVE
16 AVE
8 AVE
NO 1 HWY
FRASER HWY
HARVIE RD
COLEBROOK RD
NO 10 HWY
CRESCENT RD
NO 99 HWY
KING GEORGE HWY
NO 15 HWY
MARINE DR
120 ST
128 ST
132 ST
136 ST
140 ST
144 ST
148 ST
152 ST
156 ST
160 ST
164 ST
168 ST
176 ST
184 ST
192 ST
196 ST

City of Surrey

# Climate Adaptation Strategy

CITY OF SURREY
the future lives here.

City of Surrey

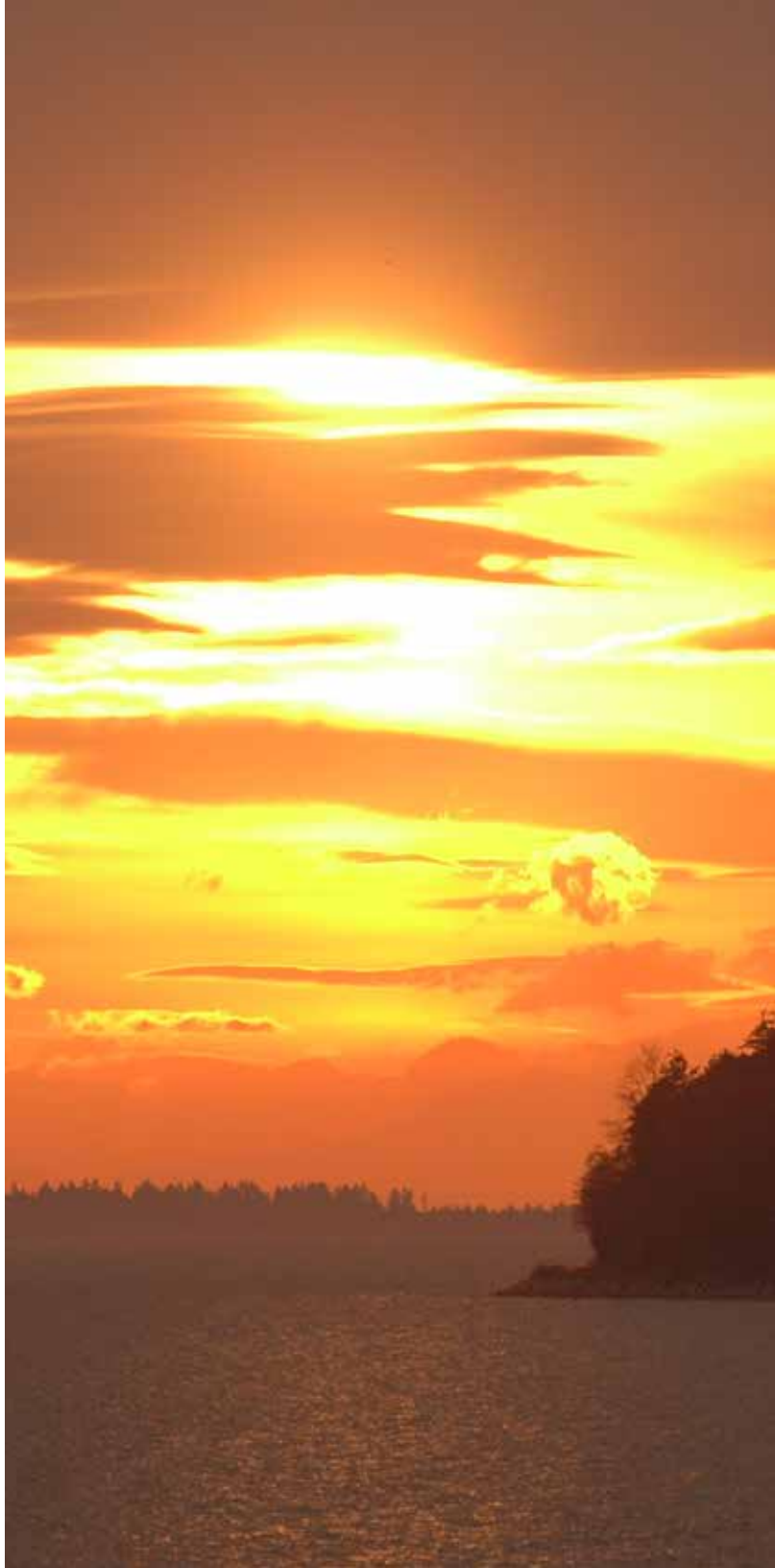
# Climate Adaptation Strategy

DRAFT

# TABLE OF CONTENTS



CITY OF SURREY



# EXECUTIVE SUMMARY

As we move forward in the 21st century, the impacts from global climate change are becoming evident, and challenging all levels of government to look to the future and develop more resilient communities. Ensuring Surrey is resilient in the face of unavoidable climate change impacts is critical to maintaining community well-being, environmental health and a vibrant local economy over the long-term. With direction from Surrey's Sustainability Charter, this Climate Adaptation Strategy has been developed using a five-milestone planning framework from the International Council for Local Environmental Initiatives (ICLEI-Canada – Local Governments for Sustainability).

Through the adaptation planning process, a risk assessment identified medium to high level risks in areas related to drainage and flooding, tree mortality and ecosystem change, energy security, and agricultural viability in Surrey. In response to these impacts, cross-departmental working groups have developed 91 actions to increase resilience in six sectors:

- Flood Management and Drainage
- Infrastructure
- Ecosystems and Natural Areas
- Urban Trees and Landscaping
- Human Health and Safety, and
- Agriculture and Food Security

Many of Surrey's existing policies and practices support community resilience, and position the City to respond proactively to new challenges posed by climate change. The actions identified within the Climate Adaptation Strategy build upon our existing adaptive capacity and provide direction for the City to further strengthen our existing policies, develop new programs or practices where gaps exist, work collaboratively with key partners and senior levels of government, and undertake the research necessary to ensure we are making the best decisions within the right time frames. The Strategy ensures that the City is doing what needs to be done, in a timely and cost effective way, based on the best available science and information. As our knowledge evolves, so will this Strategy. The Strategy further recognizes the critical role that senior levels of government will play in helping cities adapt to a changing climate, and identifies where the City will lead and where we will need assistance. Taking action is more than just preparing for uncertainty and stranger weather. A community that is resilient to climate change has a localized economy, strong and healthy ecosystems, tight-knit neighbourhoods, and a strong social fabric; it is walkable, energy efficient, and can thrive through disruptions such as rising energy and food prices or a natural disaster. Through proactive action in Surrey, we can achieve these goals and simultaneously realize a host of community

# Acknowledgements


## CITY OF SURREY STAFF

The Climate Adaptation Strategy was coordinated and written by the City's Sustainability Office: Maggie Baynham (Sustainability Coordinator), Ruth Legg (Sustainability Intern), and Polly Ng (Sustainability Intern), with oversight from Anna Mathewson (Sustainability Manager).
The Adaptation Advisory Team provided ongoing direction for the strategy's development:

- **Carrie Baron**, Drainage and Environment Manager, Engineering Department
- **Jeff Schaafsma**, Risk Management Manager, Finance & Technology Department
- **Carla Stewart**, Senior Planner, Planning & Development Department
- **Greg Ward**, Urban Forestry Manager, Parks, Recreation & Culture Department
- **Steve Whitton**, Trees and Landscape Manager, Planning & Development Department

A large number of City Staff participated in cross-departmental working groups to define the adaptation actions:

Jeff Arason, Chris Atkins, Neal Aven, Daniel Barnscher, Andrew Burger, Nadia Chan, Steve Clayton, Owen Croy, Remi Dube, Randall Epp, George Fujii, Waleed Giratalla, Stephen Godwin, David Hislop, Misty Jorgensen, Heather Kamitakahara, Colleen Kerr, Markus Kischnick, John Koch-Schulte, Kok Li, Catherina Lisiak, Shawn Low, Don Luymes, Michael McGreer, Marlis McCargar, Aileen Murphy, Jason Owen, Robert Reny, Steve Robinson, Ted Uhrich

## GUIDANCE AND SUPPORT

ICLEI Canada: Local Governments for Sustainability provided a strategy development framework and ongoing support as part of their Building Adaptive and Resilient Communities (BARC) program. Six other local governments in British Columbia were simultaneously participating in the BARC program, and shared experiences and support throughout the process.

## STAKEHOLDER CONTRIBUTIONS

The following organizations provided input and valuable feedback:
BC Healthy Communities, BC Landscape and Nursery Association, Diamond Head Consulting, Fraser Health, Golder Sustainable Communities , Metro Vancouver, Nicomekl Enhancement Society, Options BC, SFU Action on Climate Change Team, Surrey School Board, Surrey Environmental Partners, Village Surrey

# Acronyms

**BCLNA:** BC Landscape and Nursery Association
**BCSLA:** BC Society of Landscape Architects
**CEEP:** Community Energy and Emissions Plan
**CMO:** City Manager's Office
**DPA:** Development Permit Area
**ED:** Economic Development
**F&T:** Finance and Technology
**GHG:** Greenhouse gas
**IPCC:** Intergovernmental Panel on Climate Change
**ISMP:** Integrated Stormwater Management Plan
**NCP:** Neighbourhood Concept Plan
**OCP:** Official Community Plan
**PCIC:** Pacific Climate Impacts Consortium
**PRC:** Parks, Recreation and Culture
**P&D:** Planning and Development
**SLR:** Sea Level Rise
**SO:** Sustainability Office

# INTRODUCTION

## CHANGING CLIMATE, CHANGING CITIES

The global climate is rapidly changing, and the need for communities to respond has never been greater. Leading scientists have pronounced the warming of the world's climate as "unequivocal" and point to mounting evidence, including rising average air and ocean temperatures, sea level rise, changing precipitation patterns and extensive melting of icecaps and glaciers worldwide. Post-industrial human activities and the release of greenhouse gas (GHG) emissions into the atmosphere are the primary drivers of these changes. Human-caused GHG emissions increased by an unprecedented 70% between 1970 and 2004 and are likely to continue their upward trend over the coming decades.

Local governments have a unique interest and opportunity in planning for a changing climate. Municipalities will bear the greatest impacts and are best situated to proactively respond to affected services at the local level. Over the coming decades, communities will need to contend with the challenges of extreme weather events, rising sea levels, infrastructure failures, food and water shortages, increasing energy costs, and community health issues caused or exacerbated by climate change. The specific impacts for each community vary, and will depend on geography, the concentration of people and assets that are exposed to climatic risks, and the resources and willingness of the community to plan for and adapt to expected changes.

Preparing for climate change early on will help local governments to build resilient communities, reduce risks, and take advantage of opportunities. Municipal decision-makers are generally well positioned to take action because of several key factors:

**Mandate —** Local governments' legislative mandate includes many services that will be directly impacted by climate change—from infrastructure and utilities, to parks and recreation. Adapting to new climate conditions is crucial for continuing to deliver high quality municipal services.

**Local Scale —** As the level of government closest to community-scale circumstances, local governments are well placed to identify unique vulnerabilities to climate change and to prepare a response tailored to a City's needs.

**Managing Risk —** Proactive climate change adaptation planning can bolster a City's existing risk management by anticipating and mitigating future risks, as well as identifying and making the most of potential benefits.

**Fiscal Responsibility —** The cost of climate change for Canada is expected to be $21-43 billion, or 0.8-1% of GDP per year by 2050, depending on global efforts to curb emissions, and economic and population growth . Adaptation can significantly reduce these costs, and is a fiscally prudent measure given the extent of municipal services affected by climate change.

## WHAT IS CLIMATE CHANGE ADAPTATION?

The projected impacts of climate change will have far-reaching consequences for our economies, our ecosystems and our social well-being. Adaptation is about ensuring our communities are resilient in the face of these changes.

Adaptation strategies are diverse and they may occur through changes to individual behaviour, business practices, infrastructure management, or standards and regulation. Communities may adapt in anticipation of future changes, or may act in response to experienced impacts.

> Adaptation is defined as the initiatives or measures to reduce the vulnerability of human and natural systems to the actual or anticipated effects of climate change (IPCC, 2007).

Being proactive and integrating climate considerations into local government processes and decision-making allows for greater flexibility and helps to significantly reduce the cost of anticipated climate impacts. In addition to choosing adaptation strategies that represent a value for money or effort, actions that provide win-win outcomes and support broader sustainability goals should take higher priority. Many adaptation actions are aimed at maintaining healthy ecosystems, fostering regional self-sufficiency, and supporting vulnerable populations. Implementation of adaptation strategies as outlined in this document should maximize co-benefits in areas such as:

**Employment** — increased jobs in key sectors (e.g. agriculture, energy, green buildings);

**Energy** — reduced energy costs for residents and businesses;

**Air and water quality** — improved through healthy ecosystem services and protected natural areas;

**Liveability** — enhanced with improved services (e.g. drainage; tree replacements), access to green space, and security for vulnerable populations (e.g. energy efficient housing; emergency services).

**Table 1. Types of Adaptation**

| Type | Example |
|---|---|
| Anticipatory | Diversifying how rainfall is accommodated by using rainwater storage, permeable surfaces and enlarging drainage pipes during their replacement cycle |
| Reactive | Undertaking major drainage infrastructure upgrades after damage caused by heavy precipitation events |
| Supply Side | Building water reservoirs to collect rainwater |
| Demand Side | Water-metering to support water conservation |
| Top Down | Changing national or provincial standards, such as Building Codes, to address changes in climate |
| Bottom Up | Developing community by-laws to regulate building construction, and increasing areas of permeable surfaces to minimize pressure on storm water systems |
| Autonomous | Changing the timing and species planted by farmers based on observed weather changes |
| Planned | Changing water resource allocation to ensure biodiversity protection, agriculture and drinking water needs are met |

*[Modified from the Canadian Communities' Guidebook for Adaptation to Climate Change]*

## INTEGRATING ADAPTATION WITH MITIGATION

The relative stability of the earth's climate over the last 10,000 years has allowed human civilization to flourish; however, human activities have increased the concentration of greenhouse gas (GHG) emissions in the atmosphere to levels not seen for at least 650,000 years. These heat-trapping gases are contributing to a rise in global temperatures, disrupting natural and physical systems upon which our health and prosperity depend. The most recent International Panel on Climate Change (IPCC) report concluded that a temperature increase of 1 to 2°C "poses significant threats" to global ecological systems. In order to keep global temperatures from increasing beyond 2°C, global emissions need to peak before 2015 and see a 50-85% reduction below 2000 levels by 2050. For a summary of climate change science and the greenhouse effect, see Surrey's Community Climate Action Strategy overview document.

Unfortunately, the persistence of GHGs in the atmosphere means that we will experience and must prepare for some climate change impacts, regardless of global efforts to reduce GHG emissions over the coming decades. As noted in the Community Climate Action Strategy overview document, ***taking action on climate change therefore requires both mitigation and adaptation.*** Mitigation is aimed at reducing the production of greenhouse gas emissions to slow and limit the effects of climate change. Adaptation, on the other hand, seeks to minimize the inevitable impacts on our natural and human systems. Each is critical: without mitigation or a reduction in GHG emissions, no amount of adaptation will prepare us for the debilitating global effects on water, food production, biodiversity and human health. It is therefore essential that mitigation take place to "avoid the unmanageable", while adaptation concurrently aims to "manage the unavoidable."

### The Cost of Climate Change

Commissioned by the British Government and authored by former World Bank Chief Economist Nicholas Stern, the 2007 Economics of Climate Change report estimates the annual cost of reducing GHG emissions to a safe level to be 1% of global GDP by 2050.

The report also estimates the cost of climate change impacts to be equivalent to a 20% reduction in consumption per capita if no action were taken. Stern concluded that "the benefits of strong, early action on climate change outweigh the costs".

Adaptation and mitigation can have positive mutual benefits, but require careful planning to ensure strategies do not undermine each other. For example, numerous options are available to address increasing summer temperatures. To keep people cool, one adaptation strategy would be to increase the availability and installations of air conditioning systems; however, the added energy demand resulting from this adaptation measure would be in conflict with the mitigation objective of decreasing greenhouse gas emissions. By contrast, increasing tree canopy, vegetative cover, and green roofs in the City also have a cooling effect, and acts to make buildings more energy efficient. In this way, the latter option is supportive of both mitigation and adaptation goals.

A number of mutually reinforcing actions have been identified within Surrey's Climate Adaptation Strategy and Surrey's Community Energy and Emissions Plan (the City's GHG reduction plan).

These direct linkages simultaneously increase resilience to climate change impacts and reduce GHG emissions, and can be categorized into four areas:

- **Ecosystem Protection, Hazard Avoidance, Compact Land Use:** Focusing growth into dense urban land uses allows for the protection of green space which can strengthen the resilience of ecosystems and improve storm water management. Directing growth away from hazardous areas (e.g. floodplains) also reduces exposure to impacts from climate change. Compact, transit-oriented communities reduce transportation and building GHGs.

- **Ecosystem Health, Carbon Sequestration:** Healthy trees and ecosystems increase resilience to climate impacts such as increased rainfall and warmer summer temperatures. They also play an important climate change mitigation role by absorbing carbon from the atmosphere.

- **Heat Management, Passive Solar Design:** Many passive solar strategies at the site and building scale designed to manage the urban heat island (e.g. trees, reduced asphalt) and improve thermal performance (insulation and green roofs) can moderate health risks during heat waves. Many of these strategies also reduce vulnerability to extreme precipitation, and the resilience of ecosystems.

- **Community-Based Energy Supply, Self-sufficiency:** Reduced snow pack and increased variability in precipitation patterns will periodically reduce hydro electric supply. Extreme storm events, too, can reduce natural gas and gasoline supplies and increase costs. Investing in community-based energy systems such as district energy, as well as local, renewable energy supplies such as geo-exchange or biomass increases resilience to fluctuating costs and supply of global markets, while reducing GHG emissions.

In addition, more frequent intense weather events including floods, droughts and storms have the potential to temporarily or permanently disrupt global supply chains with cost implications for imported commodities, particularly food and energy. Increasing self-sufficiency and efficiency in these areas increases resilience in the local economy and reduces GHG emissions associated with transportation.

## Table 2: Surrey Community Energy and Emissions Plan and Climate Adaptation Strategy Linkages

| Climate Adaptation Strategy Goals by Sector | Ecosystem Protection, Hazard Avoidance, Compact Land Use | Ecosystem Health, Carbon Sequestration | Heat Management, Passive Solar Design | Community Energy Supply, Self-Sufficiency |
|---|---|---|---|---|
| **Cross-Cutting Actions** | | | | |
| Reinforce the implementation and enforcement of City policies and By-laws that support resilience | | | | |
| Educate and Engage Surrey Residents and Staff on Climate Impacts and Solutions | | | | |
| **Flood Management and Drainage** | | | | |
| Reach Consensus on a Regional Approach to Flood Management | ✓ | | | |
| Update Planning and Development Guidelines for Floodplains | ✓ | | | |
| **Infrastructure** | | | | |
| Deliver Proactive Climate Analysis and Management Practices for City Infrastructure | | ✓ | | |
| Support the Design of Climate-Resilient Buildings in Surrey | | | ✓ | ✓ |
| Advance Energy Self-Sufficiency Within the Community | | | | ✓ |
| **Ecosystems and Natural Areas** | | | | |
| Maximize Space for Habitat and Species Migration | ✓ | ✓ | | |
| Actively Manage City's Ecological Assets | ✓ | ✓ | | |
| Support Viability of Highly Sensitive Ecosystems | ✓ | ✓ | | |
| Protect Ecosystem Services Through Development | ✓ | ✓ | | |
| **Urban Trees and Landscaping** | | | | |
| Provide the Required Growing Environment to Sustain Trees | | ✓ | ✓ | |
| Plant Appropriate Species | | ✓ | ✓ | |
| Increase Tree Maintenance Management | | ✓ | ✓ | |
| **Agriculture and Food Security** | | | | |
| Provide Appropriate Infrastructure for Agricultural Viability | | | | ✓ |
| Encourage Greater Diversity in Local Products and Growing Methods | | | | ✓ |
| Increase Food Self-Sufficiency in the City and Region | | | | ✓ |
| Help Farmers Build Capacity to Adapt | | | | ✓ |
| **Human Health and Safety** | | | | |
| Collaborate with Key Partners on Improving Population Health | | | | ✓ |
| Minimize the Urban Heat Island Effect | | | ✓ | |
| Minimize Risks from Urban-Wildland Interface Fire | ✓ | | | |

# ADAPTATION IN CONTEXT

## SURREY'S VISION

Our Community, the City of Surrey, will be resilient in the face of a changing climate. Through bold leadership and careful forethought, Surrey will take timely action to reduce the risks of climate change and thereby minimize social, environmental, and economic costs in the future. In partnership with key stakeholders, and through the integration of adaptation in City policy, Surrey will remain a vibrant, flexible, and prosperous community for centuries to come.

## OVERARCHING GOALS

- Minimize risks and vulnerabilities to climate change impacts;
- Maximize adaptation co-benefits to achieve multiple sustainability goals;
- Integrate climate change considerations into ongoing business decisions;
- Build on existing City initiatives to make best use of existing resources;
- Ensure financial means are in place to take critical action where necessary;
- Partner with key stakeholders to take coordinated and prioritized action;
- Build adaptive capacity to respond effectively to climate change impacts over time;
- Increase awareness among the public and City staff to build support for adaptation;
- Pursue continual learning to ensure actions remain relevant and based on best practice.

To assist the City in dealing with climate change uncertainties, an adaptive management approach will be employed. Adaptive management is the process of putting in place small, flexible, incremental changes. This approach is based on regular monitoring and revision of plans using information available at the time, rather than relying on one-off, large-scale treatments. Adaptive management leaves scope for decisions about actions to be reviewed in the future, as improved information becomes available about the nature of climate change risks. The adaptive management approach helps address the challenges of uncertainty that are inherent within climate change planning, while maintaining the ability for Surrey to strengthen its risk mitigation should it become apparent that it is under-adapting to one or more climate change risks.

# POLICY CONTEXT

In September 2008, Surrey City Council unanimously adopted the Sustainability Charter, a comprehensive framework for implementing a progressive, 50-year vision for a Sustainable City. The City has been working to achieve its vision since 2008, including progress towards its commitments on climate change. In particular, the Charter commits the City to a climate change action plan (EN11), and includes action on both mitigation and adaptation:

## EN11: Surrey's Commitment to the Climate Change Action Plan

The City will undertake the following actions to reduce the causes of climate change and to mitigate potential impacts:

1. Develop strategies and take actions to achieve the goals of BC's Climate Action Charter, to which Surrey is a signatory;

2. Expedite the completion of the five milestones in the Federation of Canadian Municipalities' (FCM) Partners for Climate Protection process; and

3. Create an adaptation strategy to deal with the unavoidable impacts of climate change.

Surrey's *Community Energy and Emissions Plan (CEEP)* complements the Adaptation Strategy. The City of Surrey's Sustainability Office has coordinated the input of community members, stakeholders, City Council and City staff to create a plan to reduce energy use and greenhouse gas emissions in key sectors across the community. The goal of the CEEP is to establish Surrey as a model community in the areas of energy supply, reliability, sustainability and climate responsibility. The CEEP encourages local job creation and community re-investment; promotes vibrant, healthy neighbourhoods; and helps residents and businesses proactively address anticipated energy cost increases.

As part of the Climate Adaptation Strategy, Surrey has taken part in the Building Adaptive and Resilient Communities (BARC) initiative offered by the International Council for Local Environmental Initiatives (ICLEI Canada – Local Governments for Sustainability). The collaboration offers participating cities the opportunity to plan for anticipated impacts related to local and regional climate change. Participating cities worked in peer groups with facilitation, support, and direction from ICLEI Canada staff. Locally, other collaborators include: Metro Vancouver, the City of Vancouver, the Corporation of Delta and the City of North Vancouver.

### ICLEI – Local Governments for Sustainability

ICLEI is an international non-profit, with a local chapter in Canada. It has established itself as a leading organization and expert in climate change planning, specializing in easy-to-use frameworks that allow local governments to develop their own custom-made plans. In 2012, the City of Surrey completed ICLEI's 5 milestone process for Corporate GHG reduction as part of ICLEI's Partners for Climate Protection (PCP) program offered in partnership with the Federation of Canadian Municipalities.

With the initiation of the Climate Adaptation Strategy, Surrey was part of the first 'cohort' to participate in ICLEI's adaptation program. Choosing to partner with ICLEI on this initiative enabled the City to cost-effectively develop a strategy tailored to Surrey's needs, and work collaboratively with other municipalities in this emerging field.

# PLANNING PROCESS

The planning process began with the ICLEI collaborative in 2011, following approval by Surrey City Council in February 2011 (Council Report No.R028). Facilitated by ICLEI, the City of Surrey is following a five-milestone approach to climate change adaptation: initiate, research, plan, implement and monitor. The five-milestone process is outlined in ICLEI's Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation.

**The Initiate Phase** includes identifying stakeholders, building an adaptation team, and communicating with stakeholders.

**The Research Phase** involves recording climatic changes, identifying impacts, conducting vulnerability and risk assessments, and engaging stakeholders.

**The Plan Phase** includes setting an adaptation vision, goals, targets and objectives, identifying and assessing options, finalizing actions and establishing indicators.

Following the approval of the Adaptation Strategy, City staff will move to the **Implement** and **Monitor/Review Phases**, which include identifying implementation tools and initiating actions, engaging and communicating with residents and stakeholders, tracking progress and effectiveness of actions, and revisiting and revising the strategy as necessary.


Figure 1: ICLEI's 5 Milestone Planning Process

# Milestone 1: Initiate

## Build an Adaptation Team

An Adaptation Advisory Team representing multiple City departments was established at the outset of the process and guided the development of the Adaptation Strategy at every stage. Team members defined the overarching vision and goals, and helped to identify climate change impacts, review risk assessment outcomes, and evaluate adaptation options. They also contributed feedback and direction on staff engagement, provided a cross-sectoral perspective, and served as champions, raising interest and awareness within their respective departments.

# Milestone 2: Research

## Identify and Evaluate Impacts

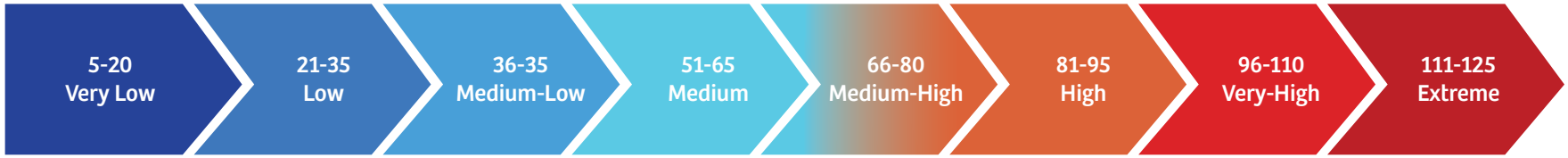
Climate change projections were obtained from the Pacific Climate Impacts Consortium, BC Ministry of Environment reports and other credible and scientific sources. Following background research and interviews with City staff, a set of 18 impact statements were developed to describe the key ways in which Surrey would be affected by projected climatic changes.

A vulnerability and risk assessment was conducted for each impact statement to determine the areas in which the City should focus its effort. The vulnerability component of the assessment considered each service area's sensitivity and adaptive capacity. The risk component assessed the likelihood of an impact occurring over the short and long term, and the consequences of the impact for public safety, the local economy and private property, regionally important infrastructure, environmental quality, and City government operations. Over 30 staff from multiple departments were brought together to

conduct the assessment in a workshop-style format. The resulting risk ratings were then reviewed by the Adaptation Advisory Team to ensure consistency between scores. See Appendix D for details on the risk assessment methodology and outcomes.

None of the impacts were calculated to be 'very high' or 'extreme' risk (see: Figure 2). Climate impacts that were assigned a low risk rating were removed and the remaining 14 were brought forward to be addressed in the strategy development phase. Given that some actions may require little effort or could have valuable ancillary benefits, impacts with a medium-low or medium risk rating were included in the strategy development phase. The level of risk assigned to each impact was later used to help prioritize adaptation strategies.

**Figure 2. Risk Rating Spectrum**




### Sensitivity:

The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli.

### Adaptive Capacity:

The ability of the built, natural and social systems to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
(IPCC, 2001)

## Risk Assessment Summary for 15 Climate Impacts:

### High Risk

- Increase in frequency and duration of flooding within low lying floodplains due to reduced system drainage resulting from sea level rise (SLR) and more intensive precipitation events
- Reduced subsurface drainage in some floodplain areas due to seepage and/or rising water table associated with SLR and more intensive precipitation events
- Increased probability that existing sea dykes will be overtopped due to a combination of SLR, subsidence, and storm surge and wind setup resulting from significant weather events

### Medium-High Risk

- Increased tree mortality rate and change in urban forest composition due to increase in hot weather, decreased summer precipitation, and increased winter precipitation leading to more saturated soils in lowlands
- Impacts on the viability of agricultural crops and other vegetation in floodplain areas, due to saltwater intrusion associated with SLR
- Change in streams' ecological composition due to increased summer temperatures and changing precipitation regimes altering stream base flow

### Medium Risk

- Increased risk of Fraser River freshet flooding due to changing temperature and precipitation regime in the Fraser River Basin, and SLR raising Fraser River water levels
- Agricultural irrigation (river and well) demand exceeds supply due to increased temperatures, decreased summer rainfall, and increased agricultural growing due to increased growing degree days
- Increased heat stress and other health ailments due to increase in heat advisory days
- Increased energy costs and energy insecurity due to increased cooling load and changing temperatures and precipitation regimes in BC electrical grid supply areas, impacting seasonal availability of hydroelectric power

*Note: Descriptions of these impacts are provided in the 'climate change impacts' sections for each sector, beginning on page X.*

## Medium-Low Risk

- Increased maintenance costs and premature failure of underground infrastructure due to saltwater intrusion
- Increased risk of urban interface fires (eg. forest fires and fires in other natural areas due to increased temperatures and drier summers)
- Loss of tidal mudflats and marshland ecosystems on seaward-side of dykes due to increased wave action and erosion associated with SLR and existing dyke positions
- Increased human health impacts including greater spread of pathogens due to warmer, wetter winter climate
- Low Risk (removed from strategy development phase)
- Domestic water demand exceeds supply due to increased temperatures and decreased summer rainfall

# Milestone 3: Plan

## Developing and Prioritizing Strategies

Following the risk assessment, cross-departmental staff teams met regularly and developed overarching goals and actions to address the climate impacts identified for different sectors. The six working groups were:

- Flood Management and Drainage
- Utilities and Infrastructure
- Ecosystems and Natural Areas
- Urban Trees and Landscaping
- Agriculture and Food Security
- Human Health and Safety

Once a refined list of actions was developed by each working group, the feasibility of implementing each action was evaluated based on criteria related to cost, ancillary benefits, urgency, political acceptability, and capacity. The feasibility outcomes were then mapped against the sectors' risk ratings to give a priority level (see Appendix E for full description of the prioritization methodology). The Advisory Team then used the prioritization ratings to identify 11 actions for immediate implementation. The expertise of external stakeholders was engaged at critical points throughout the process through one-on-one interviews and targeted workshops.

# CLIMATE SCIENCE AND PROJECTED IMPACT

## CHANGES GLOBAL TO LOCAL

At the international scale, global climate change is tracked and assessed by the Intergovernmental Panel on Climate Change (IPCC), an organization committed to providing a current, scientific and technical perspective. Leading scientists from around the globe who contribute to the IPCC agree that the Earth's climate is changing and that the chief cause of this change is human activity. Impacts at the global scale are already being experienced around the world—including increased annual temperatures, increased rate of glacier melt, more extreme weather events, increased flooding, and more pervasive droughts.

While climate change is global, the local impacts in different regions of the world vary widely. In British Columbia, the University of Victoria's Pacific Climate Impacts Consortium (PCIC) delivers high quality climate data, analysis and interpretation to local governments and other stakeholders. The City of Surrey also collects extensive weather data which assists the City in corroborating projections, undertaking finer-grained analyses and recognizing emerging trends. Climate projections and historic weather is no longer an accurate predictor of future climate.

Despite ever-improving data and projections, uncertainty is inherent in projecting climate change. The future climate hinges on how the global community responds to the task of drastically reducing GHG emissions over the coming years; as a result, differing GHG emissions scenarios play into a wide range of plausible climate outcomes. Moreover, scientists will always have an imperfect understanding of the climate system and will constantly be challenged to capture it in models; the promise of better data will always be around the corner and should not deter timely, effective and appropriate action. Following the precautionary principle, and using tools such as adaptive management, the City will strive to make the best decisions based on the best available science.

*See Appendix C for a detailed table of climate projections in Metro Vancouver and Surrey.*

## Temperature

By the 2050s, Metro Vancouver is projected to have summer temperatures that are 1.4°C to 2.8°C warmer (see Figure 3) and winter temperatures that are 0.8°C to 2.7°C warmer, with an average increase of 1.7°C year-round. Projections show changes in variables related to temperature including increased growing degree days, cooling degree days, and frost free periods, along with decreased heating degree days and precipitation as snow. Analysis of historic weather data shows Surrey has experienced statistically significant changes in all these variables between 1960 and 2000 (Figure 4).

Extreme temperatures are also anticipated to increase; extremely hot days which historically occur every 10 years (exceeding 32°C - 35°C) are projected to occur over twice as often by the 2050s in Metro Vancouver. Results from specialized high resolution models indicate that the daytime summer high temperatures can be expected to be warmer than present-day San Diego by the 2050s in a high-warming scenario, and by the 2080s in a lower-warming scenario.

Projected mean temperatures such as Figure 3 are based on a set of 30 commonly used Global Climate Models (GCMs).

**Figure 3. Metro Vancouver Mean Summer Temperature Projection (Source: PCIC, Plan2Adapt Tool (2013))**

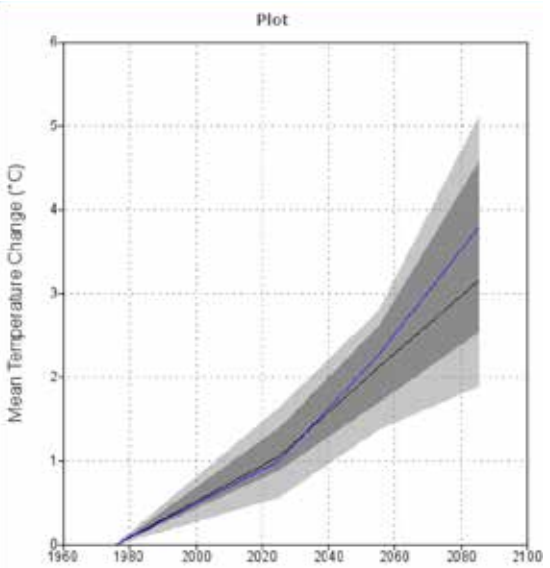
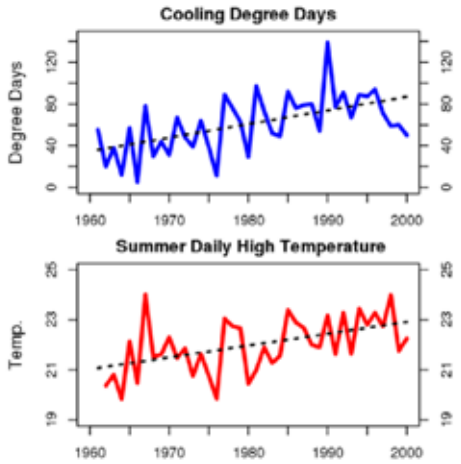



**Figure 4. Surrey Newton Historic Temperature-Based Trends (Source: PCIC, 2012)**



## Precipitation and Wind

Changes to precipitation patterns exhibit a wider range than temperature projections, with wetter winters and drier summers generally anticipated. By mid-century, Metro Vancouver is expected to see somewhere between a -4% and +15% change in winter precipitation, with the median scenario projecting a 6% increase (Figure 5). The median projection for summer precipitation is a 15% decrease, with a range of -25% to +3% (Figure 6). The amount of precipitation falling during "very wet days" (95th percentile, currently 28mm) is projected to increase by 21% in Metro Vancouver, while precipitation during "extremely wet days" (99th percentile, currently 44mm) is projected to increase by 28% in Metro Vancouver by the 2050s. Extreme precipitation events (with 3-hour duration) that in the past would occur once every 10 years, are projected to occur on average three times as often in the future.

A recent precipitation trend analysis looking at hourly rainfall data in Surrey from 1965 to 2011 showed statistically significant changes in rainfall patterns across 19 indicators. The historic analysis showed that Surrey is experiencing increases in both the frequency and intensity of moderate and heavy precipitation events. The analysis also showed that the most significant changes in intense rainfall have occurred over the past two decades; however, short-term trends are susceptible to influence from effects due to natural variability such as the Pacific Decadal Oscillation. More detailed modelling and analysis is necessary to complement the climate models and develop Surrey-specific design standards.

In Metro Vancouver, projections for wind speed return periods are varied, with occurrences projected up to 2.7 times as often or as seldom as 0.2 as often as in the past.

**Figure 5. Metro Vancouver Summer Precipitation Projection (Source: PCIC, Plan2Adapt Tool (2013)**

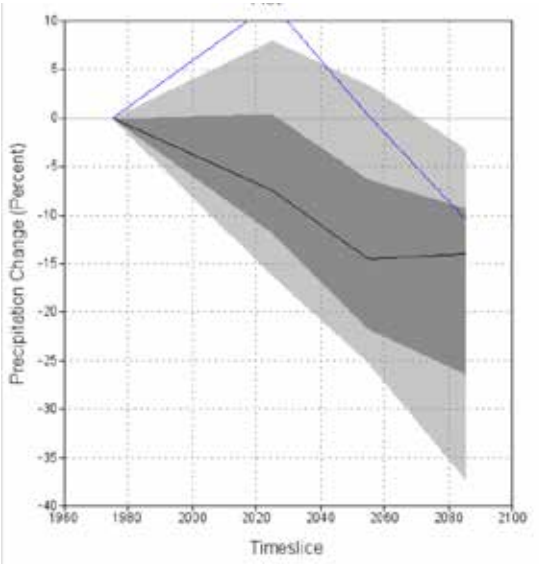
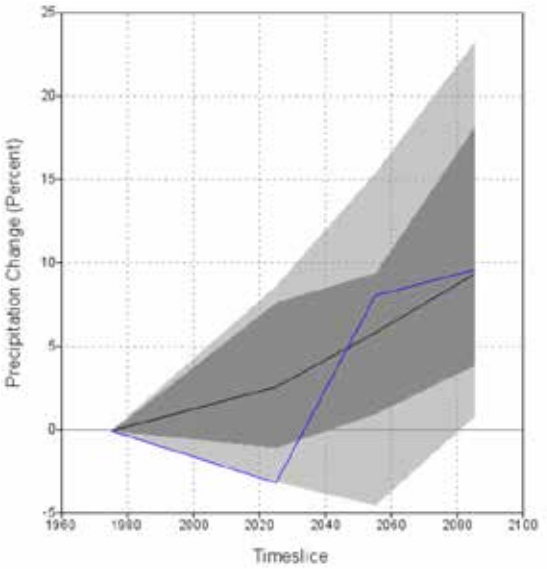


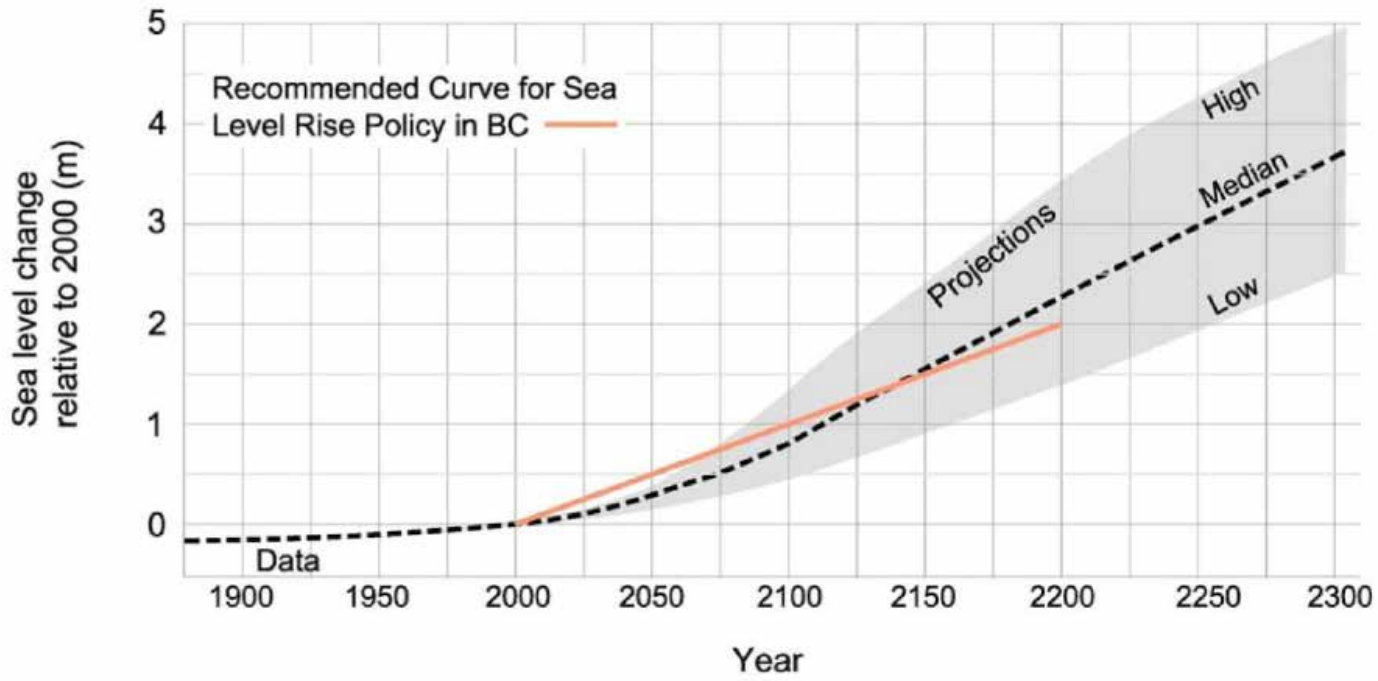

**Figure 6. Metro Vancouver Winter Precipitation Projection (Source: PCIC, Plan2Adapt Tool (2013)**



## Sea Level Rise

Global Sea Level Rise (SLR) is due to the ocean's thermal expansion and glacial melt, both products of increasing global temperatures. Sea levels have been rising at approximately 3.1mm per year in recent years, but this is expected to accelerate substantially with climate change in coming decades.

**Figure 7: Sea Level Rise Guidelines for British Columbia (Source: BC Ministry of Environment Sea Dike Guidelines)**




The BC Ministry of Environment has recommended planning for 1m of SLR by 2100 and 2m by 2200 (Figure 7). Using the provincial information as a baseline, the City has further investigated the rate of SLR and subsidence within the community. Subsidence is variable throughout the lowlands of Surrey; however, for the purposes of detailed impact work an average value of 0.225mm/year was assumed recognizing the need for more advanced assessments on this item. Combining the effects of rising seas and subsidence, Surrey is projected to see a net SLR increase of 1.195m (2010 base) by 2100. Further studies are being undertaken to better understand the combined effects of SLR with heavy precipitation events, storm surge, wave effects and wind events in Surrey.

# SECTOR REVIEW AND ACTIONS

From the City's efforts to define and protect its Green Infrastructure Network and biodiversity corridors, to the successful implementation of the Strategic Plan for Lowlands Flood Control, many of the City's past and current actions are contributing to its ability to effectively anticipate and respond to climate change. The 91 adaptation actions identified in this section seek to formalize and build upon the City's existing adaptive capacity.

In the following section, key crossing-cutting actions are identified, with the remaining adaptation actions organized under six sectoral areas:

- Flood management and drainage;
- Infrastructure;
- Ecosystems and natural areas;
- Urban trees and landscaping;
- Agriculture and food security; and
- Human health and safety.

Each section is prefaced by a description of the 'current state', which provides background information on the sector's existing strengths, stresses and adaptive capacity.

The 'potential impacts' subsection provides information on how that sector is likely to be affected by climate change, and the outcomes from the risk assessment described on page X are summarized.

The goals for each area were developed by staff working groups and adjusted based on stakeholder feedback, where applicable.

The immediate implementation actions were identified by the staff Advisory Team following a prioritization process that considered each actions's feasability and risk rating, as described on page X.

Details relevant to the implementation of each action, including the supporting City departments, related policy tools, relative costs, and spheres of influence can be found in Appendix A on page X.

# Cross-Cutting Actions

The following three actions cut across all sectors of adaptation and are central to building a resilient community through policy integration, education, and community engagement.

| | Adaptation Action | City Lead |
|---|---|---|
| CC-1.1 | Review City policies and by-laws to identify those practices that support resilience, and reinforce their implementation and enforcement. | CMO |
| CC-1.2 | Integrate climate change education and awareness into existing programs and communications, and develop new education initiatives where gaps exist for Surrey residents, businesses, and City Staff | CMO |
| CC-1.3 | Engage residents and businesses on ways they can adapt or otherwise prepare for climate change impacts (e.g. promote sustainable drainage techniques, plant appropriate tree species, emergency preparedness) | CMO |

***City Department Acronyms:*** *P&D: Planning and Development; PRC: Parks, Recreation and Culture; CMO: City Manager's Office; ED: Economic Development*

Immediate Implementation

# FLOOD MANAGEMENT AND DRAINAGE

## Current State

Flooding can occur in Surrey due to rainfall, snowmelt, rain on snow events, high tide events, or some combination of these conditions. With over 8,500 hectares of land within an existing floodplain area, the City of Surrey has developed a comprehensive system to manage drainage and flood risk issues within the community. There are four floodplains within Surrey: the Fraser River, Nicomekl/Serpentine, Campbell River and Boundary Bay floodplains, together controlled by over 100km of dykes, 30 drainage pump stations, two sea dams, and 170 flood boxes. This system not only defends municipal infrastructure, but controls flooding for private and senior government lands and assets including significant agricultural land, highways, port and railway facilities, and the community's water, sewer, energy and telecommunication utilities.

B.C. Ministry of Environment provides province-wide guidelines for dyke crest elevations and building flood construction levels. The City of Surrey is responsible for maintaining the dyking system on the Fraser River, Crescent Beach, and most of the dykes along the Serpentine and Nicomekl Rivers except for Colebrook and Mud Bay Dyking District Areas. In addition, the City is accountable for the community-wide drainage system which includes over 1,100 km of ditches and over 1,700km of storm sewers, with an average useful life of 70% remaining on this infrastructure.

The Fraser River is susceptible to freshet flooding each spring, where melted snowpack overwhelms the river's conveyance capacity and floods its banks. The flood of 1948 breached over a dozen dyking systems in the Fraser Valley, damaged or destroyed 2,300 homes, caused the evacuation of 16,000 people and cost over $150 million (2010 dollars) in damage and recovery. Another significant flood occurred in 1972. While flooding of this magnitude has since been avoided, peak snow conditions have posed significant flood risk numerous times since, including 1974, 1999, 2007, and 2011. The Nickomekl and Serpentine river basins are prone to flooding from extreme precipitation events and runoff from the uplands, strong Westerly winds, and high tide events. Prompted by persistent flooding in Surrey's agricultural land and increasing impacts from upstream development, the City invested $40 million over 10 years to upgrade drainage and flood infrastructure as part of the Strategic Plan for Lowlands Flood Control, beginning in 1997. The City has seen significant improvements to flood impacts in the lowlands since implementing the Strategic Plan.

In addition to infrastructure, the City has a number of policies in place to help limit the risk of flooding and extent of damage from flood events. While the City has long had a practice of limiting development within the lowlands, in 2008 Council endorsed the Development within the Nicomekl and Serpentine River Floodplains policy, which formally restricts development within the Serpentine/Nicomekl 200-year floodplain. The Surrey Zoning By-law provides floodproofing regulations, including community-specific policies for flood-prone areas. Stormwater management is embedded in land use decisions through the development of Integrated Stormwater Management Plans and through incorporation into Neighbourhood Concept Plans. In addition, the City's drainage infrastructure has retained open streams as the foundation of the stormwater network since the adoption of the Natural Drainage Policy in 1979.

In the case of a major flooding event, the Surrey Emergency Program is prepared to support evacuation, if necessary.

## Climate Change Impacts

If unaddressed, climate change is anticipated to significantly increase the risk of flooding in Surrey in a number of different ways. First, protective infrastructure such as sea dams and dykes are more likely to be breached with sea level rise, particularly in combination with more intense storm surges. Second, sea level rise may increase the frequency and duration of flooding in flood plain areas due to more frequent and intensive precipitation events. Third, sea level rise may cause local water tables to rise, increasing the risk of surface pooling and flooding. The degree of risk is less certain regarding Fraser River freshet flooding, given the intricate dynamics of changing snowpack, rising temperatures, and shifting precipitation patterns.

Some flooding and drainage impacts are already being experienced in Surrey due to climate change. For example, the combination of sea level rise, subsidence, and high winter tides has led to a rising water table and increasing drainage problems in Crescent Beach. The City's 2009 Crescent Beach Climate Change Adaptation Study analyzed these issues and outlined a servicing strategy with a cost of $25 to $30 million. The first component of the servicing strategy, the replacement of the Maple Drainage Pump Station, is to be completed in 2013.

There are four categories of response that can be considered in addressing sea level rise: accommodate, protect, retreat or avoid. Accommodating impacts means a certain level of flooding will be anticipated and accepted, and can involve flood proofing at the building level (e.g. elevated building construction) or developing a sophisticated emergency response system. Protection is a structural response which may involve the construction of dykes, sea walls, or natural buffers, such as wetlands, to provide a physical barrier to flooding. Retreating involves decommissioning or moving existing development back from the hazard over time. Finally, avoidance entails restricting new development from locating in flood prone areas and can be undertaken in conjunction with the other options.

In 2011, the Province released a draft report entitled Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use, which advised planning for 1.2m of sea level rise by 2100, and increased the recommended flood construction level from 3.6m to 6.2m. In 2012, a second report was released by the Province that estimated the cost of

upgrading flood protection infrastructure for sea level rise at $9.5 billion across Metro Vancouver, with $1.6 billion of that cost for infrastructure within Surrey. The City is currently undertaking more detailed analysis to model and map sea level rise impacts with more locally contextual information and a greater level of accuracy. Given the regional nature of the impacts and the tremendous expense entailed, the Fraser Basin Council recently initiated a planning process to develop a Regional Flood Management Strategy that considers different flood management options in collaboration with regional stakeholders and the provincial and federal governments.

The City articulated some concern regarding this estimate, including the proportion of the cost dedicated to seismic upgrating, and the low probability of the combined effects (e.g. high tide, storm surge. wind set up) that informed the new recommended standards (CR#5225-17).

## Risk Assessment Results

| Climate Impact Statements | Risk |
|---|---|
| Increased probability that existing sea dykes will be overtopped due to a combination of sea level rise, subsidence, and storm surge and wind setup resulting from significant weather events | High |
| Increase in frequency and duration of flooding within low lying floodplains due to reduced system drainage resulting from sea level rise and more intensive precipitation events | High |
| Reduced subsurface drainage in some floodplain areas due to seepage and/or rising water table associated with sea level rise and more intensive precipitation events | High |
| Increased risk of Fraser River freshet flooding due to changing temperature and precipitation regime in the Fraser River Basin, and SLR raising Fraser River water levels | Medium |

## Overarching Goals and Prioritized Actions

Two key goals have been identified to address impacts and increase resilience around flood management and drainage in Surrey:

1. Reach Consensus on a Regional Approach to Flood Management
2. Update Planning and Development Standards for Floodplains

| Goal 1: Reach Consensus on a Regional Approach to Flood Management | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| FL-1.1 | Support the development of the Regional Flood Management Strategy in coordination with senior levels of government, other municipalities, and key stakeholders | Engineering |
| FL-1.2 | Participate in a detailed cost-benefit analysis to assess alternative options for accommodating sea level rise and coastal climate change impacts | Engineering |
| FL-1.3 | Encourage senior levels of government to proactively commit the capital investment for flood protection infrastructure | Engineering |

Immediate Implementation

| Goal 2: Update Planning and Development Standards for Floodplains | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| FL-2.1 | Conduct detailed analysis on Surrey-specific climate impacts, including the timelines and extent of sea level rise and its related effects on flood construction levels and floodplain designations | Engineering |
| FL-2.2 | Develop drainage and flood control strategies based on cost-benefit analyses and site-specific needs | Engineering |
| FL-2.3 | Incorporate climate change into the City's Integrated Stormwater Management Plans (ISMPs) and other efforts to integrate land use planning and stormwater management | Engineering |
| FL-2.4 | Review and revise regulatory By-Laws and design standards to account for and minimize the impacts of climate change | P&D |

Immediate Implementation

# INFRASTRUCTURE

## Current State

The City of Surrey is responsible for providing and maintaining billions of dollars worth of infrastructure across the City. Capital works are funded through transportation levies, utility fees, Development Cost Charges, and tax revenue, as outlined in The City of Surrey's 10-Year Servicing Plan. Major infrastructure assets include:

- Drinking water system: pipes, service connections, pump stations, valves and fire hydrants
- Sanitary sewer systems: pipes, manholes, service connections and pump stations
- Drainage system: pipes, manholes, natural channels, ditches, detention ponds, sea dams, flood boxes, pump stations, and dykes
- Transportation systems: roads, active transportation networks, bridges, streetlights, traffic signals, and signage
- District energy systems: thermal energy generation systems, pipes, service connections, and energy transfer stations
- Buildings: civic facilities such as community and recreation centres
- Green Infrastructure Network: parks, streams, biodiversity corridors, hubs and sites

In many cases, the delivery of services occurs in cooperation with other organizations; for example, Metro Vancouver is responsible for managing the drinking water reservoirs, filtration plants, and water mains, as well as regional sewer trunks and wastewater treatment plants. Similarly, many players are involved in the delivery of the regional transportation system within Surrey's borders, including the Province, TransLink, Port Metro Vancouver, and CN, CP, BNSF and Southern Railways. BC Hydro and Fortis BC Gas have traditionally delivered the vast majority of energy needs to Surrey residents; however, the City has recently established a district energy utility, Surrey City Energy.

In addition to delivering community infrastructure, the City plays an important role in providing and enforcing building regulations from the BC Building Code and the City's Buildings By-Law. In 2012, building permits for over $1 billion of development were approved in Surrey; the extent and scope of development in Surrey represent an opportunity to ensure a resilient building stock for the community.

## Climate Change Impacts

Climate change has the potential to impact municipal infrastructure in a number of significant ways, with financial and safety implications for the community. In potentially disastrous incidents, infrastructure may sustain damage from extreme weather events such as wind storms, temperature extremes and flooding. In these instances, inadequate design or vulnerable locations may be coalescing factors that result in losses. While today's infrastructure has been carefully designed to account for historic climate extremes, it can no longer be assumed that the past will accurately represent future weather patterns. Without accounting for climate change, our built environment is vulnerable to weather events beyond what it has been designed to withstand.

Infrastructure may also be vulnerable to more gradually changing conditions, such as inundation from sea level rise or changes in the availability of water or energy. These changes may increase the operating and maintenance costs or reduce the lifespan of infrastructure. In some cases, climate impacts in the global marketplace may cause interruptions to the supply chain and have implications for the bottom line. Demand-induced effects may also be taken into consideration, such as increased pressure on water or energy resources during summer heat waves.

Adapting municipal infrastructure to climate change can take many forms, from physical interventions or structural improvements, to the relocation of assets to more secure locations. Financial and policy changes may also be needed, such as more comprehensive insurance or more thorough health and safety response plans in the event of infrastructure failure. Demand-side management programs to reduce water or energy usage may be implemented to reduce the pressure on service delivery. Complementing or replacing traditional "grey" infrastructure with "green" infrastructure can increase resilience to extreme precipitation and temperatures, as well as realize a host of other community benefits. In addition to increasing capacity to manage stormwater runoff and reduce ambient temperatures, green infrastructure can improve air quality and health, lower energy demand, increase carbon storage, and provide wildlife habitat and recreational space.

Surrey's most acute risks with respect to infrastructure are posed by the inadequacy of current flood protection and existing drainage systems to accommodate future sea level rise. Given the gravity and regional nature of this issue, it is addressed in more detail in its own section (see page X). The degree of risk for the balance of Surrey's infrastructure was deemed relatively low for a combination of reasons, including:

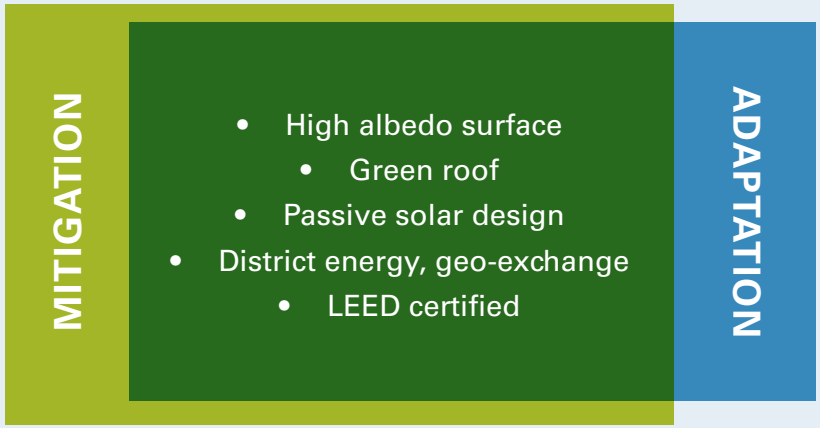
- **Limited exposure of infrastructure to climate impacts.** The City restricts new development in the floodplain, which has led to relatively little City infrastructure being exposed to flooding.
- **Mid-term replacement cycles for infrastructure.** As a fairly young City, much of Surrey's infrastructure has yet to reach the end of its service life. Fifty percent of Surrey's drainage mains will not require replacement for another 35 to 50 years, with the balance needing replacement in the latter half of the century. Given the range of uncertainty with respect to short- and mid-term precipitation projections, a longer time horizon for pipe replacement enables the City to observe trends, utilize enhanced climate projections, and develop infrastructure plans that will better accommodate climate impacts.
- **Existing investment in the City's Green Infrastructure Network.** Surrey's 1979 Natural Drainage Policy established a commitment to keep creeks open, and to maintain a naturalized drainage system, where feasible. This tradition continues today with the increasing incorporation of bioswales in street design and the identification and protection of Surrey's Green Infrastructure Network (GIN). The development of Integrated Stormwater Management Plans for each of the City's watersheds further embeds stormwater management and infrastructure planning into land use decisions.
- **Emerging capacity to adapt.** Surrey is likely to experience growing climate impacts in the decades to come, but has also demonstrated an ability to identify, plan for, and finance infrastructure improvements in response to changing circumstances. The Strategic Plan for Lowland Flood Control was established to provide standard drainage criteria for the Serpentine, Nicomekl lowlands. It was implemented over 10 years and has effectively controlled the incidents of flooding in the Serpentine and Nicomekl floodplains. More recently, the Adaptation Study and servicing plan developed for Crescent Beach responds to drainage issues exacerbated by sea level rise.

Despite these strengths, the City will need to focus on climate change considerations and how they impact infrastructure investments, in order to protect the community's assets for decades to come.

## Opportunities in Energy: Addressing both sides of the climate change coin

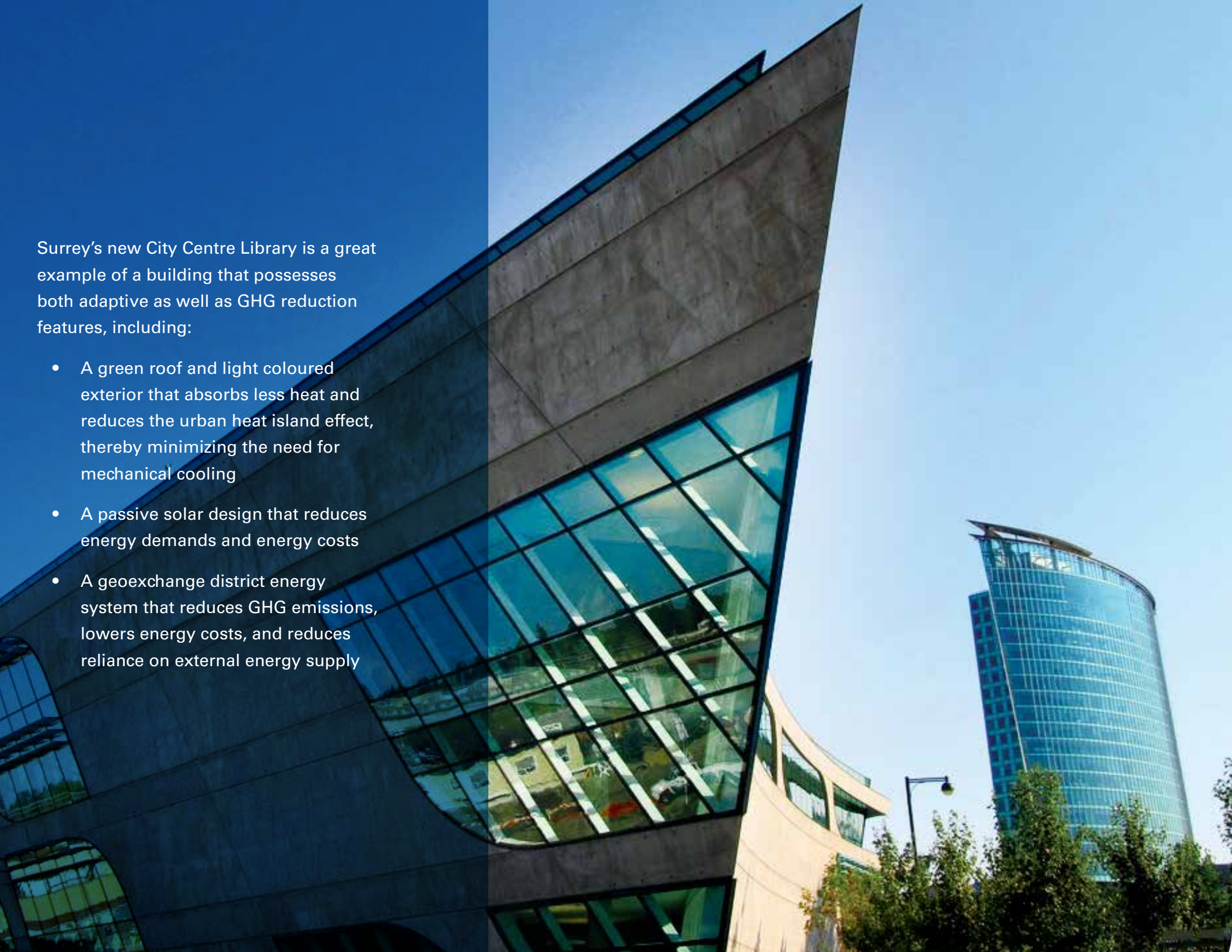
Like other types of infrastructure, our energy system has the potential to be impacted by shifting climate norms as well as an increase in extreme weather events. Hydropower generation may lose capacity because of a declining snow pack and reduced summer precipitation. At the same time, the demand for air conditioning may increase due to rising summer temperatures. These impacts may add to the rising energy costs our communities are already facing.

While adapting the Province's energy supply falls outside the City's responsibility, there are many actions that can be taken to increase energy security and at the same time help to reduce the community's greenhouse gas (GHG) emissions. These actions include reducing energy demand through conservation and efficiencies, and exploring opportunities for more localized and renewable energy supplies to help protect the community against Provincial or global energy shortfalls. To achieve these goals, the City has also initiated the development of District Energy (DE) systems in City Centre, which will use a centralized energy source to deliver heating, and in some cases cooling, to neighbouring buildings. Using a central energy source increases energy efficiency, and makes it easier to switch between different fuel types, such as natural gas, geo-exchange, biomass, or sewer-heat recovery. Increased efficiency and the opportunity to use renewable, low-carbon fuels will help to reduce the City's GHG emissions, while the increased flexibility and use of local energy sources will provide Surrey with a more resilient energy system that can respond to the price and availability of different energy sources.



Surrey's new City Centre Library is a great example of a building that possesses both adaptive as well as GHG reduction features, including:

- A green roof and light coloured exterior that absorbs less heat and reduces the urban heat island effect, thereby minimizing the need for mechanical cooling
- A passive solar design that reduces energy demands and energy costs
- A geoexchange district energy system that reduces GHG emissions, lowers energy costs, and reduces reliance on external energy supply



# Risk Assessment Results

| Climate Impact Statements | Risk |
|---|---|
| Increased probability that existing sea dykes will be overtopped due to a combination of sea level rise, subsidence, and storm surge and wind setup resulting from significant weather events | High |
| Increase in frequency and duration of flooding within low lying floodplains due to reduced system drainage resulting from sea level rise and more intensive precipitation events | High |
| Increasing energy costs and energy insecurity due to the combination of increased cooling demand and changing temperature and precipitation regimes affecting the seasonal availability of hydroelectric power in BC | Medium |
| Damages and/or increased maintenance costs to structures and infrastructure (underground and at-grade) due to more variable and extreme weather patterns and sea level rise | Medium - Low |
| Domestic water demand exceeds supply due to increased temperatures and decreased summer rainfall | Low |

## Overarching Goals and Prioritized Actions

Three key goals have been identified to address impacts and increase resilience for Surrey's infrastructure:

1. Deliver Proactive Climate Analysis and Management Practices for City Infrastructure
2. Support the Design of Climate-Resilient Buildings in Surrey
3. Advance Energy Self-Sufficiency Within the Community

| Goal 1: Deliver Proactive Climate Analysis and Management Practices for City Infrastructure | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| IN-1.1 | Enhance data collection and monitoring for climate impacts in Surrey (e.g. storm events, precipitation patterns, subsidence rates, changes in water quality, etc.) | Engineering |
| IN-1.2 | Regularly review design requirements to ensure that they adequately account for expected weather conditions due to climate change | Engineering; PRC |
| IN-1.3 | Assess existing City infrastructure and utilities for vulnerability to climate change | Engineering |
| IN-1.4 | Integrate climate change into the 10 year capital and servicing plans of relevant departments | Engineering; PRC |
| IN-1.5 | Continue to minimize the inflow and infiltration of stormwater into the sanitary sewer system in an effort to reduce the risk of sanitary sewer overflows | Engineering |
| IN-1.6 | Monitor and manage species composition and selection to enhance resilience of Surrey's Green Infrastructure Network | PRC |

Immediate Implementation

| Goal 2: Support the Design of Climate-Resilient Buildings in Surrey | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| IN-2.1 | Advance energy efficiency in new construction and building retrofits | P&D |
| IN-2.2 | Increase education and awareness on energy efficiency opportunities among City staff and developers | P&D |
| IN-2.3 | Encourage the Province to ensure the BC Building Code adequately reflects and accounts for current and projected climate (i.e. increased winter precipitation, storm events and increased summer temperatures) | CMO |
| IN-2.4 | Incorporate guidelines for water conservation in new and existing development | P&D |

| Goal 3: Advance Energy Self-Sufficiency Within the Community | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| IN-3.1 | Continue to expand on district energy systems in City Centre and support the development of district energy outside the current service areas | Engineering |
| IN-3.2 | Establish a requirement for development over a certain size to complete an energy study that identifies energy efficiency and generation opportunities | P&D |
| IN-3.3 | Explore opportunities to support local development of distributed energy systems and renewable energy sources (e.g. solar hot water, biomass, etc.) | CMO |
| IN-3.4 | Encourage the Province to establish programs that incent homeowners to invest in renewable energy generation | CMO |

***City Department Acronyms:*** *P&D: Planning and Development; PRC: Parks, Recreation and Culture; CMO: City Manager's Office; ED: Economic Development*


NRP

# ECOSYSTEMS AND NATURAL AREAS

## Current State

The City of Surrey is fortunate to be located within rich and diverse natural surroundings. Sixty percent of Surrey's parkland inventory is now classified as natural area. This includes all types of green space, from dedicated urban forest, riparian areas, wetland, bogs, marshes, grasslands, and fields, to forested areas in parks, greenbelts, and boulevards. Surrey's green network also includes regionally important natural areas such as Surrey Bend Regional Park and Tynehead Regional Park, neighbourhood-scale sites such as Port Kells Park and Redwood Park, and countless forested backyards, urban parks, and agricultural fields. Natural areas help sustain clean water, recharge groundwater, maintain clean air, and support healthy plant, fish and wildlife communities. In terms of the services it provides, this "green infrastructure" is just as essential as the network of roads that move goods and people, or the agricultural landscape that provides food and other products.

The ongoing challenge with managing the City's natural assets is finding a workable balance between environmental protection of natural areas and access to these same lands for the benefit and well being of Surrey residents and visitors. A number of factors related to the rapid development and urbanization of Surrey can place stress on ecosystems. Population growth increases the demand for and use of Surrey's natural areas and many are now bordered by residential, commercial and industrial developments. Ongoing issues with managing natural areas include: illegal dumping of waste and refuse in parklands; blazing of unauthorized trails; inappropriate use of and damage to trails; spread of invasive species; damage to waterways that threatens surrounding ecology; and management of tree and fire hazards. These ongoing pressures can both degrade natural areas and contribute to conflicts over use.

The City has a number of planning processes and tools for addressing its challenges in balancing protection and access to natural areas. These include:

- Natural Area Management Plan;
- Ecosystem Management Study;
- Biodiversity Conservation Strategy;
- Community Wildfire Protection Plan;
- Integrated Stormwater Management Plans;
- Erosion and Sediment Control By-law;
- Integrated Pest Management Policy & Pesticide By-law;
- Stormwater Drainage Regulation and Changes By-law; and
- Official Community Plan.

## Climate Change Impacts

Several climate change factors are projected to impact Surrey's ecosystems and natural areas, including an increase in average temperatures and extreme heat events, decreasing summer precipitation, and increasing winter precipitation (leads to more frequently saturated soils). These factors are anticipated to result in an increasing tree mortality rate as well as changes to ecosystem composition. Different tree species have varying adaptive capacities, or ability to cope with a quickly changing climate. While hardwoods appear to be less affected by climate change, many conifer species in BC are expected to lose a large portion of their suitable habitat. As already seen in other parts of British Columbia, tree species are becoming more vulnerable to pests, such as the Mountain Pine Beetle.

An increased tree mortality rate in Surrey would have a series of associated environmental and socio-economic risks. Less canopy cover will likely result in lowered air quality and an increased urban heat island effect. Other ecosystem services may also be diminished by the loss of trees, such as water filtration, slope stability, removal of airborne particles and gases, and stormwater retention. To mitigate increasing tree mortality, the City will need to anticipate the suitable species and management requirements for the City's projected climate.

In addition to tree impacts, many critical ecosystems in Surrey are expected to be significantly affected by climate change. Changes to the base flow of local streams, as well as shifts to their ecological composition, are anticipated due to increased summer temperatures and changing precipitation patterns. Sea level rise and increased wave action and erosion will likely cause "coastal squeeze", or a loss of tidal mudflats and marshland ecosystems that are trapped on the seaward side of dykes and are unable to naturally adapt by migrating inland. These ecosystem impacts have important implications for biodiversity health; for example, salmon are very sensitive to water temperature change and may be negatively impacted by increased stream temperatures, with cascading repercussions for other species.

## Risk Assessment Results

| Climate Impact Statements | Risk |
|---|---|
| Increased tree mortality rate and change in urban forest composition due to increase in hot weather, decreased summer precipitation, and increased winter precipitation leading to more saturated soils in lowlands | Medium - High |
| Change in streams' ecological composition due to increased summer temperatures and changing precipitation regimes altering stream base flow and water quality | Medium - High |
| Loss of tidal mudflats and marshland ecosystems on seaward side of dykes due to increased wave action and erosion associated with sea level rise and existing dyke positions | Medium - High |
| Impacts on the viability of agricultural crops and other vegetation in floodplain areas, due to saltwater intrusion and flooding associated with sea level rise | Medium - High |

## Overarching Goals and Prioritized Actions

Four key goals have been identified to address impacts and increase resilience for Surrey's ecosystems and natural areas:

1. Maximize Space for Habitat and Species Migration
2. Actively Manage Ecological Assets
3. Support Viability of Highly Sensitive Ecosystems
4. Protect Ecosystem Services Through Development

| Goal 1: Maximize Space for Habitat and Species Migration | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| EC-1.1 | Improve the quantity and quality of the City's habitat to enable species migration and resilience through the implementation of the Biodiversity Conservation Strategy | PRC |
| EC-1.2 | Strategically acquire a diverse representation of ecosystem types as part of Surrey's parks and natural areas | PRC |
| EC-1.3 | Reduce habitat fragmentation by using and protecting a comprehensive network of corridors and larger natural areas (hubs and sites) | PRC |
| EC-1.4 | Increase public awareness, and the use of planning tools (e.g. voluntary conservation easements) capacity to create higher habitat values on private property | PRC |

| Goal 2: Actively Manage City's Ecological Assets | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| EC-2.1 | Increase active management of City controlled natural areas (e.g. removal of invasive species), and encourage more active management of natural areas on Provincial, Regional, non-profit and privately owned lands. | PRC; Engineering |
| EC-2.2 | Implement evolving best practices for ecosystem management in a changing climate | PRC; Engineering |
| EC-2.3 | Consider assisted migration for species whose dispersion rate is unable to keep pace with climate change (e.g. planting tree species historically suited to more Southern climates) | PRC; Engineering |
| EC-2.4 | Increase tree risk management to minimize damage and liability from dead or dying trees | PRC; Engineering |
| EC-2.5 | Partner with key organizations and the private sector to limit the sale of invasive species and promote adaptable species at local nurseries | PRC; Engineering |
| EC-2.6 | Incorporate climate change messaging in environmental education efforts, and continue to engage the public in stewardship initiatives | PRC; Engineering |

***City Department Acronyms:*** *P&D: Planning and Development; PRC: Parks, Recreation and Culture; CMO: City Manager's Office; ED: Economic Development*

| Goal 3: Support Viability of Highly Sensitive Ecosystems | | |
|---|---|---|
| **Riparian Areas** | | |
| | **Adaptation Actions** | **City Lead** |
| EC-3.1 | Apply Surrey standards for streamside setbacks to accommodate potential erosion and optimize ecological health | P&D |
| EC-3.2 | Establish Development Permit Area Guidelines for sensitive ecosystems | P&D |
| EC-3.3 | Implement strategies to maintain stream flow affected by changing temperature and precipitation patterns | Engineering |
| **Intertidal Areas** | | |
| | **Adaptation Actions** | **City Lead** |
| EC-3.4 | Promote the development of regional cost/benefit analyses of sea level rise and flood management options that considers ecological values and protection of property and infrastructure | Engineering |
| EC-3.5 | Evaluate options for installing physical interventions to support ecosystems (e.g. construction of a breakwater) | Engineering |

| Goal 4: Protect Ecosystem Services through Development | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| EC-4.1 | Incorporate climate change into the City's Integrated Stormwater Management Plans (ISMPs) and other efforts to integrate land use planning and stormwater management | Engineering |
| EC-4.2 | Provide direction to developers on suitable vegetative species and development features that enhance habitat values | P&D |
| EC-4.3 | Host workshops for the City's staff, management and Council on 'green' development features and their effectiveness in protecting ecosystem services | P&D |
| EC-4.4 | Review landscape design guidelines to ensure they support habitat values | P&D |

***City Department Acronyms**: P&D: Planning and Development; PRC: Parks, Recreation and Culture; CMO: City Manager's Office; ED: Economic Development*

# URBAN TREES AND LANDSCAPING

## Current State

The City of Surrey values its urban trees for the quality of life they bring to residents as well as the many benefits and ecosystem services they provide. A number of policies are in place to protect and enhance the urban landscape, including the Tree Protection By-law, which outlines requirements for tree preservation and replacement on private property. The City also engages residents and schools through the Surrey Nature Centre, the ReLeaf Tree Planting Program, ReLeaf Days, Environmental Extravaganza, Party for the Planet – Earth Day, Arbor Day, and by providing public education on watering, pruning and other aspects of tree care.

A number of existing challenges face the City regarding shade trees and urban landscaping. As a fast growing community, development is displacing many mature trees. As well, densification, important for achieving many of the City's climate mitigation and liveability goals, makes it difficult to give newly planted trees the space they require to grow into healthy, fully grown trees. Practices are evolving to accommodate more trees in dense new neighbourhoods, such as the use of structural soil to allow more space for root development.

Warmer, drier summers are already placing increased stress on young trees. In 2001, the City watered its newly planted trees for 14-16 weeks of the year, for up to four years. In 2010, newly planted trees required water for 16-18 weeks of the year, and trees required watering for up to eight years. This has added considerable cost in terms of staff time and water resources for the City.

## Climate Change Impacts

As a result of climate change, urban trees will be impacted by hotter, drier summers, and soil saturation may increase during winter months. A primary concern is that the species that currently thrive in Surrey may not be suitable for the future local climate. The projected rate of climatic change may make it very difficult for existing species to adapt, or for southern species to migrate north. A key challenge for the City will be to anticipate a range of tree species that may be suited to Surrey's future climate and to maintain species diversity to ensure resilience across a range of possible future climates.

Urban trees, or shade trees, include those on public lands such as streets, boulevards, and urban parks, as well as trees on private property. Street trees are considered unique from Surrey's natural areas due to the differing management considerations; however, they do provide important contributions to habitat and ecosystem values.

The current issue of prolonged watering requirements for newly planted trees will persist, with costs increasing for replanting and maintenance. Minimizing tree mortality through diversified species and adequate space and soil quality will help to offset these increasing costs. With increasing tree mortality, valuable habitat may be lost, air and water quality may decline, and there may be a greater risk of hazards from trees near homes and roads. Ensuring a healthy urban landscape is critical for a number of Surrey's objectives, including enhancing liveability and the public realm, increasing biodiversity, and maintaining clean air and water. Maintaining our urban trees will also become increasingly important for other components of climate action in Surrey, such as managing stormwater, reducing the urban heat island effect, and maximizing building efficiency.

## Risk Assessment Results

| Climate Impact Statement | Risk |
|---|---|
| Increased tree mortality rate and change in urban forest composition due to increase in hot weather, decreased summer precipitation, and increased winter precipitation leading to more saturated soils in lowlands | Medium - High |

## Overarching Goals and Prioritized Actions

Three key goals have been identified to address impacts and increase resilience for Surrey's urban trees and landscaping:

1. Provide the Required Growing Environment to Sustain Trees
2. Plant Appropriate Species
3. Increase Tree Maintenance Management

| Goal 1: Provide the Required Growing Environment to Sustain Trees | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| TR-1.1 | Utilize City By-laws, standards, and permitting processes to ensure adequate canopy, root crown and root growth space for trees on public and private property to mature to optimal size | Engineering; PRC; P&D |
| TR-1.2 | Utilize City by-laws, standards, and permitting processes to optimize soil conditions for shade trees on public and private property (e.g. soil quality, quantity and moisture content) | Engineering; PRC; P&D |

Immediate Implementation

| Goal 2: Plant Appropriate Species | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| TR-2.1 | Plant tree species that will be well adapted to Surrey's 100 year climate projections, particularly with respect to temperature and drought increases | PRC |
| TR-2.2 | Monitor survival rate of trees planted on public property to confirm species suitability over time | PRC |
| TR-2.3 | Increase the species diversity of shade trees on public and private property | PRC |
| TR-2.4 | Develop an educational resource that encourages residents to plant trees which enhance species diversity (e.g. an annual "feature tree" pamphlet) | P&D |

Immediate Implementation

| Goal 3: Increase Tree Maintenance Management | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| TR-3.1 | Increase tree replacement and maintenance activities (such as watering) to sustain trees, as necessary | PRC |
| TR-3.2 | Anticipate a growing need for tree risk assessments and abatement due to tree decline and mortality | PRC |
| TR-3.3 | Undertake a Pest Threat Assessment to better understand the risks to trees and ecosystems posed by changing disease vectors and invasive species | PRC |
| TR-3.4 | Explore a requirement for local residents to water boulevard trees during summer months | PRC |

# AGRICULTURE AND FOOD SECURITY

## Current State

A mild climate and some of the most fertile soils in the country make the agricultural industry a unique and critical sector within Metro Vancouver. , Over one third of the City's land is designated for agriculture within the Agriculture Land Reserve (ALR); agriculture also contributes significantly to the City's economy and regional food security. Approximately 3,300 people or 1.6% of Surrey's labour force are employed in agriculture, with most farms being family owned. The 2011 Census of Agriculture reports that Surrey's total farm receipts, a measure of agriculture sales, total over $167 million.

Surrey's farmers face numerous challenges in the operation of their farms, many of which Surrey's Agriculture Protection and Enhancement Strategy seeks to address. Farm businesses, regardless of size, are experiencing increasing input costs and pressure from global commodity prices, and are continually competing with inexpensive imports.

Financial returns are low, with most farm operators relying on a second, off-farm income. , As a result, it is difficult and often undesirable for young farmers to enter the sector, and the average age of B.C.'s farmers is increasing. Access to irrigation water is also a pressing concern, with limited options for expansion. Surface water licences for the Nicomekl, Serpentine, and Campbell Rivers are currently oversubscribed, with all available licences allocated by the Province. Much of the groundwater in Surrey is of marginal quality and not easily available to farms. Potable water is only available to farmers for residential use, as the water network was not designed for irrigation purposes. Other existing issues for farmers include ensuring appropriate drainage and effectively managing salt water intrusion in areas adjacent to Boundary Bay and Mud Bay.

## Climate Change Impacts

Drainage and flooding pose some of the greatest risks to farmers in Surrey, with the potential for crop and livestock losses, soil salinization, and a loss of agricultural land due to permanent inundation. Wetter winters and increased weather variability may lead to soil saturation, more frequent flooding, increased nutrient leaching, interruptions to planting and harvesting, and increased pressure on drainage infrastructure and management. Addressing these issues through increased pumping or other infrastructure improvements could be costly to the City.

Warmer temperatures and extreme precipitation events may increase the risk of food-borne pathogens, such as E.coli. In addition, higher temperatures may increase the winter survival rates and the number of pest cycles experienced each year, with new pests and diseases being introduced. Pollination may be delayed or prevented due to pests and diseases, and may be interrupted by increasing precipitation and weather variability. Challenges with accessing irrigation are also likely to become more pronounced with warmer, drier summers, leading to water stress and a decline in the productivity and quality of crops and livestock.

Climate change research predicts that BC will experience increasing agricultural capability and a broader range of suitable crops in the short term. In the long term, however, climate change will likely increase uncertainty and the costs of weather damage for BC's agricultural operations. A switch to new high-value crops may be challenged by exposure to pests, soil salinization, limited irrigation access, and inconsistent productivity, quality, and prices in global markets due to weather fluctuations.

It is estimated that 40 to 50% of the food consumed in BC is currently imported. Extreme weather and deteriorating agricultural conditions internationally will likely increase the costs of production and lead to a greater demand for local food products. For example, a significant portion of imported food comes from California, which has experienced severe drought in recent years with implications for food production. This makes a strong case for building a well-adapted and increasingly self-sufficient agricultural sector that hedges its investments through diversifying its products and growing methods. Locally, more frequent extreme weather events such as storms, winds and heat may increase farm building maintenance costs, the risk of crop and livestock losses, and increase costs for cooling and ventilation. The sum of these changes will mean increased management complexity for the agricultural sector in Surrey

# Risk Assessment Results

| Climate Impact Statements | Risk |
|---|---|
| Increase in frequency and duration of flooding within low lying floodplains due to reduced system drainage resulting from sea level rise and more intensive precipitation events | High |
| Reduced subsurface drainage in some floodplain areas due to seepage and/or rising water table associated with sea level rise and more intensive precipitation events | High |
| Increased probability that existing sea dykes will be overtopped due to a combination of sea level rise, subsidence, and storm surge and wind setup resulting from significant weather events | High |
| Impacts on the viability of agricultural crops and other vegetation in floodplain areas, due to saltwater intrusion and flooding associated with sea level rise | Medium - High |
| Agricultural irrigation (river & well) demand exceeds supply due to increased temperatures, decreased summer rainfall, and increased agricultural growing due to increased growing degree days | Medium |

## Overarching Goals and Prioritized Actions

Four key goals have been identified to address impacts and increase resilience for food security and agriculture in Surrey:

1. Provide Appropriate Infrastructure for Agricultural Viability
2. Encourage Greater Diversity in Local Products and Growing Methods
3. Increase Food Self-sufficiency in the City and Region
4. Help Farmers Build Capacity to Adapt

| Goal 1: Provide the Required Growing Environment to Sustain Trees | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| AG-1.1 | Continue to improve lowland drainage and flood management infrastructure in keeping with the Lowland Flood Control Strategic Plan | Engineering |
| AG-1.2 | Work with all levels of government to evaluate long-term flood management options in response to sea level rise impacts with considerations for agricultural vulnerability | Engineering |
| AG-1.3 | Continue to enhance rainwater storage and stormwater management in all areas of Surrey, including agricultural areas | Engineering |
| AG-1.4 | Investigate ways of improving access to an adequate and safe water supply for food production and processing purposes | Engineering |

Immediate Implementation

| Goal 2: Encourage Greater Diversity in Local Products and Growing Methods | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| AG-2.1 | Continue to work closely with the Federal Department of Fisheries and Oceans to protect fish habitat within the City | Engineering |
| AG-2.2 | Work with key partners to help maintain and grow the food processing industry in Surrey | P&D |
| AG-2.3 | Encourage local research to help identify resilient agricultural practices (e.g. mapping crop varieties to future climate scenarios; integrated pest management strategies, etc.) | CMO |
| AG-2.4 | Support farmers and other key partners to pursue innovative agricultural practices (e.g. vertical farming) within and beyond designated agricultural lands | P&D |
| AG-2.5 | Encourage farmers to diversify crop selection and choose adaptable varieties (e.g. less dependent on irrigation, more resistant to saline soils) | P&D |

| Goal 3: Increase Food Self-sufficiency in the City and Region | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| AG-3.1 | Continue to support residents' direct access to local food through farm gate sales and partnerships with farmers' markets | P&D |
| AG-3.2 | Increase opportunities for residents to produce their own food (e.g. support community gardens; review parcel size requirements for backyard chickens) | CMO |
| AG-3.3 | Maximize the use of public and private urban landscape features, terraces, and rooftops for food production (e.g. edible landscaping guidelines for new strata developments) | P&D |
| AG-3.4 | Encourage local research on the types and quantity of crops needed to increase self-sufficiency | CMO |
| AG-3.5 | Encourage the restoration of pollinator-friendly habitat and housing of apiaries on private and public lands, where practical | P&D |
| AG-3.6 | Investigate the feasibility of a farm incubator program to ensure new farmers are able to enter the industry | P&D |
| AG-3.7 | Collaborate with others to reduce the quantity of food that is wasted at each stage in the supply chain (e.g. finding markets for food that is not perfectly symmetrical or aesthetically conventional) | CMO |

| Goal 4: Help Farmers Build Capacity to Adapt | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| AG-4.1 | Review and update Surrey's Agricultural Plan to account for climate change impacts | P&D |
| AG-4.2 | Manage urban-rural interface relations as agricultural practices change and adapt | P&D |
| AG-4.3 | Explore and support best practices from other global communities that currently face challenges our agricultural system may face in the future (e.g. innovative dyking technologies, growing practices in warmer/dryer climates, etc.) | CMO |
| AG-4.4 | Consider an agriculture co-ordinator position to help build capacity for the development of agriculture and sustainable food systems within the City | P&D |

***City Department Acronyms:*** *P&D: Planning and Development; PRC: Parks, Recreation and Culture; CMO: City Manager's Office; ED: Economic Development*

# HUMAN HEALTH AND SAFETY

## Current State

The health and wellbeing of Surrey residents is central to creating a strong and vibrant community. While health care formally falls into the jurisdiction of the Provincial Government and the Fraser Health Authority, many of the City's actions contribute to the health and safety of citizens. For example, providing recreational facilities, planning for walkable neighbourhoods, developing guidelines for construction on steep slopes, and the delivery of natural disaster emergency response all falls within the City's realm of responsibilities.

Climate change has the potential to modify environmental factors, and as a result, increase the level of exposure or risk for certain climate-sensitive health concerns. Environmental factors, however, are only one piece of the puzzle: the social determinants of health act as key indicators for whether a population is predisposed to health issues. The social determinants of health include income, social support networks, education levels, employment status, child development opportunities, gender, and culture. For example, populations most vulnerable to climate-related health impacts include the young and old, low income individuals, people who are socially isolated, and those with pre-existing conditions. An emphasis on improving the socio-economic status of individuals can lead to positive outcomes for health, as well as other aspects of community well-being.

To this end, the City of Surrey has a number of policies and initiatives in place to not only support our most vulnerable populations, but create a more inclusive, resilient and vibrant City for everyone. These include:

- Plan for the Social Well-Being of Surrey Residents (Social Plan)
- Poverty Reduction Plan
- Child and Youth Friendly City Strategy
- Master Plan for Housing the Homeless
- Crime Reduction Strategy
- Learning for Life Strategy

The City works with a diverse set of community groups, non-profit organizations, government agencies and service providers to continually improve the health and safety of Surrey residents.

## Climate Change Impacts

Changing temperatures, rainfall patterns and storm events have the potential to affect health and safety in a myriad of ways; however, community members without the means, abilities or social networks to respond to climate impacts are likely to be most affected by altered conditions. In Surrey, health and safety will likely be affected by climate change in four primary ways: 1) rising temperatures and extreme heat, 2) the spread of communicable diseases, 3) the increase of flood and storm events, and 4) the expansion of urban-interface fire risks.

**Heat Waves:** Extreme heat events are already affecting health outcomes in Metro Vancouver. An eight-day heat wave in 2009 saw temperatures above 34°C and contributed to approximately 156 excess deaths recorded in the Fraser and Vancouver Coastal Health Authorities .There is a high level of certainty in climate projections that an increase in the frequency and intensity of heat waves will lead to additional deaths and illnesses due to hot weather and heat stress. Vulnerable populations include individuals who are: older and home-bound, very young, socially isolated (low income, homeless, living alone), living in densely populated areas, unable to access air conditioning, in heat-exposed occupations, taking certain medications, having pre-existing medical conditions, vigorous exercisers, or tourists.

While other areas of B.C. and Canada may regularly see temperatures of this magnitude, Metro Vancouver residents are acclimatized to a relatively narrow band of temperatures and very few homes are equipped with air conditioning, which can lead to heighted vulnerability. As urbanization and densities increase within Surrey, ensuring an urban design that minimizes the urban heat island effect will be imperative. In the case of heat waves that pose a human health threat, Fraser Health and Environment Canada are responsible for issuing heat alerts. An Extreme Heat-Wave Advisory issued by Vancouver Coastal Health and Fraser Health, in coordination with Environment Canada, is meant to trigger municipal heat response plans . In 2011, Health Canada's Climate Change and Health Office funded a joint Extreme Heat Response Plan for the City of Surrey and White Rock, which is currently in draft form.

**Infectious Disease:** Climate change will likely contribute shifts in the patterns of infectious disease occurrence and spread in B.C. (data is unavailable for the city scale). Water-borne diseases will likely increase as a result of increased precipitation and flooding, while respiratory pathogens may become less seasonal. Food-borne illnesses will likely rise due to increases in the average summer temperature. Some vectors of human disease (e.g. moquitoes and

ticks) could acquire an expanded geographic range, increased reproductive or biting rates, and shortened pathogen incubation periods as a result of higher average temperatures and rainfall. New fungal pathogens are also expected to develop due to a warmer and wetter climate. Evidence of climate affecting the incidence of disease is emerging; for instance, Cryptococcus gattii, a fungal pathogen previously found in the tropics has become prevalent on Vancouver Island since 1999, with 28 diagnosed cases per 1 million island residents and a 4.5% fatality rate. ,

Fraser Health and the BC Centre for Disease Control (BCCDC) currently monitors changing conditions and collects surveillance data on communicable diseases—tracking what disease strains are circulating regionally and in relation to strains in other parts of the world. While Fraser Health does not have a formal climate change adaptation plan, its existing programs create adaptive capacity. For example, Fraser Health and the BCCDC have a program for monitoring the potential spread of West Nile virus. Transmitted by mosquitoes, West Nile virus will likely become more prevalent in the wetter, warmer winters expected with climate change.

**Flood and Storm Events:** Flooding poses a very real and growing risk in Surrey, as discussed on page X. While storm and wind events are more difficult to project, there is some evidence that the region will experience an increase in the number and intensity of storms, with implications for public safety. These events may result in downed power lines and more power outages, falling trees and debris, severed transportation routes and limited access to goods and services, inundation from flood waters, and degraded water quality. Emergency access and evacuation may pose a challenge in some scenarios, due to limited North-South transportation routes across the Serpentine-Nicomekl lowlands and limited street connectivity in some areas of the City. In these instances, the most resilient and resourceful communities are those with a strong social support network, able to support the most vulnerable individuals throughout the disaster.

The Surrey Fire Service is responsible for implementing the Emergency Program in the case of disasters, including flood and storm events. The exact response, including the number and location of reception centres and evacuation orders, is dependent on the nature of the situation. Information and instructions are disseminated to residents by radio. Part of the response includes the Emergency Social Services Program, which is run by volunteers and provides support, services, and supplies such as food, clothing, shelter, and blankets. The City also runs a Neighbourhood Emergency Preparedness Program that delivers workshops to help neighbourhood groups formalize their network and develop response plans.

**Urban-Wildland Interface Fire:** The current risk of urban-wildland interface fire in Surrey is relatively low, chiefly due to the dominant low-risk forest type (deciduous stands) and frequent rainfall year-round. Over the past twenty years there have been no recorded large-scale fires within Surrey's park natural areas; however, the risk of wildfires is likely to increase with warmer, drier temperatures and increasing tree mortalities. As a case in point, fall of 2012 was one of the driest periods on record in the coastal region, and led to 265 wildfires—one of which occurred in a wet floodplain area that would normally have been an area of low fire risk.

The magnitude of the risk posed by climate change will depend on development patterns, tree planting and building practices, and the ecosystem health and maintenance measures within urban-wildland interface areas. Roughly 60% of Surrey's parks are managed natural areas, though unmaintained wildlands also exist along Hydro right of ways and other sites across the City. Many natural areas are adjacent to important structures that are at risk should a natural area fire occur. In 2013, the City completed a Community Wildfire Protection Plan that identifies areas at high risk of wildfires, acknowledges the importance of climate change in managing wildfire risk in the future, and recommends the plan be reviewed every five years. Wildfires are the joint responsibility of the local fire department and the Province's Wildfire Management Branch. In the case of disasters such as wildfires, the City has an Emergency Program in place that outlines response and evacuation procedures.


480

## Risk Assessment Results

| Climate Impact Statements | Risk |
|---|---|
| Increase probability that existing sea dykes will be overtopped due to a combination of sea level rise, subsidence, and storm surge and wind setup resulting from significant weather events. | High |
| Increased human health impacts including greater spread of pathogens due to warmer, wetter winter climate | Medium |
| Increased risk of urban interface fires (e.g. forest fires and fires in other natural areas) due to increased temperature and drier summers | Medium - Low |
| Increased heat stress and other health ailments due to increase in heat advisory days | Medium - Low |

## Overarching Goals and Prioritized Actions

Four key goals have been identified to address impacts and increase resilience for health and safety in Surrey:

1. Collaborate with Key Partners on Improving Population Health
2. Minimize the Urban Heat Island Effect
3. Minimize Risks from Urban-wildland Interface Fire
4. Build Emergency Response Capacity at the City

| Goal 1: Collaborate with Key Partners on Improving Population Health | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| HS-1.1 | Continue to collaborate with community organizations and service agencies to improve the socio-economic conditions and health outcomes of vulnerable populations | P&D |
| HS-1.2 | Encourage health agencies and research institutions to anticipate, monitor and reduce the impact of climate change on the spread of infectious disease | CMO |
| HS-1.3 | Work with key partners to integrate climate change messaging into communication materials related to public health and safety | CMO |
| HS-1.4 | Work with health agencies to better identify and respond to the needs of vulnerable populations specific to climate-related health risks | P&D |

| Goal 2: Minimize the Urban Heat Island Effect | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| HS-2.1 | Ensure sufficient space and adequate soil medium for shade trees in urban areas | P&D |
| HS-2.2 | Encourage development to incorporate passive building design features that keep buildings cool while reducing reliance on air conditioning | P&D |
| HS-2.3 | Utilize landscaping and site design to increase green space and strategically cool buildings and the urban environment | P&D |
| HS-2.4 | Explore opportunities for green roofs and walls on institutional, commercial, industrial and large residential development | P&D |
| HS-2.5 | Engage vulnerable neighbourhoods in programs that keep indoor and outdoor environments cool (e.g. energy retrofit programs, tree planting and water fountain installations) | CMO |
| HS-2.6 | Reduce the impacts of surface parking lots by increasing canopy coverage and the use of alternative paving surfaces | P&D |
| HS-2.7 | Increase the use of high albedo (i.e. light coloured, reflective) surfaces on buildings and pavings | P&D |

Immediate Implementation

| Goal 3: Minimize Risks from Urban-wildland Interface Fire | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| HS-3.1 | Implement the City of Surrey Community Wildfire Protection Plan, and monitor changes to fire risk over time as a result of climate change | PRC |
| HS-3.2 | Enforce "Firesmart" guidelines for developments within 100m of moderate or high risk wildfires | PRC |
| HS-3.3 | Provide "Firesmart" education to the Surrey public, targeting residents in close proximity to areas of high and moderate risk of wildfire | Fire Department |

| Goal 4: Build Emergency Preparedness Capacity at the City | | |
|---|---|---|
| | **Adaptation Action** | **City Lead** |
| HS-4.1 | Continue to build community capacity to respond effectively in an emergency (i.e. neighbours helping neighbours) | Fire Department |
| HS-4.2 | Review and support implementation of the Surrey-White Rock Extreme Heat Response Plan in the case of heat advisories | Fire Department |
| HS-4.3 | Look at gaps in emergency prevention and response, taking into account climate change impacts | Fire Department |
| HS-4.4 | Ensure emergency response capacity keeps pace with the need for services, given increasing climate impacts | Fire Department |

***City Department Acronyms:*** *P&D: Planning and Development; PRC: Parks, Recreation and Culture; CMO: City Manager's Office; ED: Economic Development*

Immediate Implementation

# IMPLEMENTATION AND MONITORING

The Climate Adaption Strategy identifies 91 actions to help Surrey prepare for and respond to the impacts of climate change. Many of the actions are cross-sectoral, in that they help build the City's adaptive capacity in more than one area. Effort has been made to minimize potential conflicts or trade-offs between actions (e.g. habitat vs. agricultural protection); however, more exploration and analysis may be required to resolve these issues in the implementation of some actions. As a relatively new and rapidly evolving issue, the Climate Adaptation Strategy will be a living document to be revisited regularly and updated as necessary.

## ROLES AND RESPONSIBILITIES

Each adaptation action has been assigned a lead City department responsible for implementation, however, not all actions are within the jurisdiction of the City to carry out. Indeed, the role of senior governments in helping cities adapt to climate change will be critial. In these cases, City staff may collaborate with other stakeholders and look to other levels of government to implement or partner on certain actions. To clarify the sphere of influence and align with the structure of Surrey's Sustainability Charter, each action has been categorized as either: corporate operations, municipal jurisdiction, or influencing others in Appendix A.

For the actions that fall within the realm of corporate operations or municipal jurisdiction, actions may be tied into departmental plans and budgeting processes. The lead department will work with the other supporting departments, using identified planning and policy tools, with an emphasis on the priority actions highlighted for immediate implementation. The full list of actions with other implementation considerations including supporting departments, policy tools, and relative cost can be found in Appendix A.

## PRIORITY ACTIONS FOR IMMEDIATE IMPLEMENTATION

Of the 91 actions developed for the Climate Adaptation Strategy, 11 actions have been distinguished as immediate priorities for the City to pursue. These actions were chosen by the staff Advisory Team following the prioritization process (see page X) and were considered based on urgency, ease of implementation, and representation across a spectrum of issues. The adaptation actions for immediate implementation are:

| Adaptation Actions for Immediate Implementation | |
|---|---|
| CC-1.1 | Review City policies and by-laws to identify those practices that support resilience, and reinforce their implementation and enforcement |
| CC-1.2 | Integrate climate change education and awareness into existing programs and communications, and develop new education initiatives where gaps exist for Surrey residents and City Staff |
| FL-1.1 | Support the development of a Regional Flood Management Strategy in coordination with senior levels of government, other municipalities, and key stakeholders |
| FL-2.1 | Conduct detailed analysis on Surrey-specific climate impacts, including the timelines and extent of sea level rise and its related effects on flood construction levels and floodplain designations |
| IN-1.1 | Enhance data collection and monitoring for climate impacts in Surrey (e.g. storm events, precipitation patterns, subsidence rates, changes in water quality, etc.) |
| EC-1.1 | Improve the quantity and quality of the City's habitat to enable species migration and resilience through the implementation of the Biodiversity Conservation Strategy |
| TR-1.1 | Utilize City by-laws, standards, and permitting processes to ensure adequate canopy, root crown and root growth space is provided for trees to mature to optimal size on public and private property |
| TR-2.1 | Plant tree species that will be well adapted to Surrey's 100 year climate projections, particularly with respect to temperature and drought conditions |
| AG-1.2 | Work with all levels of government to evaluate long-term flood management options in response to sea level rise impacts with considerations for agricultural viability |
| HS-2.2 | Encourage development to incorporate passive building design features that keep buildings cool while reducing reliance on air conditioning |
| HS-4.1 | Continue to build community capacity to respond effectively in an emergency (i.e. neighbours helping neighbours) |

# TARGETS, INDICATORS AND MONITORING

To ensure the successful implementation of the Adaptation Strategy, a series of indicators have been proposed to track progress over time (Appendix B) that are aligned with existing reporting efforts. The City's Sustainability Office will collect the data to establish a baseline and monitor progress of these metrics. Surrey staff will convene as needed to review progress on the adaptation actions and assess the indicator data as it is collected and as trends emerge.

Finally, the climate impact statements and actions will be integrated into the City's Enterprise Risk Management (ERM) Framework, where they can be strategically managed by the department responsible. The ERM is a structured and continuous process that engages departments across the organization to identify and respond to risks that threaten the achievement of the City's objectives. By prioritizing and monitoring risks, their consideration is strategically embedded into management functions. The development of the Climate Adaptation Strategy takes a risk-based approach (including a risk assessment, the development of actions, prioritization and the development of indicators), and can therefore be seamlessly integrated into the City's ERM. The ERM's online platform allows "risk owners" to track the implementation of actions, monitor any changes to risks, and report this information out in a timely and consistent manner.

# CONCLUSION

As the impacts of climate change become increasingly tangible, all levels of government have a responsibility to ensure our communities are resilient and adaptable. By taking informed and proactive action, the City of Surrey is positioned to make the right decisions within the timeframes necessary, using the best available science and knowledge. The actions identified within the Climate Adaptation Strategy provide a blueprint for City staff and stakeholders that will help ensure Surrey continues to grow into a vibrant and livable community for decades to come. Together, with the Community Energy and Emissions Plan (CEEP), the City of Surrey's comprehensive Climate Action Strategy is preparing our community for a new future.

# APPENDIX A: IMPLEMENTATION

| | |
|---|---|
| P&D | Planning and Development |
| PRC | Parks, Recreation and Culture |
| CMO | City Manager's Office |
| ED | Economic Development |
| F&T | Finance and Technology |

| | |
|---|---|
| $ | < $75,000 |
| $$ | $75 - 300,000 |
| $$$ | $300-500,000 |
| $$$$ | $500,000 - $1 million |
| $$$$$ | >$1 million |

# Cross Cutting Actions

| | Adaptation Action | Sphere of Influence | City Lead | Support | Tools | Cost |
|---|---|---|---|---|---|---|
| CC-1.1 | Review City policies and by-laws to identify those practices that support resilience, and reinforce their implementation and enforcement. | Municipal Jurisdiction | CMO | All | | $ |
| CC-1.2 | Integrate climate change education and awareness into existing programs and communications, and support the development of new education initiatives where gaps exist for Surrey residents and City Staff | Municipal Jurisdiction | CMO | All | | $$ |
| CC-1.3 | Engage citizens on ways they can adapt their households or otherwise prepare for climate change impacts (e.g. promote sustainable drainage techniques, plant appropriate tree species, emergency preparedness) | Municipal Jurisdiction | CMO | All | | $$ |

Immediate Implementation

# Flood Management and Drainage

| Goal 1: Coordinate with all Levels of Government and Key Stakeholders on Regional Flood Management | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| FL-1.1 | Support the development of a Regional Flood Management Strategy in coordination with senior levels of government, other municipalities, and key stakeholders | Municipal Jurisdiction | Eng | CMO; P&D | | $$ |
| FL-1.2 | Participate in a detailed cost-benefit analysis to assess alternative options for accommodating sea level rise and coastal climate change impacts | Municipal Jurisdiction | Eng | CMO; P&D | | $$ |
| FL-1.3 | Encourage senior levels of government to proactively commit the capital investment for flood protection infrastructure | Influencing Others | Eng | CMO; P&D | | $ |

Immediate Implementation

| Goal 2: Update Planning and Development Standards for Floodplains | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| FL-2.1 | Conduct detailed analysis on Surrey-specific climate impacts, including the timelines and extent of sea level rise and its related effects on flood construction levels and floodplain designations | Municipal Jurisdiction | Eng | P&D; CMO | | $$$$ |
| FL-2.2 | Develop drainage and flood strategies based on cost-benefit analyses and site-specific needs | Municipal Jurisdiction | Eng | P&D; CMO | OCP (DPAs); NCPs, ISMPs; By-Laws | $$$$ |
| FL-2.3 | Incorporate climate change into the City's Integrated Stormwater Management Plans (ISMPs) and other efforts to integrate land use planning and stormwater management | Municipal Jurisdiction | Eng | P&D; CMO | OCP (DPAs); NCPs; ISMPs | $ |
| FL-2.4 | Review and revise regulatory and design standards to account for and minimize the impacts of climate change | Municipal Jurisdiction | P&D | Eng; CMO | OCP (DPAs); NCPs; ISMPs; By-Laws | $ |

Immediate Implementation

# Infrastructure

| Goal 1: Deliver Proactive Climate Analysis and Management Practices for City Infrastructure | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| IN-1.1 | Enhance data collection and monitoring for climate impacts in Surrey (e.g. storm events, precipitation patterns, subsidence rates, changes in water quality, etc.) | Corporate Operations | Eng | P&D; PRC | Monitoring equipment | $$ |
| IN-1.2 | Regularly review design requirements to ensure that they adequately account for expected weather conditions due to climate change | Corporate Operations | Eng; PRC | | Engineering Design Criteria; Park Design Standards | $ |
| IN-1.3 | Assess existing City infrastructure and utilities for vulnerability to climate change | Corporate Operations | Eng | CMO | | $$ |
| IN-1.4 | Integrate climate change into the 10 year capital and servicing plans of relevant departments | Corporate Operations | Eng | PRC | | $ |
| IN-1.5 | Continue to minimize the inflow and infiltration of stormwater into the sanitary sewer system in an effort to reduce the risk of sanitary sewer overflows | Municipal Jurisdiction | Eng | P&D | Engineering Design Criteria | $$ |
| IN-1.6 | Monitor and manage species composition and selection to enhance resilience of Surrey's Green Infrastructure Network | Municipal Jurisdiction | PRC | Eng | Biodiversity Conservation Strategy | $ |

| Goal 2: Support The Design of Climate-Resilient Buildings in Surrey | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| IN-2.1 | Advance energy efficiency in new construction and building retrofits | Municipal Jurisdiction | P&D | CMO; Eng | CEEP; District Energy By-law; OCP; Design Guidelines; Sustainable Development Checklist | $$ |
| IN-2.2 | Increase education and awareness on energy efficiency opportunities among City staff and developers | Corporate Operations | CMO | P&D; Eng | | $ |
| IN-2.3 | Encourage the Province to ensure the BC Building Code adequately reflects and accounts for current and projected climate (i.e. increased winter precipitation, storm events and increased summer temperatures) | Influencing Others | CMO | P&D; Eng | | $ |
| IN-2.4 | Ensure incorporation of guidelines for water conservation in new and re-development | Municipal Jurisdiction | P&D | Eng | DPAs; Design Guidelines; Sustainable Development Checklist | $ |

| Goal 3: Advance Energy Self-Sufficiency within the Community | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| IN-3.1 | Continue to expand on district energy systems in City Centre and support the development of district energy outside the current service areas | Municipal Jurisdiction | Eng | P&D | District Energy By-Law; Community Energy and Emissions Plan | $$$$$ |
| IN-3.2 | Establish a requirement for development over a certain size to complete an energy study that identifies energy efficiency and generation opportunities | Municipal Jurisdiction | P&D | Eng | CEEP; OCP (Zoning) | $ |
| IN-3.3 | Explore opportunities to support local development of distributed energy systems and renewable energy sources (e.g. solar hot water, biomass, etc.) | Influencing Others | CMO | P&D; Eng | Community Energy and Emissions Plan | $ |
| IN-3.4 | Encourage the Province to establish programs that incent homeowners to invest in renewable energy generation | Influencing Others | CMO | P&D; Eng | DPAs; Design Guidelines; Sustainable Development Checklist | $ |

# Ecosystems and Natural Areas

| Goal 1: Deliver Proactive Climate Analysis and Management Practices for City Infrastructure | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| EC-1.1 | Improve the quantity and quality of habitat across the City to enable species migration and resilience through the implementatin of the Biodiversity Conservation Strategy | Municipal Jurisdiction | PRC | P&D; Eng | Ecosystem Management Study; Biodiversity Conservation Strategy; Park Natural Areas Strategic Management Plan; PRC Strategic Management Plan | $$ |
| EC-1.2 | Strategically acquire a diverse representation of ecosystem types as part of Surrey's parks and natural areas | Municipal Jurisdiction | PRC | P&D; Eng | Biodiversity Conservation Strategy; Park Natural Areas Strategic Management Plan; PRC Strategic Management Plan | $$ |
| EC-1.3 | Reduce habitat fragmentation by using and protecting a comprehensive network of corridors and larger natural areas (hubs and sites) | Municipal Jurisdiction | PRC | P&D; Eng | Ecosystem Management Study; Biodiversity Conservation Strategy; Park Natural Areas Strategic Management Plan | $ |
| EC-1.4 | Increase public awareness and capacity to create higher habitat values on private property | Influencing Others | P&D | PRC; Eng | Biodiversity Conservation Strategy; Ecosystems Management Study | $ |

Immediate Implementation

| Goal 2: Actively Manage City's Ecological Assets | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| EC-2.1 | Increase active management of City controlled natural areas (e.g. removal of invasive species), as necessary and encourage more active management of natural areas on Provincial, Regional and non-profit and privately owned lands. | Corporate Operations | PRC; Eng | P&D; Eng | Biodiversity Conservation Strategy; Park Natural Area Strategic Management Plan | $$$ |
| EC-2.2 | Implement evolving best practices for ecosystem management in a changing climate | Corporate Operations | PRC; Eng | Eng | Ecosystem Management Study; Biodiversity Conservation Strategy; Park Natural Areas Strategic Management Plan | $$ |
| EC-2.3 | Consider assisted migration for species whose dispersion rate is unable to keep pace with climate change (e.g. planting tree species historically suited to more Southern climates) | Corporate Operations | PRC; Eng | P&D; Eng | Biodiversity Conservation Strategy; Park Natural Area Strategic Management Plan | $$ |

| Goal 2: Actively Manage City's Ecological Assets (continued) | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| EC-2.4 | Increase tree risk management to minimize damage and liability from dead or dying trees | Municipal Jurisdiction | PRC | F&T; Eng | Tree Removal Policy | $$ |
| EC-2.5 | Partner with key organizations and the private sector to limit the sale of invasive species and promote adaptable species at local nurseries | Influencing Others | PRC | CMO; Eng; P&D | Park Natural Area Strategic Management Plan | $ |
| EC-2.6 | Incorporate climate change messaging in environmental education efforts, and continue to engage the public in stewardship initiatives | Municipal Jurisdiction | PRC | Eng | High School Urban Forestry Program; SHaRP Program; Coho Crew; SNAP Program, etc. | $ |

| Goal 3: Support Viability of Highly Sensitive Ecosystems | | | | | | |
|---|---|---|---|---|---|---|
| | Adaptation Action | Sphere of Influence | City Lead | Support | Tools | Cost |
| **Riparian Areas** | | | | | | |
| EC-3.1 | Apply Surrey standards for streamside setbacks to accommodate potential erosion and optimize ecological health | Municipal Jurisdiction | P&D | PRC; Eng | OCP/DPAs; NCPs | $ |
| EC-3.2 | Establish Development Permit Area Guidelines for sensitive ecosystems | Municipal Jurisdiction | P&D | PRC; Eng | OCP/DPAs | $ |
| EC-3.3 | Implement strategies to maintain stream flow affected by changing temperature and precipitation patterns | Corporate Operations | Eng | PRC; P&D | ISMPs | $$$$ |

| Goal 3: Support Viability of Highly Sensitive Ecosystems (continued) | | | | | | |
|---|---|---|---|---|---|---|
| | Adaptation Action | Sphere of Influence | City Lead | Support | Tools | Cost |
| Intertidal Areas | | | | | | |
| EC-3.4 | Promote the development of a regional cost/benefit analysis of sea level rise and flood management options that considers ecological values and protection of property and infrastructure | Municipal Jurisdiction | Eng | P&D | | $$$ |
| EC-3.5 | Evaluate options for installing physical interventions to support ecosystems (e.g. construction of a breakwater) | Municipal Jurisdiction | Eng | P&D | | $$ |

| Goal 4: Protect Ecosystem Services through Development | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| EC-4.1 | Incorporate climate change into the City's Integrated Stormwater Management Plans (ISMPs) and other efforts to integrate land use planning and stormwater management | Municipal Jurisdiction | Eng | P&D | NCPs; OCP Guidelines; ISMPs | $ |
| EC-4.2 | Provide direction to developers on suitable vegetative species and development features that enhance habitat values | Municipal Jurisdiction | P&D | Eng; PRC | NCPs; OCP Guidelines | $ |
| EC-4.3 | Host workshops for the City's staff, management and Council on 'green' development features and their effectiveness in protecting ecosystem services | Corporate Operations | P&D | CMO; Eng | NCPs; OCP Guidelines | $ |
| EC-4.4 | Review landscape design guidelines to ensure they support habitat values | Municipal Jurisdiction | P&D | PRC; Eng | NCPs; OCP Guidelines | $ |

# Urban Trees and Landscaping

| Goal 1: Provide the Required Growing Environment to Sustain Trees | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| TR-1.1 | Utilize City By-laws, standards, and permitting processes to ensure adequate canopy, root crown and root growth space for trees on public and private property to mature to optimal size | Municipal Jurisdiction | P&D | Eng; PRC | Park Construction Standards, Engineering Design Criteria, NCPs, Tree Protection By-law, BCSLA & BCLNA Landscape Standards, ISMPs | $$ |
| TR-1.2 | Utilize City By-laws, standards, and permitting processes to optimize soil conditions for shade trees on public and private property (e.g. soil quality, quantity and moisture content) | Municipal Jurisdiction | P&D | Eng; PRC | Park Construction Standards, Engineering Design Criteria, NCPs, Tree Protection By-law, BCSLA & BCLNA Landscape Standards, ISMPs | $ |

Immediate Implementation

| Goal 2: Plant Appropriate Species | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| TR-2.1 | Plant tree species that will be well adapted to Surrey's 100 year climate projections, particularly with respect to temperature and drought increases | Municipal Jurisdiction | PRC | P&D; Eng | Park Construction Standards, Tree Protection By-law | $ |
| TR-2.2 | Monitor survival rate of trees planted on public property to confirm species suitability over time | Corporate Operations | PRC | P&D; Eng | | $ |
| TR-2.3 | Increase the species diversity of shade trees on public and private property | Corporate Operations | PRC | Eng; P&D | Park Construction Standards, Shade Tree Strategic Management Plan, Tree Protection By-law | $ |
| TR-2.4 | Develop an educational resource that encourages residents to plant trees which enhance species diversity (e.g. an annual "feature tree" pamphlet) | Influencing Others | P&D | PRC | | $ |

Immediate Implementation

| Goal 3: Increase Tree Maintenance Management | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| TR-3.1 | Increase tree replacement and maintenance activities (such as watering) to sustain trees, as necessary | Corporate Operations | PRC; P&D | P&D | Tree Protection By-law | $$$ |
| TR-3.2 | Anticipate a growing need for tree risk assessments and abatement due to tree decline and mortality | Municipal Jurisdiction | PRC | F&T; P&D | | $$ |
| TR-3.3 | Undertake a Pest Threat Assessment to better understand the risks to trees and ecosystems posed by changing disease vectors and invasive species | Corporate Operations | PRC | P&D | | $ |
| TR-3.4 | Explore a requirement for local residents to water boulevard trees during summer months | Municipal Jurisdiction | PRC | P&D; Legal Services | | $ |

| Objective 4: Improve Public Understanding of Climate Change Impacts | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Adaptation Action | Sphere of Influence | City Lead | Support | Tools | Cost | Priority |
| TR-4.1 | Increase education and awareness of the climate change impacts on trees and ecosystems amongst Surrey residents and City Staff | Corporate Operations | PRC | All | | $ | High |
| TR-4.2 | Develop an educational resource that encourages residents to plant trees which enhance species diversity (e.g. an annual "feature tree" pamphlet) | Influencing Others | P&D | PRC | | $ | Medium |

# Agriculture and Food Security

| Goal 1: Provide Appropriate Infrastructure for Agricultural Viability | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| AG-1.1 | Continue to improve lowland drainage and flood management infrastructure in keeping with the Lowland Flood Control Strategic Plan | Municipal Jurisdiction | Eng | P&D | Agricultural Strategy; Lowland Flood Control Strategic Plan; Agri Food Regional Development Subsidiary Agreement (ARDSA) | $$$$$ |
| AG-1.2 | Work with all levels of government to evaluate long-term flood management options in response to sea level rise impacts with considerations for agricultural vulnerability | Influencing Others | Eng | P&D | BC Flood Construction Guidelines | $$ |
| AG-1.3 | Continue to enhance rainwater storage and stormwater management in all areas of Surrey, including agricultural areas | Municipal Jurisdiction | Eng | P&D | OCP; NCPs; ISMPs; Engineering Design Criteria | $$ |
| AG-1.4 | Investigate ways of improving access to an adequate and safe water supply for food production and processing purposes | Influencing Others | Eng | P&D | Agricultural Strategy | $ |

Immediate Implementation

| Goal 2: Encourage Greater Diversity in Local Products and Growing Methods | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| AG-2.1 | Continue to work closely with the federal Department of Fisheries and Oceans to protect fish habitat within the City | Municipal Jurisdiction | Eng | PRC | Biodiversity Conservation Strategy | $$ |
| AG-2.2 | Work with key partners to help maintain and grow the food processing industry in Surrey | Municipal Jurisdiction - zoning | P&D | | Agricultural Strategy; Economic Development Strategy; Zoning By-law; NCPs; OCP | $ |
| AG-2.3 | Encourage local research to help identify resilient agricultural practices (e.g. mapping crop varieties to future climate scenarios; integrated pest management strategies, etc.) | Influencing Others | CMO | P&D | Agricultural strategy | $ |
| AG-2.4 | Support farmers and other key partners to pursue innovative agricultural practices (e.g. vertical farming) within and beyond designated agricultural lands | Influencing Others | P&D | ED | Agricultural Strategy; Economic Development Strategy | $ |
| AG-2.5 | Encourage farmers to diversify crop selection and choose adaptable varieties (e.g. less dependent on irrigation, more resistant to saline soils) | Influencing Others | P&D | Eng | Agricultural Strategy | $ |

| Goal 3: Increase Food Self-Sufficiency in the City and Region | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| AG-3.1 | Continue to support residents' direct access to local food through farm gate sales and partnerships with farmers' markets | Municipal Jurisdiction | P&D | Eng; CMO | Agricultural Strategy | $ |
| AG-3.2 | Increase opportunities for citizens to produce their own food (e.g. support community gardens; review parcel size requirements for backyard chickens) | Municipal Jurisdiction | CMO | | Zoning By-law | $ |
| AG-3.3 | Maximize the use of public and private urban landscape features, terraces, and rooftops for food production (e.g. edible landscaping guidelines for new strata developments) | Municipal Jurisdiction | P&D | PRC; Eng | Zoning By-law; OCP; NCPs; Design Guidelines | $ |
| AG-3.4 | Encourage local research on the types and quantity of crops needed to increase self-sufficiency | Influencing Others | CMO | | | $ |
| AG-3.5 | Encourage the restoration of pollinator-friendly habitat and the housing of apiaries on private and public lands, where practical | Influencing Others | P&D | | Biodiversity Conservation Strategy | $ |

| Goal 3: Increase Food Self-Sufficiency in the City and Region (continued) | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| AG-3.6 | Investigate the feasibility of a farm incubator program to ensure new farmers are able to enter the industry | Influencing Others | P&D | PRC; ED | Agricultural Strategy | $$ |
| AG-3.7 | Collaborate with others to reduce the quantity of food that is wasted at each stage in the supply chain (e.g. finding markets for food that is not perfectly symmetrical or aesthetically conventional) | Influencing Others | CMO | P&D; PRC; Eng | Surrey Waste Reduction Strategy | $ |

| Goal 4: Help Farmers Build Capacity to Adapt | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| AG-4.1 | Review and update Surrey's Agricultural Plan to account for climate change impacts | Municipal Jurisdiction | P&D | Eng | | $ |
| AG-4.2 | Manage urban-rural interface relations as agricultural practices change and adapt | Municipal Jurisdiction | P&D | | OCP, DPAs, Zoning By-law | $ |
| AG-4.3 | Explore and support best practices from other global communities that currently face challenges our agricultural system may face in the future (e.g. innovative dyking technologies, growing practices in warmer/ dryer climates, etc.) | Influencing Others | CMO | P&D | | $ |
| AG-4.4 | Consider an agriculture co-ordinator position to help build capacity for the development of agriculture and sustainable food systems within the City | Municipal Jurisdiction | P&D | | Agricultural Plan | $ |

# Human Health and Safety

| Goal 1: Collaborate with Key Partners on Improving Population Health | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| HS-1.1 | Continue to collaborate with community organizations and service agencies to improve the socio-economic conditions and health outcomes of vulnerable populations | Municipal Jurisdiction | P&D; PRC | PRC; CMO; Eng; Crime Reduction; Libraries | Social Plan; Poverty Reduction Plan; Child and Youth Friendly City Strategy; Master Plan for Housing the Homeless | $ |
| HS-1.2 | Encourage health agencies and research institutions to anticipate, monitor and reduce the impact of climate change on the spread of infectious disease | Influencing Others | CMO | P&D; PRC; Eng | | $ |
| HS-1.3 | Work with key partners to integrate climate change messaging into communication materials related to public health and safety | Influencing Others | CMO | P&D, PRC; Fire; Eng | | $ |
| HS-1.4 | Work with health agencies to better identify and respond to the needs of vulnerable populations specific to climate-related health risks | Influencing Others | P&D | PRC; Fire | Surrey Emergency Social Services Program; Social Plan | $ |

| Goal 2: Minimize the Urban Heat Island Effect | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| HS-2.1 | Ensure sufficient space and adequate soil medium for shade trees in urban areas | Municipal Jurisdiction | P&D | PRC; Eng | Park Construction Standards, Engineering Design Criteria, NCPs | $ |
| HS-2.2 | Encourage development to incorporate passive building design features that keep buildings cool while reducing reliance on air conditioning | Municipal Jurisdiction | P&D | CMO; Eng | OCP (DPAs), NCPs (Design Guidelines), Sustainable Development Checklist; CEEP | $ |
| HS-2.3 | Utilize landscaping and site design to increase green space and strategically cool buildings and the urban environment | Municipal Jurisdiction | P&D | PRC | NCPs, DPAs, Landscaping Design Guidelines, Sustainable Development Checklist | $ |

Immediate Implementation

| Goal 2: Minimize the Urban Heat Island Effect | | | | | | |
|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** |
| HS-2.4 | Explore opportunities for green roofs and walls on institutional, commercial, industrial and large residential development | Municipal Jurisdiction | P&D | CMO; PRC; Eng | Sustainable Development Checklist; By-Laws | $ |
| HS-2.5 | Engage vulnerable neighbourhoods in programs that keep indoor and outdoor environments cool (e.g. energy retrofit programs, tree planting and water fountain installations) | Municipal Jurisdiction | CMO | P&D; Eng; PRC | | $ |
| HS-2.6 | Reduce the impacts of surface parking lots by increasing canopy coverage and the use of alternative paving surfaces | Municipal Jurisdiction | P&D | Eng | OCP (DPAs) | $ |
| HS-2.7 | Increase the use of high albedo (i.e. light coloured, reflective) surfaces on buildings and pavings | Municipal Jurisdiction | P&D | PRC; Eng | OCP (DPAs); NCPs (Design Guidelines); Sustainable Development Checklist | $ |

| Goal 3: Minimize Risks from Urban-wildland Interface Fire | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** | **Priority** |
| HS-3.1 | Implement the City of Surrey Community Wildfire Protection Plan, and monitor changes to fire risk over time as a result of climate change | Municipal Jurisdiction | PRC | P&D; Fire | | $ | Medium |
| HS-3.2 | Enforce "Firesmart" guidelines for developments within 100m of moderate or high risk wildfires | Municipal Jurisdiction | PRC | P&D; Fire | NCPs, DPAs | $ | Medium |
| HS-3.3 | Provide "Firesmart" education to the Surrey public, targeting residents in close proximity to areas of high and moderate risk of wildfire | Municipal Jurisdiction | Fire | PRC | | $ | Low |

| Goal 4: Build Emergency Preparedness Capacity at the City | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Adaptation Action** | **Sphere of Influence** | **City Lead** | **Support** | **Tools** | **Cost** | **Priority** |
| HS-4.1 | Continue to build community capacity to respond effectively in an emergency (i.e. neighbours helping neighbours) | Municipal Jurisdiction | Fire | All | Neighbourhood Emergency Preparedness Program; Surrey Emergency Program | $$ | Medium |
| HS-4.2 | Review and support implementation of the Surrey-White Rock Extreme Heat Response Plan in the case of heat advisories | Municipal Jurisdiction | Fire | F&T; P&D | Surrey-White Rock Extreme Heat Response Plan; Surrey Emergency Program | $ | Medium |
| HS-4.3 | Look at gaps in emergency prevention and response, taking into account climate change impacts | Corporate Operations | Fire | F&T; All | Surrey Emergency Program | $ | Medium |
| HS-4.4 | Ensure emergency response capacity keeps pace with the need for services, given increasing climate impacts | Corporate Operations | Fire | F&T; All | Surrey Emergency Program | $ | Low |

# APPENDIX B:
# PROPOSED INDICATORS

# Flood Management and Drainage

| Goal | Proposed Indicator | Related Plan or Source | Department |
|---|---|---|---|
| Coordinate with all Levels of Government and Key Stakeholders on Regional Flood Management | Value of regional and City-owned assets in unprotected coastal flood-prone areas | | Engineering; Planning |
| Update Planning and Development Standards for Floodplains | Number of days/incidents of dykes breached per year | | Engineering |
| | Percentage (or total) population residing in floodplain areas | | Engineering; Planning |
| | Number of high tides greater than Xm/year | | Engineering |
| | Number of rainfall events with a return period greater than 2 years | | Engineering |

# Infrastructure

| Goal | Proposed Indicator | Related Plan or Source | Department |
|---|---|---|---|
| Deliver Proactive Climate Analysis and Management Practices for City Infrastructure | Number of sanitary sewer overflows per year | | Engineering |
| | Total losses (dollar value) due to weather related events incurred by the City | | Risk Management |
| Support the design of climate-resilient buildings in Surrey | Energy use from community buildings | Sustainability Dashboard | Sustainability |
| | Daily water consumption per capita (in winter months) | Sustainability Dashboard | Sustainability |
| | Number and/or cost of insurance claims from extreme weather events in the community | | |
| | Number of new certified green buildings | Sustainability Dashboard | Sustainability |
| Advance energy self-sufficiency within the community | Total floor space connected to district energy system | | Engineering |

# Ecosystems and Natural Areas

| Goal | Proposed Indicator | Related Plan or Source | Department |
|---|---|---|---|
| Maximize space for habitat and species migration | Proportion of Green Infrastructure Network established | Biodiversity Conservation Strategy | Planning; Engineering; Parks |
| | Proportion of Surrey's land base with vegetative coverage, by type | Sustainability Dashboard, Biodiversity Conservation Strategy | Planning; Engineering; Parks |
| Actively manage ecological assets | Proportion of invasive alien plant species compared to native plant species | Biodiversity Conservation Strategy | Engineering; Parks |
| | Management strategies and action plans for species at risk | Biodiversity Conservation Strategy | Engineering; Parks |
| Support viability of highly sensitive ecosystems | Total area of protected riparian zones | | Planning; Engineering; Parks |

# Urban Trees and Landscaping

| Goal | Proposed Indicator | Related Plan or Source | Department |
|---|---|---|---|
| Provide required growing environment to sustain trees | Mortality rate of trees in public inventory | | Parks |
| | Tree canopy coverage | Surrey Tree Canopy Study | Planning; Parks |
| Plant appropriate species | Number of species exceeding 10% of total tree inventory; Number of genii exceeding 15% of total tree inventory | | Parks |
| | Total number of tree species and genii in the public tree inventory | | Parks |
| | Mortality rate of trees, by species | | Parks |
| Increase Tree Maintenance Management | Dollars expended on abatement per year | | Parks |
| Improve public understanding of Climate Change Impacts | Ratio trees planted to trees removed on private property | Sustainability Dashboard | Planning |
| | Tree canopy coverage on private property | | Planning |

# Agriculture and Food Security

| Goal | Proposed Indicator | Related Plan or Source | Department |
|---|---|---|---|
| Provide appropriate infrastructure for agricultural viability | Number of flooding events that exceed standards set by Agri Food Regional Development Subsidiary Agreement (ARDSA) | Lowlands Flood Control Project | Engineering |
| Encourage greater diversity in local product and growing methods | Total number of food products grown in Surrey | Agriculture Strategy; Agricultural Plan | Sustainability; Planning |
| | Gross revenue from processing and/or number of processing facilities | Agriculture Strategy | Sustainability; Planning |
| Increase food self-sufficiency in the City and region | Gross annual farm receipts | Sustainability Dashboard | Planning |
| | Total land in food production | Sustainability Dashboard | Sustainability |
| | Number of Community Garden Plots | Sustainability Dashboard | Sustainability |

# Human Health and Safety

| Goal | Proposed Indicator | Related Plan or Source | Department |
|---|---|---|---|
| Collaborate with Key Partners on Improving Population Health | Incidence of West Nile Virus (humans and birds) | BC Centre for Disease Control's WNV Surveillance Data | Sustainability |
| Minimize the Urban Heat Island Effect | Tree canopy coverage in urban areas | Surrey Tree Canopy Study | Planning |
| Minimize risk from urban-wildland interface fires | Number of wildfires per year | Community Wildfire Protection Plan | Fire Department; Parks |
| | Number of households within 100m of areas that are rated at moderate to high risk of wildfires | Community Wildfire Protection Plan | Parks |
| Build Emergency Preparedness Capacity at the City | Number of neighbourhoods participating in the Neighbourhood Emergency Preparedness Program | Neighbourhood Emergency Preparedness Program | Fire Department |

# APPENDIX C:
# DETAILED CLIMATE PROJECTIONS

| Climatic Change | Variable | Historical Baseline | Projected Climatic Change | | |
|---|---|---|---|---|---|
| | | | 2020s | 2050s | 2080s |
| Temperature | Mean Annual Temperature | 1961-1990 | +1°C<br>(+ 0.5°C to 1.4°C) | +1.7 °C<br>(+1.0 °C to +2.5 °C) | +2.7 °C<br>(+1.5 °C to +4.1 °C) |
| | Extremely Hot Days | 1971-2000 | By 2050s: 5-, 10-, and 25-year return period events occur 2.4, 2.8, and 3.2 times as often as in the past, respectively | | |
| | Heating Degree Days<br>(deg-days <18°C)* | 1961-1990 | -334 deg-days<br>(-479 to -171 deg-days) | -589 deg-days<br>(-853 to -360 deg-days) | -919 deg-days<br>(-1344 to -520 deg-days) |
| | Cooling Degree Days<br>(deg-days <18°C)* | 1961-1990 | - | +142% to +597% | +329% to +1043% |
| | Growing Degree Days<br>(deg-days >5°C)* | 1961-1990 | +225 deg-days<br>(+104 to +314 deg-days) | +415 deg-days<br>(+250 to +609 deg-days) | +680 deg-days<br>(+373 to +1072 deg-days) |
| | Frost Free Days | 1961-1990 | +13 days<br>(+6 to +21 days) | +22 days<br>(+14 to +33 days) | +33 days<br>(+19 to +47 days) |
| Precipitation | Mean Annual Precipitation | 1961-1990 | +4%<br>(-2% to +8%) | +7%<br>(-2% to +11%) | +8%<br>(+1% to +18%) |
| | Winter Precipitation | 1961-1990 | +3%<br>(-3 to +9%) | +6%<br>(-4 to +15%) | +9%<br>(+1 to +23%) |
| | Summer Precipitation | 1961-1990 | -7%<br>(-16 to +8%) | -15%<br>(-25 to +3%) | -14%<br>(-37 to -3%) |
| | Peak Precipitation: Intensity | 1971-2000 | By 2050s: Amount of precipitation on 'very wet days' (>95th percentile) to increase by 21%; 'extremely wet days) (>99th percentile) to increase by 28% | | |
| | Peak Precipitation: Frequency | 1971-2000 | By 2050s: 5-, 10-, and 25-year daily precipitation return periods occur 1.6, 1.9, and 2.5 times as often as in the past, respectively | | |
| | Winter Precipitation as Snow | 1961-1990 | -22%<br>(-42% to -5%) | -36%<br>(-56% to -19%) | -52%<br>(-74% to -26%) |
| Sea Level Rise (SLR) | Sea Level Rise (Surrey) | - | Surrey is currently experiencing +3.1mm of SLR plus 0.225mm of subsidence per year | | 1.2m by 2100 (including subsidence) |

**Degree-days measure the accumulation of degrees (temperature) above or below a stated baseline. For example, with a baseline of 5°C (the minimum temperature conducive to vegetative growth), a day with an average temperature of 10°C would have a value of 5 growing degree days. Growing degree days are often used to measure the potential for agricultural productivity; heating degree days are used to assess the energy demand required for heating buildings on cold days (< 18°C); cooling degree days are used to assess the energy demand required for cooling buildings on hot days (> 18°C).*

# APPENDIX D: RISK ASSESSMENT METHODOLOGY AND OUTCOMES

ICLET's Milestone 3 (Plan) involved a vulnerability and risk assessment to determine the areas in which the City should focus effort. Vulnerability describes how susceptible a service area (e.g. water utility) is to the impacts of climate change and is a function of the service area's sensitivity and adaptive capacity; that is, how sensitive the service area is to existing and future climatic stresses and how effectively it can accommodate and adjust to impacts. Key determinants of adaptive capacity include economic resources, level of technology, available information and skills, social capital, and the efficacy of existing institutions.

The sensitivity and adaptive capacity scores were mapped on a matrix (Table 3) to give the resulting vulnerability rating. The impacts to which Surrey was least vulnerable (V1) were removed, and 15 of the original 18 climate impacts were carried forward to the risk assessment.

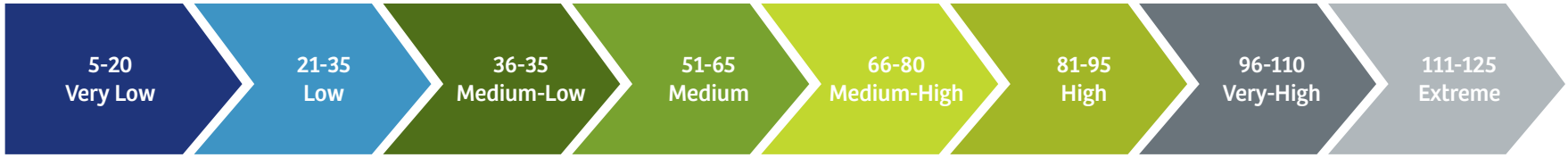
**Table 3: Vulnerability Matrix (Source: ICLEI's Adaptation Tool)**

| | | | Sensitivity | | | | |
|---|---|---|---|---|---|---|---|
| | | | Low → | | | | High |
| | | | S1 | S2 | S3 | S4 | S5 |
| Adaptive Capacity | Low | AC1 | V2 | V2 | V4 | V5 | V5 |
| | | AC2 | V2 | V2 | V3 | V4 | V5 |
| | | AC3 | V2 | V2 | V3 | V4 | V4 |
| | | AC4 | V1 | V2 | V2 | V3 | V3 |
| | High | AC5 | V1 | V1 | V2 | V3 | V3 |

Surrey's risk assessment evaluated the probability of an impact occurring and multiplied this likelihood by the consequences, should it occur. The likelihood of a climate impact was considered as either a recurrent risk, such as flooding or heat waves, or a single event, such as permanent inundation due to sea level rise. The likelihood rating considered the chances of events occurring in the near term and over the next 50 years. The potential consequences were estimated across five dimensions: public safety, local economy and private property, regionally important infrastructure, environmental quality, and City government.

The likelihood and consequence scores were multiplied to give the resulting risk rating. None of the impacts were calculated to be 'very high' or 'extreme' risk. Climate impacts that were assigned a low risk rating (< 35) were removed and the remaining 14 were brought forward to be addressed in the strategy development phase. Given that some actions may require little effort or could have valuable ancillary benefits, impacts with a medium-low or medium risk rating were included in the strategy development phase. The level of risk assigned to each impact was later used to help prioritize adaptation strategies. See Table 4 for the scoring results from the risk assessment outcomes.

**Figure 8. Risk Rating**



### Table 4: Risk Assessment Scoring and Results

| Potential Resulting Impact from Climate Change Condition | Likelihood | Consequence | Risk |
|---|---|---|---|
| **Increase in Temperature** | | | |
| Increased tree mortality rate and change in urban forest composition due to increase in hot weather, decreased summer precipitation, and increased winter precipitation leading to more saturated soils in lowlands | 5 | 16 | 80 (medium-high) |
| Change in streams' ecological composition due to increased summer temperatures and changing precipitation regimes altering stream base flow and water quality | 5 | 14 | 70 (medium-high) |
| Increased risk of Fraser River freshet flooding due to changing temperature and precipitation regime in the Fraser River Basin, and sea level rise raising Fraser river water levels | 4 | 16 | 64 (medium) |
| Agricultural irrigation (river & well) demand exceeds supply due to increased temperatures, decreased summer rainfall, and increased agricultural growing due to increased growing degree days | 5 | 12 | 60 (medium) |
| Increased human health impacts including greater spread of pathogens due to warmer, wetter winter climate | 4 | 15 | 56 (medium) |
| **Increase in Temperature** | | | |
| Increasing energy costs and energy insecurity due to the combination of an increased cooling load and changing temperature and precipitation regimes affecting the seasonal availability of hydroelectric power in BC | 4 | 14 | 56 (medium) |
| Increased risk of urban interface fires (e.g. forest fires and fires in other natural areas) due to increased temperature and drier summers | 3 | 13 | 39 (medium-low) |
| Increased heat stress and other health ailments due to increase in heat advisory days | 5 | 10 | 50 (medium-low) |
| Domestic water demand exceeds supply due to increased temperatures and decreased summer rainfall | 2 | 11 | 22 (low) |

| | | | |
|---|---|---|---|
| **Increase in Winter Precipitation** | | | |
| Drainage system flooding in floodplain areas due to reduced gravity drainage associated with sea level rise and more intensive precipitation events | 5 | 19 | 95 (high) |
| Reduced soil drainage in floodplain areas due to seepage and rising water tables associated with sea level rise and heavier winter rainfall | 5 | 18 | 90 (high) |
| Increased tree mortality rate and change in urban forest composition due to increase in hot weather, decreased summer precipitation, and increased winter precipitation leading to more saturated soils in lowlands | 5 | 16 | 80 (medium-high) |
| Increased risk of Fraser River freshet flooding due to changing temperature and precipitation regime in the Fraser River Basin, and sea level rise raising Fraser river water levels | 3 | 16 | 64 (medium) |
| Increased human health impacts including greater spread of pathogens due to warmer, wetter winter climate | 4 | 15 | 56 (medium) |
| **Decrease in Summer Precipitation** | | | |
| Increased tree mortality rate and change in urban forest composition due to increase in hot weather, decreased summer precipitation, and increased winter precipitation leading to more saturated soils in lowlands | 5 | 16 | 80 (medium-high) |
| Change in streams' ecological composition due to increased summer temperatures and changing precipitation regimes altering stream base flow and water quality | 5 | 14 | 70 (medium-high) |
| Agricultural irrigation (river & well) demand exceeds supply due to increased temperatures, decreased summer rainfall, and increased agricultural growing due to increased growing degree days | 5 | 12 | 60 (medium) |

| | | | |
|---|---|---|---|
| Increasing energy costs and energy insecurity due to the combination of an increased cooling load and changing temperature and precipitation regimes affecting the seasonal availability of hydroelectric power in BC | 4 | 14 | 56 (medium) |
| Increased risk of urban interface fires (e.g. forest fires and fires in other natural areas) due to increased temperature and drier summers | 3 | 13 | 39 (medium-low) |
| Domestic water demand exceeds supply due to increased temperatures and decreased summer rainfall | 2 | 11 | 22 (low) |
| **Increase in Sea Level and Storm Events** | | | |
| Drainage system flooding in floodplain areas due to reduced gravity drainage associated with sea level rise and more intensive precipitation events | 5 | 19 | 95 (high) |
| Reduced soil drainage in floodplain areas due to seepage and rising water tables associated with sea level rise and heavier winter rainfall | 5 | 18 | 90 (high) |
| Flooding and/or permanent inundation of floodplains due to rising seas and more intense storm surges breaching sea dams and/or dykes | 5 | 19 | 95 (high) |
| Impacts on the viability of agricultural crops and other vegetation in floodplain areas, due to saltwater intrusion and flooding associated with sea level rise | 4 | 19 | 76 (medium-high) |
| Loss of tidal mudflats and marshland ecosystems on seaward side of dykes due to increased wave action and erosion associated with sea level rise and existing dyke positions | 5 | 14 | 70 (medium-high) |
| Damages and/or increased maintenance costs to structures and infrastructure (underground and at-grade) due to more variable and extreme weather patterns and sea level rise | 3 | 12 | 36 (medium-low) |

# APPENDIX E:
# PRIORITIZATION FRAMEWORK

Once a refined list of adaptation actions was developed, each option was assessed using a modified evaluation framework from Natural Resources Canada and University of British Columbia's Canadian Communities' Guidebook for Adaptation to Climate Change. Table 5 summarizes the evaluation framework, which includes criteria related to cost, ancillary benefits, political acceptability, and capacity. Actions that are easier or more feasible to implement receive a higher score under the following criteria.

**Table 5: Evaluation Framework for Assessing Feasibility of Potential Actions**

| Criteria | 1 (Low) | 2 (Medium) | 3 (High) |
|---|---|---|---|
| Mitigation Co-benefit | Results in increased GHG emissions | Would not affect GHG emissions | Results in reduced GHG emissions |
| Implementation Cost | Cost is high | Cost is moderate | Cost is low |
| Operating and Maintenance Cost | Cost is high | Cost is moderate | Cost is low |
| Urgency | Impacts are likely to occur in the longer term | Impacts are beginning to occur or are likely to occur in the near to mid-term | Impacts are already occurring |
| Ancillary Benefits | Will contribute little or not at all to other community goals | Will contribute somewhat to other community goals | Will contribute significantly to other community goals |
| Window of Opportunity | There is no window of opportunity currently | A window of opportunity could be created | A window of opportunity exists to implement |
| Political Acceptability | Likely to be politically contentious | Likely to require political direction | Likely to be easily politically supported |
| Funding Sources | Funding is required but has not been identified | Funding is required and likely to be secured | Funding is available (or not required) |
| Capacity | Current capacity is insufficient and gaps not easily addressed | Gaps exist but could be addressed | Current capacity is sufficient |

The results of the evaluation provided a feasibility rating, and were projected against the risk rating for the climate impact that each action was intended to address. For example, the action "Provide Fire Smart education to residents" is in response to an increased risk of urban-interface fires, which has a risk rating of 2, or Medium-Low. This methodology results in a priority level, as illustrated in Table 6. Through this process, proposed actions that emerged as higher priority were those that were developed to address high risk and urgent impacts and/or those that could be implemented relatively easily and often aligned with other City goals and priorities.

**Table 6: Prioritization Framework**

| | | Risk Rating | | | | |
|---|---|---|---|---|---|---|
| | | Low Risk | Medium-Low Risk | Medium Risk | Medium-High Risk | High Risk |
| Feasibility Rating | 1 | Low Priority | Low Priority | Low Priority | Medium Priority | Medium Priority |
| | 2 | Low Priority | Medium Priority | Medium Priority | Medium Priority | High Priority |
| | 3 | Medium Priority | Medium Priority | High Priority | High Priority | High Priority |

# REFERENCES

Ausenco Sandwell (2011). Climate Change Adaptation Guidelines for Sea Dikes and Coastal Flood Hazard Land Use: Draft Policy Discussion Paper. Prepared for the BC Ministry of Environment.

Bizikova L., T. Neale and I. Burton. (2008). Canadian Communities' Guidebook for Adaptation to Climate Change. First Edition. Environment Canada and University of British Columbia.

BC Agriculture & Food Climate Action Initiative (2010). BC Agriculture Climate Change Action Plan 2010-2013.

BC Agriculture & Food Climate Action Initiative (2012). BC Agriculture Climate Change Adaptation Risk + Opportunity Assessment Series: Fraser Valley & Metro Vancouver Snapshot Report.

BC Ministry of Forests, Lands and Natural Resource Operations (2012). Cost of Adaptation – Sea Dikes and Alternative Strategies.

Carlson, Deborah (2012). Preparing for Climate Change: An implementation guide for local governments in British Columbia. West Coast Environmental Law.

Datta, K., Bartlett, K., Marr, K. (2009). Cryptococcus gattii: Emergence in Western North America: Exploitation of a Novel Ecological Niche. Interdisciplinary Perspectives on Infectious Disease.ID: 176532.

Dillon Consulting (2013). Rainfall Trending Analysis for the City of Surrey.

Foster, J., Lowe, A., Winkelman, S. (2011). The Value of Green Infrastructure for Urban Climate Adaptation. The Centre for Clean Air Policy.

Fraser Health (2012). Personal correspondence with David Portesi, Public Health Director, Fraser Health.

Fraser Health & Vancouver Coastal Health. Presentation to Municipal Social Planners: Hot Weather – New Lower Mainland Warning System and Hot Weather Planning. July 13, 2011.

Government of Canada (2009). Climate Change Adaptation in the Canadian Energy Sector, workshop report. Policy Research Initiative.

Government of Canada (2011). National Round Table on the Environment and the Economy. (2011). Paying the Price: The Economic Impacts of Climate Change for Canada

Hamann, A., and T. Wang. (2006). Potential effects of climate change on ecosystem and tree species distribution in British Columbia. Ecology 87, 2773–2786.

IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

IPCC. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kosatsky, T. (2010). Hot day deaths, summer 2009: What happened and how to prevent a recurrence. BCMJ, Vol. 52, No. 5, page(s) 261 — BC Centre for Disease Control.

Kowalenko, G.C., Schmidt, O. and G. Hughes-Games (2007). Fraser Valley Soil Nutrient Study 2005. The Canada-British Columba Environmental Farm Plan Program delivered by the British Columbia Agriculture Council.

Metro Vancouver (2011). Regional Food System Strategy.

Murdock, T.Q., S.R. Sobie, H.D. Eckstrand, and E. Jackson, 2012: Georgia Basin: Projected Climate Change, Extremes, and Historical Analysis, Pacific Climate Impacts Consortium, University of Victoria, Victoria, BC.

Neumann, J.E. & Price, J.C. (2009). Adapting to Climate Change: The Public Policy Response, Public Infrastructure. Resources for the Future.

Ostry, A.M. Ogborn, Bassil, K.M., Takaro, T., and Allen, D.M. (2010). Climate Change and Health in British Columbia: Projected Impacts and a Proposed Agenda for Adaptation Research. International Journal of Environmental Research and Public Health, 7: 1018-1035.

Pacific Climate Impacts Consortium (PCIC) Plan2Adapt Tool. Accessed April 2013 from: http://www.pacificclimate.org/tools-and-data/plan2adapt

Patz, J.A., A. K. Githeko, J. P. McCarty, S. Hussein, U. Confalonieri, and N. de Wet. (2003). Chapter 6: Climate change and infectious diseases in Climate Change and Human Health: Risks and Responses. Eds. A.J. McMichael, D.H. Campbell-Lendrum, C.F. Corvalán, K.L. Ebi, A.K. Githeko, J.D. Scheraga, A. Woodward. Geneva: World Health Organization.

Public Health Agency of Canada. What determines health? Retrieved April 9, 2013 from: http://www.phac-aspc.gc.ca/ph-sp/determinants/index-eng.php

Thomson,R., B. Bornhold, and S. Mazzotti. (2008). An Examination of the Factors Affecting Relative and Absolute Sea Level in Coastal British Columbia. Canadian Technical Report of Hydrography and Ocean Sciences 260. Fisheries and Oceans Canada, Institute of Ocean Sciences.

Thomson, R.E., Bornhold, B.D., and Mazzotti, S. (2008). An examination of the factors affecting relative and absolute sea level in coastal British Columbia. Can. Tech. Rep. Hydrogr. Ocean Sci. 260: v + 49 p. [Addendum]

World Bank. (2012). Climate Change and the World Bank. Retrieved August 9, 2012 from: http://climatechange.worldbank.org/overview/

World Health Organization. (2009). Protecting Health from Climate Change: Connecting Science, Policy and People.

## Contact Us

**CITY OF SURREY**
**Economic Development Office**

**604.591.4128**
**econdev@surrey.ca**

## City of Surrey Mayor and Council

MAYOR
DIANNE WATTS

COUNCILLOR
TOM GILL

COUNCILLOR
BRUCE HAYNE

COUNCILLOR
LINDA HEPNER

COUNCILLOR
MARVIN HUNT

COUNCILLOR
MARY MARTIN

COUNCILLOR
BARINDER
RASODE

COUNCILLOR
BARBARA STEELE

COUNCILLOR
JUDY
VILLENEUVE

www.surrey.ca/sustainability

CITY OF SURREY
the future lives here.

## Appendix B: Community Climate Action Strategy

## Actions within Municipal Jurisdiction and Corporate Operations

CMO: City Manager's Office
Eng: Engineering
P&D: Planning and Development
PRC: Parks, Recreation and Culture
F&T: Finance and Technology
Fire: Surrey Fire Service
Libraries: Surrey Libraries

*NOTE: One or numerous divisions may be involved in implementing actions for each departments identified below.*

**CLIMATE ADAPTATION STRATEGY (CAS) ACTIONS:**

| CAS # | Climate Adaptation Strategy Action | City Lead | Supporting Departments |
|---|---|---|---|
| CC-1.1 | Review City policies and by-laws to identify those practices that support resilience, and reinforce their implementation and enforcement. | CMO | All |
| CC-1.2 | Integrate climate change education and awareness into existing programs and communications, and support the development of new education initiatives where gaps exist for Surrey residents and City Staff | CMO | All |
| CC-1.3 | Engage citizens on ways they can adapt their households or otherwise prepare for climate change impacts (e.g. promote sustainable drainage techniques, plant appropriate tree species, emergency preparedness) | CMO | All |
| FL-1.1 | Support the development of a Regional Flood Management Strategy in coordination with senior levels of government, other municipalities, and key stakeholders | Eng | CMO; P&D |
| FL-1.2 | Participate in a detailed cost-benefit analysis to assess alternative options for accommodating sea level rise and coastal climate change impacts | Eng | CMO; P&D |

| CAS # | Climate Adaptation Strategy Action | City Lead | Supporting Departments |
|---|---|---|---|
| FL-2.1 | Conduct detailed analysis on Surrey-specific climate impacts, including the timelines and extent of sea level rise and its related effects on flood construction levels and floodplain designations | Eng | P&D; CMO |
| FL-2.2 | Develop drainage and flood control strategies based on cost-benefit analyses and site-specific needs | Eng | P&D; CMO |
| FL-2.3 | Incorporate climate change into the City's Integrated Stormwater Management Plans (ISMPs) and other efforts to integrate land use planning and stormwater management | Eng | P&D; CMO |
| FL-2.4 | Review and revise regulatory by-laws and design standards to account for and minimize the impacts of climate change | P&D | Eng; CMO |
| IN-1.1 | Enhance data collection and monitoring for climate impacts in Surrey (e.g. storm events, precipitation patterns, subsidence rates, changes in water quality, etc.) | Eng | P&D; PRC |
| IN-1.2 | Regularly review design requirements to ensure that they adequately account for expected weather conditions due to climate change | Eng | PRC |
| IN-1.3 | Assess existing City infrastructure and utilities for vulnerability to climate change | Eng | |
| IN-1.4 | Integrate climate change into the 10 year capital and servicing plans of relevant departments | Eng; PRC | CMO |
| IN-1.5 | Continue to minimize the inflow and infiltration of stormwater into the sanitary sewer system in an effort to reduce the risk of sanitary sewer overflows | Eng | P&D |
| IN-1.6 | Monitor and manage species composition and selection to enhance resilience of Surrey's Green Infrastructure Network | PRC | Eng |
| IN-2.1 | Advance energy efficiency in new construction and building retrofits | P&D | CMO; Eng |
| IN-2.2 | Increase education and awareness on energy efficiency opportunities among City staff and developers | P&D | CMO; Eng |
| IN-2.4 | Ensure incorporation of guidelines for water conservation in new and re-development | P&D | Eng |
| IN-3.1 | Continue to expand on district energy systems in City Centre and support the development of district energy outside the current service areas | Eng | P&D |
| IN-3.2 | Establish a requirement for development over a certain size to complete an energy study that identifies energy efficiency and generation opportunities | P&D | Eng |
| EC-1.1 | Improve the quantity and quality of the City's habitat to enable species migration and resilience through the implementation of the Biodiversity Conservation Strategy | PRC | P&D; Eng |
| EC-1.2 | Strategically acquire a diverse representation of ecosystem types as part of Surrey's parks and natural areas | PRC | P&D; Eng |

| CAS # | Climate Adaptation Strategy Action | City Lead | Supporting Departments |
|---|---|---|---|
| EC-1.3 | Reduce habitat fragmentation by using and protecting a comprehensive network of corridors and larger natural areas (hubs and sites) | PRC | P&D; Eng |
| EC-2.1 | Increase active management of City controlled natural areas (e.g. removal of invasive species) | PRC | P&D; Eng |
| EC-2.2 | Implement evolving best practices for ecosystem management in a changing climate | PRC | Eng |
| EC-2.3 | Consider assisted migration for species whose dispersion rate is unable to keep pace with climate change (e.g. planting tree species historically suited to more Southern climates) | PRC | P&D; Eng |
| EC-2.4 | Increase tree risk management to minimize damage and liability from dead or dying trees | PRC | F&T; Eng |
| EC-2.6 | Incorporate climate change messaging in environmental education efforts, and continue to engage the public in stewardship initiatives | PRC | Eng |
| EC-3.1 | Apply Surrey standards for streamside setbacks to accommodate potential erosion and optimize ecological health | P&D | PRC; Eng |
| EC-3.2 | Establish Development Permit Area Guidelines for sensitive ecosystems | P&D | PRC; Eng |
| EC-3.3 | Implement strategies to maintain stream flow affected by changing temperature and precipitation patterns | Eng | PRC; P&D |
| EC-3.4 | Promote the development of a regional cost/benefit analysis of sea level rise and flood management options that considers ecological values and protection of property and infrastructure | Eng | P&D |
| EC-3.5 | Evaluate options for installing physical interventions to support ecosystems (e.g. construction of a breakwater) | Eng | P&D |
| EC-4.1 | Incorporate climate change into the City's Integrated Stormwater Management Plans (ISMPs) and other efforts to integrate land use planning and stormwater management | Eng | P&D |
| EC-4.2 | Provide direction to developers on suitable vegetative species and development features that enhance habitat values | P&D | Eng; PRC |
| EC-4.3 | Host workshops for the City's staff, management and Council on 'green' development features and their effectiveness in protecting ecosystem services | P&D | CMO; Eng |
| EC-4.4 | Review landscape design guidelines to ensure they support habitat values | P&D | PRC; Eng |
| TR-1.1 | Utilize City by-laws, standards, and permitting processes to ensure adequate canopy, root crown and root growth space is provided for trees to mature to optimal size on public and private property | P&D | Eng; PRC |
| TR-1.2 | Utilize City by-laws, standards, and permitting processes to optimize soil conditions for | P&D | Eng; PRC |

| CAS # | Climate Adaptation Strategy Action | City Lead | Supporting Departments |
|---|---|---|---|
| | shade trees on public and private property (e.g. soil quality, quantity and moisture content) | | |
| TR-2.1 | Plant tree species that will be well adapted to Surrey's 100 year climate projections, particularly with respect to temperature and drought increases | PRC | Eng; P&D |
| TR-2.2 | Monitor survival rate of trees planted on public property to confirm species suitability over time | PRC | P&D; Eng |
| TR-2.3 | Increase the species diversity of shade trees on public and private property | PRC | Eng; P&D |
| TR-2.4 | Develop an educational resource that encourages residents to plant trees which enhance species diversity (e.g. an annual "feature tree" pamphlet) | P&D | PRC |
| TR-3.1 | Increase tree replacement and maintenance activities (such as watering) to sustain trees, as necessary | PRC | P&D |
| TR-3.2 | Anticipate a growing need for tree risk assessments and abatement due to tree decline and mortality | PRC | F&T; P&D |
| TR-3.3 | Undertake a Pest Threat Assessment to better understand the risks to trees and ecosystems posed by changing disease vectors and invasive species | PRC | P&D |
| TR-3.4 | Explore a requirement for local residents to water boulevard trees during summer months | PRC | P&D; CMO |
| AG-1.1 | Continue to improve lowland drainage and flood management infrastructure in keeping with the Lowland Flood Control Strategic Plan | Eng | P&D |
| AG-1.2 | Work with all levels of government to evaluate long-term flood management options in response to sea level rise impacts with considerations for agricultural vulnerability | Eng | P&D |
| AG-1.3 | Continue to enhance rainwater storage and stormwater management in all areas of Surrey, including agricultural areas | Eng | P&D |
| AG-2.1 | Continue to work closely with the federal Department of Fisheries and Oceans to protect fish habitat within the City | Eng | PRC |
| AG-3.1 | Continue to support residents' direct access to local food through farm gate sales and partnerships with farmers' markets | P&D | CMO |
| AG-3.2 | Increase opportunities for citizens to produce their own food (e.g. support community gardens; review parcel size requirements for backyard chickens) | CMO | P&D; PRC |
| AG-3.3 | Maximize the use of public and private urban landscape features, terraces, and rooftops for food production (e.g. edible landscaping guidelines for new strata developments) | P&D | PRC; Eng |
| AG-4.1 | Review and update Surrey's *Agricultural Plan* to account for climate change impacts | P&D | Eng |
| AG-4.2 | Manage urban-rural interface relations as agricultural practices change and adapt | P&D | |

| CAS # | Climate Adaptation Strategy Action | City Lead | Supporting Departments |
|---|---|---|---|
| AG-4.4 | Consider an agriculture co-ordinator position to help build capacity for the development of agriculture and sustainable food systems within the City | P&D | |
| HS-1.1 | Continue to collaborate with community organizations and service agencies to improve the socio-economic conditions and health outcomes of vulnerable populations | P&D | CMO; Eng; Libraries; PRC |
| HS-2.1 | Ensure sufficient space and adequate soil medium for shade trees in urban areas | P&D | PRC; Eng |
| HS-2.2 | Encourage development to incorporate passive building design features that keep buildings cool while reducing reliance on air conditioning | P&D | CMO; Eng |
| HS-2.3 | Utilize landscaping and site design to increase green space and strategically cool buildings and the urban environment | P&D | PRC |
| HS-2.4 | Explore opportunities for green roofs and walls on institutional, commercial, industrial and large residential development | P&D | CMO; PRC; Eng |
| HS-2.5 | Engage vulnerable neighbourhoods in programs that keep indoor and outdoor environments cool (e.g. energy retrofit programs, tree planting and water fountain installations) | CMO | PRC; P&D; Eng |
| HS-2.6 | Reduce the impacts of surface parking lots by increasing canopy coverage and the use of alternative paving surfaces | P&D | Eng |
| HS-2.7 | Increase the use of high albedo (i.e. light coloured, reflective) surfaces on buildings and pavings | P&D | PRC; Eng |
| HS-3.1 | Implement the City of Surrey *Community Wildfire Protection Plan*, and monitor changes to fire risk over time as a result of climate change | PRC | P&D; Fire |
| HS-3.2 | Enforce "Firesmart" guidelines for developments within 100m of moderate or high risk wildfires | PRC | P&D; Fire |
| HS-3.3 | Provide "Firesmart" education to the Surrey public, targeting residents in close proximity to areas of high and moderate risk of wildfire | Fire | PRC |
| HS-4.1 | Continue to build community capacity to respond effectively in an emergency (i.e. neighbours helping neighbours) | Fire | All |
| HS-4.2 | Review and support implementation of the *Surrey-White Rock Extreme Heat Response Plan* in the case of heat advisories | Fire | F&T; P&D |
| HS-4.3 | Look at gaps in emergency prevention and response, taking into account climate change impacts | Fire | F&T; All |
| HS-4.4 | Ensure emergency response capacity keeps pace with the need for services, given increasing climate impacts | Fire | F&T; All |

## Appendix B: Community Climate Action Strategy (Cont'd)

## Actions within Municipal Jurisdiction - Draft Community Energy and Emissions Plan

CMO: City Manager's Office includes Sustainability Office, Bylaws and Licensing, Economic Development, Legal Services
Eng: Engineering includes Utilities, Transportation, Operations
P&D: Planning and Development includes Community Planning, Area Planning, Buildings
PRC: Parks, Recreation and Culture including Parks Planning
F&T: Finance and Technology
Fire: Surrey Fire Service
Libraries: Surrey Libraries

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 2A.1 | Build on existing policies and plans to support City Centre as the region's second metropolitan core | P&D | All |
| 2A.2 | Build on existing policies and plans to focus residential and commercial growth in Town Centres, reinforcing the success of rapid transit infrastructure investment | P&D | Eng |
| 2A.3 | Focus growth in interconnected nodes and along transit corridors | P&D | Eng |
| 2A.4 | Encourage gentle intensification of mature neighbourhoods | P&D | Eng |
| 2A.5 | Build out Neighbourhood Concept Plans (NCPs) with leading best practices | P&D | Eng |
| 2A.6 | Support commercial and industrial growth in areas that encourage transportation efficiency and rapid transit success | P&D | Eng; CMO |
| 2B.1 | Clearly define transit corridors for intensification using the OCP and its breadth of policy | Eng | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | tools to supportive effective design and development | | |
| 2B.2 | Encourage a variety of housing types to attract diverse households within transit corridors | P&D | Eng |
| 2B.3 | Encourage major employers to locate in nodes and then corridors | CMO | P&D |
| 2B.4 | Ensure high quality urban design along rapid transit corridors to encourage walking, cycling, and access to transit | P&D | Eng |
| 2C.1 | Review City policy to increase opportunities for gentle intensification of mature neighbourhoods in frequent and secondary transit corridors with townhouses and ground-oriented multiplexes, and small lot micro-houses | P&D | Eng |
| 2C.2 | Evaluate opportunities for micro-suites and lock-off suites | P&D | Eng |
| 2C.3 | Encourage live/work use appropriately across the community focusing on frequent and secondary transit corridors | P&D | Eng |
| 2D.1 | Create Low Carbon Development Permit Area Guidelines | P&D | CMO |
| 2D.2 | Amend the Terms of Reference for the City's Advisory Design Panel to ensure at least one member has expertise in applying the Low Carbon DPA Guidelines | P&D | CMO |
| 2D.3 | Integrate Low Carbon DPA Guidelines into the Sustainable Development Checklist update | P&D | CMO |
| 2E.1 | Select, develop, and roll our key pilot strategies in an appropriate neighbourhood, evaluate progress, strengthen strategies, and potentially apply them more broadly. | P&D | Eng; CMO |
| 2F.1 | Consult with staff, developers, builders, Council and other key stakeholders in updating the Sustainable Checklist content and process. | P&D | CMO |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 2F.2 | Consider phasing in a third Occupancy Permit Stage to confirm performance objectives and cover the full life-cycle of the construction process. | P&D | CMO |
| 2F.3 | Update the Sustainable Development Checklist (SDC) to include key performance benchmarks, guidance on suggested targets and certification programs to support them, and linkages to related strategies that will help builders and developers meet these targets (e.g. BC Hydro PowerSmart for New Homes incentive and the *Green Loan Local Incentive Program*). | P&D | CMO |
| 2F.4 | Evaluate the opportunity for developing Stage 2 (Building Permit Application) and Stage 3 (Occupancy Permit) of the SDC to provide guidance over the development life-cycle. | P&D | CMO |
| 2F.5 | Train key City staff on emerging green building practices and targets and how they are integrated into the SDC. | P&D | CMO |
| 2F.6 | Communicate the updated SDC through existing outreach channels like developer and builder associations. | P&D | CMO |
| 2F.7 | Identify and integrate key resources such as training, information, and third party incentives. Establish a "living" list of resources including current capacity building and financing opportunities. Update these resources on an ongoing basis, at least once per year. | CMO | P&D |
| 2F.8 | Include a line item in the SDC for submitting new development to the City Awards program for Clean Energy Leadership. | P&D | CMO |
| 3.1A.1 | To maximize ridership, focus complete and compact development along designated rapid transit corridors. Use the Frequent Transit Development Area (FTDA) designation and the complementary *Complete, Compact, and Connected Corridors* strategy (in the *Land Use* section, above) to facilitate growth in these corridors and in Town Centres, specifically on: | Eng | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | • King George Boulevard from City Centre to South Newton and extending to Highway 10;<br>• 104 Avenue from City Centre connecting to Guildford Town Centre to 156 Street; and<br>• Fraser Highway from City Centre through Fleetwood Town Centre to Langley City. | | |
| 3.1A.2 | To maximize potential for shaping growth and attracting ridership, work with TransLink, Metro Vancouver local governments, and senior governments to establish an LRT-oriented rapid transit network, specifically LRT from City Centre to three town centres: Guildford, Langley City and Newton; and Bus Rapid Transit from Newton to White Rock City Centre. | Eng | CMO; P&D |
| 3.1A.3 | Work with TransLink, Metro Vancouver local governments, senior governments, and major employers and investors to support rapid transit south of the Fraser through a combination of innovative local and senior government financial tools which could include one or more of the following options:<br>• An equitable, regional road pricing regime;<br>• An updated provincial carbon tax that would recycle revenue towards low carbon priorities, specifically public transit in Greater Vancouver;<br>• Special transportation sales tax;<br>• Vehicle registration surcharge;<br>• Expanded regional parking tax to include parking spaces;<br>• Balanced provincial/regional spending on public transit and active transportation relative to road, bridge and tunnel spending; and<br>• "Prosperity" Fund for Low Carbon Community Development, establishing an envelope from Liquefied Natural Gas Royalties to invest in low carbon community projects. | CMO | All |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 3.1B.1 | Work with TransLink to increase bus service outside rapid transit corridors and enhance connectivity to rapid transit stations. | Eng | P&D |
| 3.1B.2 | Continue to expand multi-modal linkages for transit such as Park-and-Ride and Bike-and-Ride. | Eng | P&D |
| 3.1B.3 | Use the designation of Frequent Transit Development Areas (FTDA) and Frequent Transit Network corridors to support increased transit mode share. | Eng | P&D |
| 3.2C.1 | Build on existing Walking and Cycling Plan guidance for education and outreach to promote interest in and awareness of pedestrian and cycling networks, health and consumer benefits, and City spending benefits. | Eng | P&D; PRC |
| 3.2C.2 | Build on existing Walking and Cycling Plan guidance to enhance pedestrian and bicycle connectivity through existing suburban loops and cul-de-sacs. | Eng | P&D; PRC |
| 3.2C.3 | Increase active transportation connectivity in new greenfield developments through the use of grid pattern street networks or residential quadrant-style streets. | Eng | P&D |
| 3.2C.4 | Building on the City's Walking and Cycling Plan, ensure new neighbourhoods establish cycling and pedestrian plans that include strong connectivity, an appropriate variety of route types (neighbourhood routes, greenways where appropriate, and separated bike paths), intersection push buttons, and end-of-trip facilities for key destinations (commercial, institutional and transit). | Eng | P&D; PRC |
| 3.2C.5 | Update the Sustainable Development Checklist to encourage pedestrian and bike routes and infrastructure in the private realm and connectivity to the public realm. | P&D | Eng; CMO |
| 3.2C.6 | Evaluate potential to invest in active transportation infrastructure through "cash-in-lieu" | Eng | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | from developers in exchange for reduced parking. | | |
| 3.2D.1 | Strengthen diversity, density and quality of the bicycle network, including a system and design to support Triple A (All Ages and Abilities) routes. | Eng | P&D; PRC |
| 3.2D.2 | Work with partners to improve quality and distribution of end-of-trip bike facilities (i.e. secure, weather-protected bike parking at origins and destinations as well as shower and change room facilities for employees in commercial buildings), and some access to basic 110 volt electrical outlets for E Bike charging. | Eng | P&D |
| 3.2D.3 | Working with the School District, improve safe access to schools by including intersection push buttons, separated bike lanes or neighbourhood bike routes, and student/staff end-of-trip facilities. | Eng | P&D |
| 3.2D.4 | Establish a consistent and clear bicycle way finding system, integrated with the public transit system and supported by digital tools and physical maps. | Eng | P&D |
| 3.2E.1 | Focus walking infrastructure improvements in higher density mixed use areas, especially within the Frequent Transit Network. | Eng | P&D |
| 3.2E.2 | Update the Sustainable Development Checklist and use Development Permit Areas to promote active transportation and pedestrian infrastructure and network design in the private realm. | P&D | Eng; CMO |
| 3.2E.3 | Ensure new Area Plans effectively integrate pedestrian plans into their development. | P&D | Eng |
| 3.2E.4 | Incrementally and opportunistically enhance pedestrian connectivity through suburban loops and cul-de-sacs. | Eng | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 3.2F.1 | Work with TransLink and the City's active transportation initiatives (walking and cycling) to strengthen education and outreach. | Eng | P&D; CMO |
| 3.2F.2 | Examine parking supply and price adjustments. Price signals and supply should be sensitive to cost effective, safe, convenient options. | Eng | P&D |
| 3.3G.1 | Convene FleetSmart driver training and Fuel Management 101 workshops in Surrey for commercial and institutional fleets. The City may play a role in workshop promotion, hosting, and even customization. | CMO | Eng |
| 3.3G.2 | Consider requirements and incentives through business licensing. | CMO | All |
| 3.3G.3 | Work with the BC Trucking Association, Metro Vancouver, and the Port Authority to explore opportunities for a Surrey-based green loan and incentive program tailored for small trucking businesses. The program would focus on overcoming knowledge and capital barriers, and could be organized as a self-sustaining loan in partnership with a financial institution. | CMO | All |
| 3.3G.4 | Explore through Metro Vancouver local governments the idea of integrated inter-municipal passenger vehicle licensing to improve driving optimization. This would allow taxis to return to their places of origin with passengers. | CMO | Eng |
| 3.3G.5 | Work with other organizations and agencies to develop market-specific driver training and social marketing focusing on large sectors with high emissions and easier intervention like construction sites. Use leverage points such as site/project orientations to provide training and issuance of decals or tags that would allow entrance to sites. | CMO | All |
| 3.3G.6 | Consider innovative opportunities for integrating freight into any road congestion charging or tolling system that would expedite regional freight traffic and contribute to public transit | CMO | All |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | funding. | | |
| 3.3G.7 | Consider further traffic signal synchronization alignment along major Surrey arteries and extending permissible hours for truck loading, unloading and operation in appropriate locations. | Eng | P&D |
| 3.3H.1 | Continue to promote car-sharing to residents, businesses, developers, and public institutions, and facilitate discussions around the uptake of car sharing within the City. | Eng | P&D; CMO |
| 3.3H.2 | Encourage car sharing by including dedicated on street parking in key neighbourhoods across the City, and protect car share parking in residential areas. | Eng | P&D |
| 3.3H.3 | Evaluate opportunities to expand car sharing in residential developments through the Sustainable Development Checklist and parking variances. | Eng | P&D, CMO |
| 3.3I.1 | Expand opportunities for all low emission vehicles. | CMO | Eng |
| 3.3I.2 | Expand opportunities for electric vehicle charging infrastructure. | CMO | Eng; P&D |
| 4.1A.1 | Awareness, training and institution building for new and existing buildings. | CMO | P&D |
| 4.1A.2 | Sustainable Energy Leadership Recognition: Integrate sustainable energy leadership recognition into the existing City Awards program, including the Clean Energy Award. This recognition would acknowledge the small constituency of leading builders, developers, architects, engineers as well as business, home owners and the public sector. The exercise would be intended to normalize these best practices. | CMO | P&D; Eng |
| 4.2B.1 | Work through the Building Permit Division to promote retrofits. Enable clerks and front-counter staff to connect applicants with appropriate energy efficiency retrofit information and programs, optimizing efforts based on knowledge of building type and use and planned | CMO | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | renovations. Engage BC Hydro and FortisBC in training sessions. Integrate incentives into online and hard copy application processes. | | |
| 4.2B.2 | Actively promote retrofits for local businesses. Work with business associations (e.g. BIA, Surrey Board of Trade, Chamber of Commerce and other key organizations) to develop workshops, lunch and learns, and "BIA Blitzes" with third-party organizations providing funding and training opportunities. | CMO | All |
| 4.2B.3 | Consider using business licenses to target retrofit program promotion for more energy intensive sectors (e.g. grocery, small industry, food services). This data could be used to target marketing. It is also possible to consider revenue neutral shifts in business licensing to reward companies that improver energy efficiency. | CMO | All |
| 4.2B.4 | Evaluate collaboration with the Condo Homeowner's Association (CHOA), the Building Owners and Managers Association (BOMA), and various property management companies to promote existing and emerging retrofit financing programs, including training for building managers. | CMO | P&D |
| 4.2C.1 | Develop a framework to support purpose-built rental housing retrofits. | CMO | P&D |
| 4.2C.2 | Support outreach to non– profit housing to deepen retrofit rates. | CMO | P&D |
| 4.3D.1 | Increase awareness of incentives by hosting workshops and info sessions from utilities, building associations, LiveSmart and other third-parties. Host workshops through the Sustainability Office &/or Building Division. | CMO | P&D |
| 4.3D.2 | Integrate third party incentives into the permitting process and the Sustainable Development Checklist | P&D | CMO |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 4.3D.3 | Facilitate involvement in BC Hydro or FortisBC programs during rezoning, notably for large buildings. | P&D | CMO |
| 4.2E.1 | Determine applicability and design of an energy efficiency density bonusing policy for appropriate zones and building types across the City. | P&D | Eng; CMO |
| 4.2E.2 | Evaluate the relative merits of a more broad-based financial instrument such as a community amenity contribution financed Community Energy Fund or Green Loan. | CMO | P&D, Eng |
| 4.2E.2 | Integrate financial instruments into the Sustainable Development Checklist and permitting process. | P&D | CMO |
| 4.2F.1 | Offer capacity building opportunities on key practices for improving building energy performance, focusing on low cost, high impact, easily enforceable opportunities. Adjust training by audience, including staff, builders, developers and construction trades. Use workshops, pamphlets, info sessions, site briefings, and collaborate with other interested parties (e.g. utilities, and construction/developer/builder associations) on program delivery. | CMO | P&D |
| 4.2F.2 | Identify and implement practical opportunities for enhancing code compliance. | P&D | CMO |
| 4.2F.3 | Evaluate the opportunity of testing compliance with minimum energy performance ratings. | P&D | CMO |
| 4.2F.4 | Integrate capacity building resources and amendments to permitting and inspection process into the Sustainable Development Checklist. | P&D | CMO |
| 5A.1 | Continue current plans for establishing and extending district energy nodes in City Centre, focusing on Surrey Central, King George, and Gateway. | Eng | P&D |
| 5A.2 | Evaluate the opportunity to extend district energy from the three City Centre nodes into adjacent planning areas with high DE potential to establish a large, contiguous service area, | Eng | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | specifically consider 104th Avenue Corridor and Guildford Town Centre. | | |
| 5B.1 | Conduct planning area district energy opportunity assessments. Use screening analysis from this Plan (see *District Energy Technical Memorandum* in Appendix), and more detailed area-level plans to further screen potential. Confirm potential, or opportunity to further adjust policies and plans to strengthen business case. | Eng | P&D |
| 5B.2 | Evaluate governance/ownership options for the specific location. If there is high potential, make a decision about whether system ownership would be best developed and operated by the municipal utility or by a private utility or a hybrid. This will influence whether a Request for Expressions of Interest is issued to utility providers or if the City secures financing to carry out detailed feasibility analysis. Consult key stakeholders to inform this decision. | Eng | P&D |
| 5B.3 | Conduct detailed feasibility analysis. Determine the basic technical and financial viability of a project, including detailed heating and cooling load projections, supply options analysis, phasing, net present value calculation or other internal financial tests, carbon, power and energy savings, and district energy plant siting and network mapping. Engage internal and external stakeholders. Execute technical Go/No Go. | Eng | P&D |
| 5B.4 | If it is *No Go*, consider other low carbon, sustainable energy solutions. If it is a *Go*, conduct detailed investment analysis and business and governance modeling. Build on the technical and financial feasibility, identify actions to support the business case including securing customers, adjusting land use plans, attracting anchor tenants, developing a phasing strategy, and determine the optimal business and governance model for the unique development and area, outlining specific financing, ownership elements, and operation details. Situations that may be more conducive to private or hybrid models include a large public or private owner/developer with a large site, small district energy service areas, or a large industrial heat generator. | Eng | P&D |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 5B.5 | Carry out detailed policy, planning and promotion. Building on the actions to support the business case outlined above, flesh out policies, plans, and promotional activities. | Eng | P&D |
| 5C.1 | Deeply integrate district energy and rapid transit agendas. Use both to help focus growth, and reinforce the success of each of these important initiatives. | Eng | P&D |
| 5C.2 | Integrate district energy development into broader land use and infrastructure planning. | Eng | P&D |
| 5C.3 | Establish a building retrofit policy and program framework to support district energy expansion. | Eng | P&D, CMO |
| 5C.4 | Protect rights of way for district energy distribution networks. | Eng | P&D |
| 5C.5 | Establish policies and plans to guide the City and private sector to transition out of natural gas and into renewables to reduce the carbon intensity of buildings on DE systems. | Eng | CMO; P&D |
| 6A.1 | Continue to extend outreach on organics pickup in single detached homes. | Eng | P&D |
| 6A.2 | Work with partners to develop targeted outreach for multi-family residential buildings for organics and recyclables. | Eng | CMO |
| 6A.3 | Support Metro Vancouver's outreach with key business and institutional sub-sectors, such as restaurants, grocery stores and food processors on organic diversion and offices for paper diversion. | Eng | CMO |
| 6A.4 | Evaluate and address key barriers to organics and recycling diversion in multi-unit residential buildings, and large commercial/institutional buildings, considering the unique opportunities in new and existing buildings. | Eng | CMO |
| 6A.5 | Update bylaw to require organic and recycling separation and transportation to appropriate | Eng | CMO |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| | facilities (with exemptions for on-site management systems) using Metro Vancouver's sample bylaw as a basis. | | |
| 6B.1 | Develop a construction and deconstruction policy framework to support resource recovery and zero waste. | Eng | P&D, CMO |
| 6C.1 | Encourage senior governments to establish stronger policies on packaging and extended producer responsibility. | Eng | CMO |
| 6C.2 | Support and engage with the national zero waste marketing council initiated by Metro Vancouver. | Eng | CMO |
| 6D.1 | If Surrey becomes a favoured location for an energy recovery from waste plant, the City should advocate a solution that is district energy-based and maximizes energy and waste management sustainability, and minimizes GHGs and criteria air contaminants. | Eng | CMO |
| 6D.2 | The City should ensure a clear set of planning and design principles for energy recovery from waste underpin a district energy system that would be located in its community. | Eng | CMO |
| 7A.1 | Develop a decision making lens to support staff, council, and potentially private, public and social sector players in the community to evaluate impact and provide guidance for managing GHGs and energy, and, if desired, broader sustainability policy. A straightforward, qualitative scoring tool could situate and optimize key decisions. | CMO | All |
| 7B.1 | Create a dialogue with the Provincial Government to establish a *Clean Air and Healthy Community Fund* to build a legacy of deep carbon reduction/community development projects financed through a constructively renewed provincial carbon tax and LNG-financed prosperity fund for low carbon community development. | CMO | All |

| CEEP # | Community Energy and Emissions Plan Draft Strategy | Lead Dept | Supporting Depts |
|---|---|---|---|
| 7B.2 | Work through and/or with Metro Vancouver and other key stakeholder to advance these opportunities. | CMO | All |
| 7C.1 | If BC's Carbon Neutral Agenda continues and the City aims to achieve carbon neutrality, the City should establish a Community Carbon Offset Framework to help meet a corporate carbon neutral commitment and support high value community emission reduction projects that offset City or PSO carbon liability. | CMO | All |