Community Energy & Emissions Plan

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ACKNOWLEDGEMENTS

Under the guidance of Council, the City's Sustainability Office managed the development of the Plan with the active involvement of an Interdepartmental Steering Committee.

FINANCIAL SUPPORT

Generous support from the Federation of Canadian Municipalities Green Municipal Fund and the BC Hydro Sustainable Communities Group supported the development of the Community Energy & Emissions Plan.

PUBLIC & STAKEHOLDER ENGAGEMENT

Input from stakeholders as well as many local citizens and businesses contributed greatly to this Plan. Please see Section 2.1 for further details on engagement.

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 Credit: Century Group

EXECUTIVE SUMMARY

The Surrey Community Energy & Emissions Plan (CEEP) tackles the twin challenges of climate change and energy insecurity. It provides long-term direction with a 2040 horizon as well as short-term actionable strategies that support the City's Sustainability Charter and reinforce diverse core community priorities.

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

CURRENT ENERGY & EMISSIONS CONTEXT

Over the period of this Plan from 2007 to 2040, Surrey's population will rise from 447,000 to 740,000. By mid-century, Surrey will be BC's largest city. The City'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. As such, Surrey's future is of fundamental interest to energy utilities, transportation agencies, and waste managers in British Columbia. Surrey's Community Energy & Emissions Plan can help to 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, however, a majority of greenhouse gas emissions (GHGs) is in the transportation sector.

In the base year of 2007, businesses, residents, and institutions in Surrey generated 2 million tonnes of carbon dioxide equivalent (CO_2e) and consumed 42.5 million gigajoules of energy in buildings, transportation activity, and solid waste. The average per capita GHGs were 4.9 tonnes per year.

Compared to the region:

- Per capita emissions in Surrey are similar to most municipalities in Metro Vancouver;
- Building emissions are lower due to newer building stock and less commercial floor space per capita;
- Transportation emissions are higher due to a higher share of short haul freight vehicles and longer distances travelled by personal automobile for work and services; and
- Transit and active transportation trips are lower due to lower transit services and less proximate employment and services.

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

In 2007, less than 1% of households in Surrey 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 and could have significant negative implications for lower and lower-middle income families.

STRATEGIC DIRECTIONS

The Community Energy & Emissions Plan's strategic directions include the following:

- 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.
- Rapid transit development, improved bus service, walking infrastructure, and all ages and abilities bike infrastructure in and between Town Centres and City Centre to increase transit use, reduce congestion, support safe and cost-effective transport, and promote physical fitness, complementing the City's growing active transportation investment.
- Building energy retrofit strategies 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 agenda with specific strategies for residential, commercial, institutional, and construction sector markets.

STRATEGY & TARGET SUMMARY

The Plan's strategies are organized into five sectors, supported by a section on cross-cutting institutional priorities. Key targets are established for each sector.

Land Use Strategies aim to focus growth in Town Centres and transportation corridors, diversify the building stock, and contribute to the public realm. They support transit use, active transportation, higher efficiency buildings, low-carbon district energy, and overall livability. The objective of these strategies is to set the foundation for sustainable land use that supports and enables strategies in other sectors.

Key Target
- Increase proportion of Surrey residents within a 5 minute walk to Frequent Transit Stations 10% by 2020 and 21% by 2040

Strategies

- Focused Growth
- Complete, Compact, Connected Corridors
- Compact & Live/Work Housing
- Low Carbon Development Permit Areas
- Neighbourhood Sustainable Energy Pilot
- Sustainable Development Checklist Update
- Grid Scale Energy Infrastructure Planning & Coordination

Transportation Strategies build on land use strategies to support a high quality rapid transit network, an extensive active transportation infrastructure, and diverse low emission vehicle opportunities for residents and businesses. The objective of these strategies is to accelerate a transition to attractive, low carbon transportation options.

Public Transit Strategies

- Rapid Transit Development
- Bus Service Improvements

Active Transportation & Transportation Demand Management Strategies

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

Low Emission Vehicle Strategies

- Green Fleet Management & Efficiency Support
- Car Sharing Promotion
- Low Emission Vehicle Infrastructure Development

Key Targets:
- Reduce personal vehicle driving distances 4% by 2020 and 9% by 2040
- Increase bicycle route kilometers 57% by 2020 and 148% by 2040

Building Strategies aim to enhance the capacity of City staff and the construction industry to meet steadily rising building standards and to increase energy retrofit rates in residential, commercial, industrial, and institutional buildings. The objective of these strategies is to improve the energy and GHG emissions performance of new and existing buildings.

Cross-Cutting Building Strategies

- Capacity Building for Low Carbon, 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:
- Improve building energy performance 10% beyond typical new construction by 2040
- Increase the annual retrofit rate of existing buildings to 2% from 1% by 2040

District Energy strategies build on the land use strategies to support the extension of City district energy (DE) utility services within City Centre and to contiguous high potential areas, and to evaluate opportunities in other higher density areas for diverse business models. The objective of these strategies is to increase local, low-carbon energy generation.

Strategies

- City Centre District Energy Extension
- New District Energy Node & Corridor Evaluation
- Integrated District Energy Policy & Planning

Key Target:
- Meet City-owned DE energy requirements with 40% renewables by 2020 and 75% renewables by 2040 (illustrative and modeling purposes only; see section for notes).

Solid Waste Strategies continue existing policies and plans to reduce total waste, increase recycling rates, and virtually eliminate organics from landfills with specific strategies for residential, commercial, institutional, and construction sector markets. The objective of these strategies is to reduce landfill waste.

Strategies

- Zero Waste Residents, Businesses & Institutions
- Zero Waste Construction & Deconstruction
- Senior Government 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 among key stakeholders.

Strategies

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

FUTURE ENERGY & EMISSIONS

Implementing the strategies in the Community Energy & Emissions Plan will reduce GHG emissions by 47% on a per capita basis by 2040 relative to 2007 levels.

A Business as Usual (BAU) future is where no action is taken to manage energy and emissions beyond existing City plans and policies and currently legislated senior government commitments. When presented relative to that BAU, the CEEP in combination with continued senior government action could cut emissions by 47% on a per capita basis and by 41% on a total community wide basis by 2040.

Energy demand is forecasted to drop by 29% on a per capita basis by 2040 relative to 2007 levels. Community-wide energy savings are projected to be $420 million in savings or 20% below the Business As Usual future in 2030 and $832 million or 31% below BAU by 2040.

Together, the strategies proposed in this Plan will move the City towards rigorous and ambitious GHG and energy reduction targets.

TABLE OF CONTENTS

PART 1: CONTEXT

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

The vision for Surrey's Community Energy & Emissions Plan is as follows:

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 livability 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, to:

- Provide long-term direction with a 2040 horizon and identify short-term actionable strategies;
- Provide a base year energy and emission profile against which progress will be measured;
- 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; and
    - Reduce greenhouse gas emissions from waste;
- 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;
- Provide direction for integrating strategies with climate change adaptation; and
- Support the City's Sustainability Charter and complement core community priorities.

1.3 SURREY'S CHALLENGE & OPPORTUNITY

Over the period of this Plan from 2007 to 2040, Surrey's population will rise from 447,000 to 740,000. By mid-century, Surrey will be BC's largest city. The City'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. As such, Surrey's future is of fundamental interest to energy utilities, transportation agencies, and waste managers in British Columbia. Surrey's Community Energy & Emissions Plan can help to constrain demand at smart meters, gas pumps, and traffic lights.

Separating rapid population and job growth from energy consumption, waste, and greenhouse gases is a long-term challenge for the City that can be addressed through 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. This Plan can make an important contribution to the discussion of sustainable growth in these 21st century cities.

1.4 STRATEGIC POLICY CONTEXT

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

1.5 REPORT STRUCTURE

The Community Energy & Emissions Plan is organized into three major parts and includes a set of appendices.

Part 1 establishes the context for the Plan. It articulates the Plan's vision and goals; discusses the twin challenges of climate change and energy vulnerability; describes the methodology for developing the Plan; and analyzes Surrey's baseline energy and emissions profile.

Part 2 is the essence of the Plan. The first six sections delineate essential background analysis, key targets, indicators, and recommended strategies for land use, transportation, buildings, district energy, solid waste, and cross-cutting strategies. A number of key indicators and targets are selected for monitoring Plan implementation; these can be found in tables at the beginning of each section as well as in Part 3. The penultimate section analyzes the potential energy and emission reductions and energy savings from implementing the CEEP. Part 2 concludes with a discussion of linkages between climate change mitigation and adaptation and how the Community Energy & Emissions Plan is integrated with Surrey's Climate Adaptation Strategy.

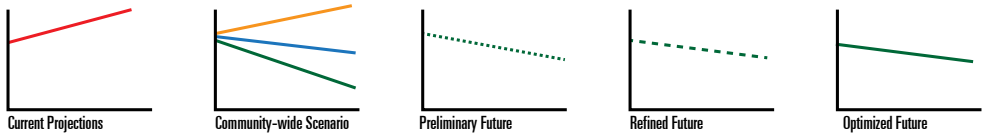
Part 3 highlights priority action opportunities for exploration, summarizes the Plan's targets and indicators, and describes how progress will be monitored. Select references and a glossary are included as appendices. The Plan is also accompanied by the following two stand-alone supporting documents:

- Detailed Modeling Methodology, which describes the modeling work that underpins the CEEP; and
- BC Hydro Power Conservation Analysis, which provides an in-depth analysis of reductions in electricity consumption from CEEP implementation.

2. GENERAL METHODOLOGY

This Plan was developed with active engagement with City staff and key stakeholders, rigorous analysis, and innovative policy and planning. The Plan was developed over four phases (see Figure 1).

Figure 1: Community Energy & Emissions Planning Process Overview



	Analyzing the Situation Summer 2011 - Fall 2011	Exploring Options Fall 2011- Winter 2012	Defining the Future Spring 2012 - Fall 2012	Developing a Plan Winter 2012 - Spring 2013
Community Activities	Canada Day Lunch	Public Forum		Community ENERGY Shift Cafe
Stakeholders Public, Private, Non-Profit Council Staff		Idea Workshops	Action Workshops	Roundtables New Buildings & Retrofits Rapid Transit Corridors Low Emission Cars & Trucks
Council & Staff	Idea Workshops	Options Workshops	Action Workshops	Review Meetings
Deliverables	• Community Energy & Emission Profile	• Energy & Emission Options Paper	• Preliminary Community Energy & Emissions Plan	• Final Community Energy & Emissions Plan

ENERGY Shift Taking Action on Surrey's Energy Future

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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. During this phase, the City kicked off public engagement on the Plan at Surrey's annual Canada Day celebration in 2011 by inviting hundreds of citizens to share their thoughts on how the City can support action on climate change and sustainable energy (see below for more detailed descriptions of this and all other key public and community stakeholder engagement activities). The key deliverable was a Community Energy & Emissions Profile that provided a baseline understanding of current energy and emissions performance and 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 of the future comprised of strategies that could be led by the City. Stakeholder and staff workshops, a youth forum, a public discussion and open house, and Council consultation were held to further examine community priorities and brainstorm strategies. The key deliverable was a Community Energy & Emissions Options Paper outlining several distinct futures largely defined by intensity of effort. As well as the energy and emissions 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. Surrey residents were invited to a World Café event to refine draft strategies and generate ideas on how to actively involve residents across the community in managing GHG emissions. 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. Round Table discussions were held with key stakeholders to gather their input on draft strategies. City staff and consultants then refined the priority and implementation framework while the project team updated strategies based on stakeholder feedback, re-calculated the energy and emissions implications of the final set of strategies, and finalized the Community Energy & Emissions Plan.

2.1 KEY PUBLIC AND COMMUNITY STAKEHOLDER ENGAGEMENT ACTIVITIES

PHASE I: ANALYZING THE SITUATION

In July 2011, the City launched public engagement on the Plan at Surrey's annual Canada day event. City staff had a booth with fun educational activities on reducing energy and emissions (including human –powered bike blenders on which over 1,500 people powered their own pineapple and strawberry slushies!). Staff were dressed up as Energy Superheros to get people thinking about what they can do in their everyday lives to be an energy hero. Over 150 residents contributed their energy hero stories and photos for the City's webpage on the CEEP. Staff also asked people what they think Surrey should do to help the community reduce energy and GHGs. Common suggestions were improving transit services, improving cycling and walking infrastructure, and providing more solar power opportunities.

Figure 2: Surrey residents share their thoughts on sustainable energy over bike-powered smoothies on Canada Day, 2011.

PHASE II: EXPLORING OPTIONS

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. In November, the City hosted a youth forum to solicit young people's ideas and vision for a low-carbon future. The forum generated dozens of creative, innovative, and exciting ideas, including renewable energy for all new buildings, separated bike lanes, and sustainability education integrated into all school curricula.

In February 2012, over 100 government and community representatives, developers, youth, and City staff attended a Panel Discussion and Open House to give their feedback on draft strategies. 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. The evening included a lively panel discussion hosted by CBC Radio host Mark Forsythe. Panelists Gordon Price, Penny Pridy, Nimal Rajapaske, and Nancy Olewiler spoke about Surrey's growing significance in the region, the role of clean energy technologies in supporting resiliency to climate change, and the importance of strategic land use, development, and transportation planning in reducing energy and emissions.

Figure 3: More than 100 people attended a Panel Discussion and Open House 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).

PHASE III: DEFINING THE FUTURE

In October 2012, the City brought key stakeholders together to review and comment on draft strategies proposed in the six major sectors of the CEEP.

In December 2012, Surrey residents were invited to a World Café event to discuss ideas for how to support community actions and initiatives to realize emission reductions across the City, as well as to provide high-level feedback on the Plan's draft strategies.

Figure 4: The City hosted several workshops to gain input from the public, staff, and key stakeholders in developing the Community Energy & Emissions Plan.

PHASE IV: DEVELOPING A PLAN

In January 2013, the City collaborated with BC Hydro to host sectoral Round Table discussions with key stakeholders to further refine strategies and identify opportunities for collaboration and implementation. Stakeholders included Fortis BC, TransLink, Metro Vancouver, members of the construction and development industry, local businesses and associations, and non-profits involved in green buildings and transportation.

2.2 TECHNICAL ANALYSIS: MODELING & MAPPING SUMMARY

Rigorous modeling was used to support analysis of and strategy development for the Community Energy & Emissions Plan's key sectors. Modeling was used to estimate the potential energy and emissions impacts of different combinations or bundles of strategy types and intensities. This fostered a deep understanding of the energy and emissions implications of land use, transportation, buildings, district energy, and waste. It also supported the development of high-impact strategies that balance GHG and energy reductions with feasibility, opportunities, and challenges. Additionally, modeling was used to forecast indicators, key targets, and the energy and emissions reductions that could be achieved by implementing the Plan's strategies.

Golder's Community Energy and Emissions Modeling and Planning tool CEEMAP was used for the modeling. CEEMAP uses several dynamic and interactive modules that incorporate quantitative assumptions (i.e. indicators) to estimate future energy use and greenhouse gas emissions for a neighbourhood, community, or region. CEEMAP integrates indicators 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, number and frequency of transit routes);
- Building Type & Performance (e.g. single detached or multi family home type, building energy rating, retrofit rate);
- Heat & Electricity Supply (e.g. electricity from the grid or other sources, specific district energy technology); and
- Solid Waste Management (e.g. waste composition and mass, waste management practices).

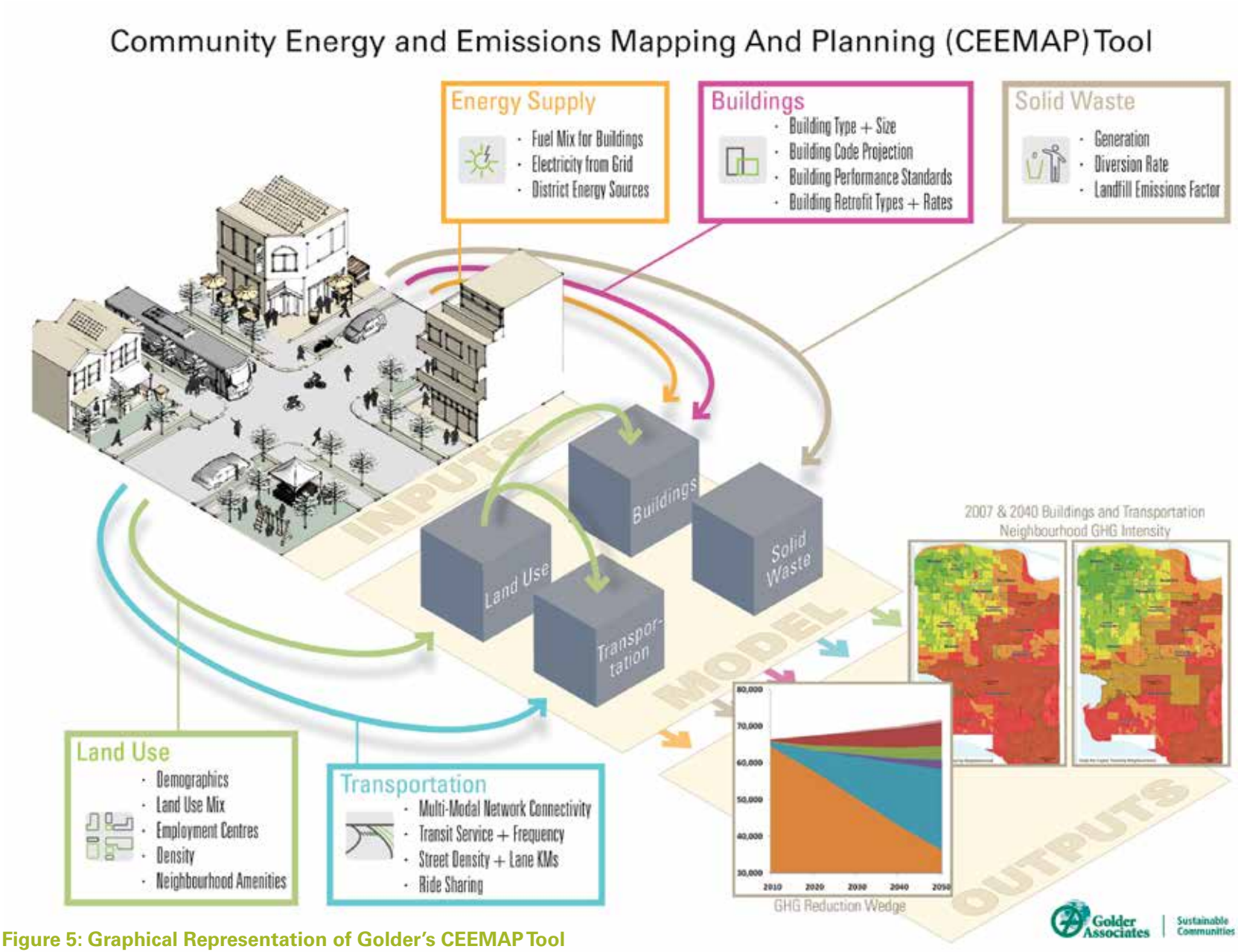


Figure 5: Graphical Representation of Golder's CEEMAP Tool

CEEMAP was populated with indicator values from 2007 to model a detailed energy and emissions baseline. 2007 is the base year for two inter-related reasons. It is the first year for which good data is available due to the BC Government's Community Energy and Emissions Inventory (CEEI) initiative. The initiative provides every community in the Province with a basic energy and emissions inventory or profile. Secondly, the BC Government announced its ambitious climate action agenda in 2007 and most institutions in BC use this year as the base year for measuring emission reductions.

Values for these indicators were then projected into the future for 2020 and 2040, the Plan's two milestone years. 2040 is the CEEP's final milestone year because it aligns with the 30-year outlook in PlanSurrey2013, the City's Official Community Plan, as well as in Metro Vancouver's Regional Growth Strategy. 2020 is a useful interim milestone year between the base year and the final milestone year for measuring progress.

Indicator projections were bundled together into two broad scenarios of the future, defined by different combinations of strategy types (e.g., for land use or transportation) and intensities. Using empirically-derived knowledge of the relationships between the indicators, CEEMAP calculated projected changes in energy use and GHG emissions for 2020 and 2040 for the two future scenarios. These projections were used to inform a multi-criteria analysis that assessed the scenarios based on energy and emissions reduction potential, feasibility, and other factors. This was collated into a Community Energy & Emissions Options Paper, the major deliverable for Phase II of Plan development.

Following identification of a preferred path forward, strategies for the six sectors were then developed and refined through Phases III and IV of Plan development. CEEMAP re-calculated the energy and emissions implications of the final set of strategies, with resulting projections for community-wide and per capita energy and GHG reductions. These projections are discussed in Part 2.

A number of indicators were selected for monitoring Plan implementation; these can be found in tables at the beginning of each strategy section. One to two monitoring indicators were identified as key targets against which Plan implementation will be evaluated; key targets are included in the indicator tables and highlighted in green.

Because so many indicators affecting energy supply, energy use, and emissions in transportation and buildings are influenced by location, CEEMAP was also used in combination with Geographic Information Systems (GIS) to generate maps that show the current and future conditions of energy and emissions drivers (e.g. employment density) and location-sensitive indicators (e.g. vehicle kilometers traveled, building energy consumption, etc.). These maps are included in the Energy and Emissions Profile section in Part 1 as well as throughout the strategy sections in Part 2 of the Plan.

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

3. CLIMATE, ENERGY AND OUR COMMUNITY

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

3.1 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 800,000 years. These heat-trapping gases are contributing to an incremental rise in global temperatures, which is disrupting natural and physical systems upon which human health and prosperity depend. The Fourth 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 and lead to impacts such as severe agricultural collapses, water shortages, droughts, and sea level rise.

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 to be one percent of global gross domestic product (GDP); compared to a loss of up to 20% of global GDP if nothing is done. Stern concluded that "the benefits of strong, early action on climate change outweigh the costs".

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 five to ten years and has attributed much of this increase to climate change. From floods to fires and windstorms, BC communities have been experiencing rising costs. Many local governments have begun to realize that when disaster strikes, they are on the front lines.

Climate 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 of high rain and wind events causing flooding and disturbance of natural and built environments; and
- Increased risk of forest fire in or near Metro Vancouver, adversely impacting local air quality.

In addition, the community will experience the local implications of global disruptions such as rising prices and periodic constraints in agricultural production.

THE GREENHOUSE EFFECT & CLIMATE CHANGE

Greenhouse gases such as 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 agriculture have 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 concentrations 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 that have resulted in floods and droughts; reduced snow packs, glaciers and sea ice leading to rising sea levels, hydro-electric insecurity; and changing ecosystems. Deep GHG reductions will enable people and the planet to avoid the most serious consequences of climate change.

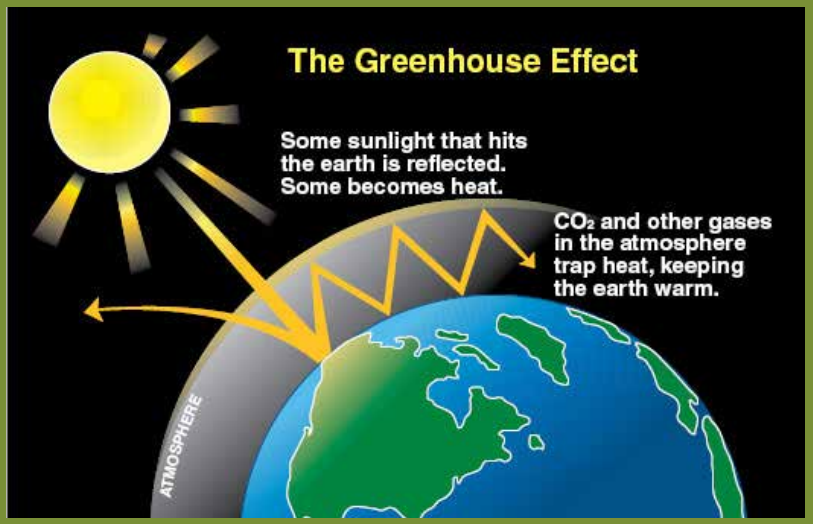


Figure 7: The Greenhouse Effect (University of Washington).

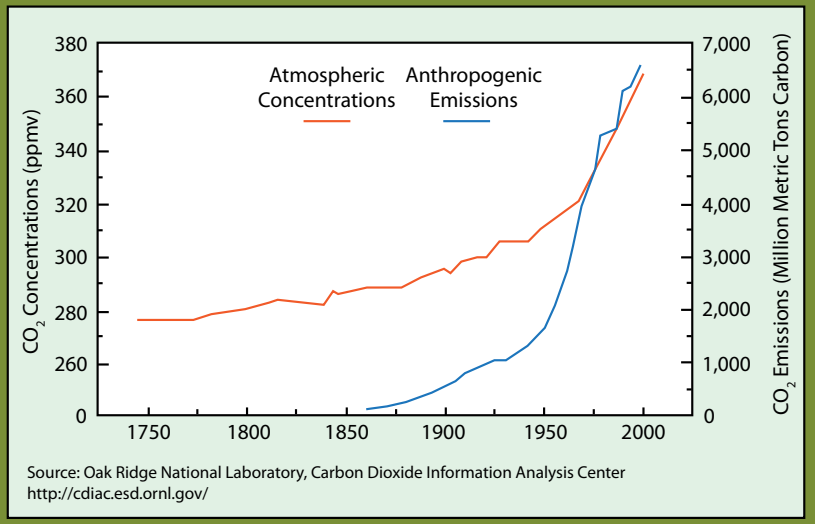


Figure 8: Trends in Atmospheric Concentrations and Anthropogenic (human generated) CO2 Emissions (Oak Ridge National Laboratory, US DoE)

3.2 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 increasing costs of production and growing demand:

- Oil prices are projected to rise from the current price of $95 a barrel to $115-$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 by 2025 (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, and utilities.

Additionally, many conventional sources of energy production are also vulnerable to climate changes; such as growing variability and unpredictability in hydro-electric reservoir levels due to precipitation changes and refinery disruptions in coastal areas due to coastal storm events.

3.3 LOCAL ENERGY VULNERABILITY

At the household level, energy spending is projected to rise 7% per year. When combined with household income growth – rising at only 2% per year -- energy spending growth will have significant implications for households and communities. In 2007, less than 1% of households spent 10% or more of their household income on energy; by 2020, almost 20% will do so.

Under these circumstances, high income households may reduce travel and luxury goods spending. Medium income households may 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.

Over the longer term, rising energy vulnerability could affect where people work and eventually where they live (e.g. smaller and 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 could decline as households have fewer funds available for discretionary spending. Businesses that benefit from discretionary spending, such as restaurants and entertainment services, will be most impacted. Low income workers in these sectors could be doubly impacted from reductions in purchasing power and employment hours.

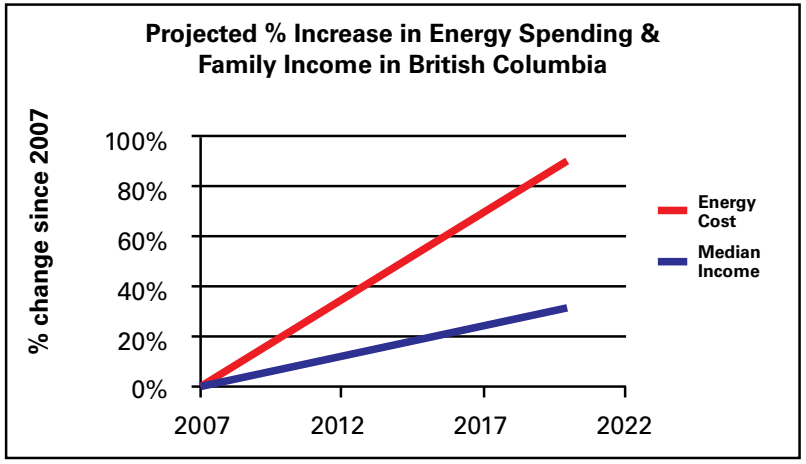


Figure 9: Projected Increase in Energy Spending Relative to Household Income .Total energy spending is projected to rise 7% per year while household income is projected to rise 2% per year. Household income estimates are based on historical trends from 2002 projected forward. Prices are in nominal dollars.

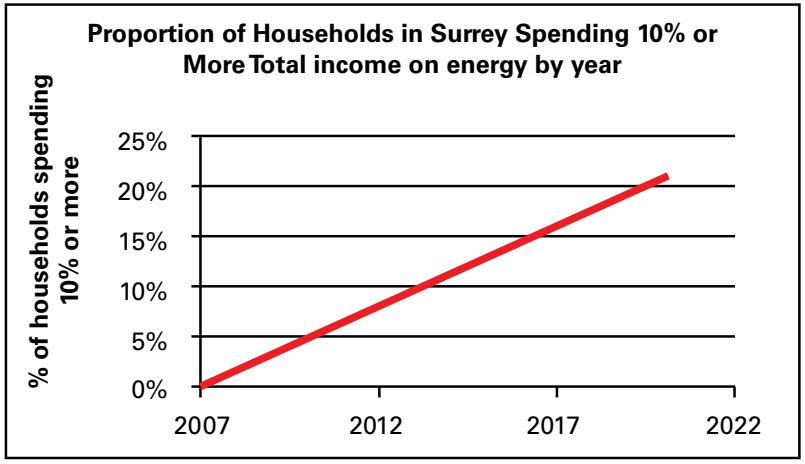


Figure 10: Households Spending 10% or More of Income on Energy. This share rises from under 1% in the base year 2007 to almost 20% in 2020.

3.4 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 disastrous impacts to our climate.

This commitment, as well as growing power supply shortfalls, marketplace changes, and increasing concerns over climate change reinforced work by the Province and energy utilities to accelerate energy performance improvements in new construction and conservation in existing buildings.

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 municipalities. While carbon and energy management priorities may not always be at the forefront politically, the trend supports a lower carbon and more energy efficient future. Surrey's Community Energy & Emissions Plan facilitates this transition and helps build capacity for residents, businesses, builders, developers, and the 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 pledge to take action to create "complete, compact, more energy efficient rural and urban communities."
Greenhouse Gas 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	Among 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 & 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 focusing on buildings and low emission vehicles is established. 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.

BC Carbon & Energy Management Policy & Planning Chronology (continued)	
Energy Efficient Buildings Strategy 2008	This Strategy commits to introducing the highest building energy efficiency standards in Canada and adopts 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, the BC Building Code introduces energy efficiency, which reduces energy demand by up to 27 per cent for new homes and by 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 Emissions 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 currently frozen.
BC Clean Energy Act 2010	The Clean Energy Act increases the BC Government's commitment to meet 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 augments strategies for low carbon district energy.
Clean Energy Vehicles 2011	A new program incentivizes uptake of clean energy vehicles, including an aggressive electric vehicle charging station deployment program.
BC Building Code Update 2013	The Building Code introduces even more prominent energy efficiency standards for multi-family residential, commercial, and institutional buildings. It also introduces performance standards for windows and heating equipment and a new efficiency section for wood frame buildings.

3.5 CITY OF SURREY: TAKING ACTION ON CLIMATE & ENERGY

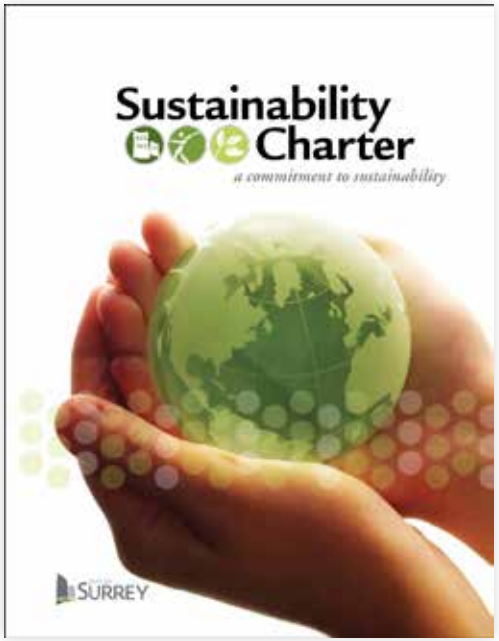
The City of Surrey has increasingly been integrating sustainability into policy, planning, and daily business in both its corporate operations and the broader community.

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

In 2008, Surrey City Council unanimously endorsed the Surrey Sustainability Charter, a 50-year vision to become a more sustainable City. The Charter included an ongoing commitment to complete the five milestones of the Federation of Canadian Municipalities' (FCM) and ICLEI – Local Governments for Sustainability's Partners for Climate Protection process and develop a local action plan that minimizes GHG emissions through the application of a range of established best practices.

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

- FCM and ICLEI's Partners for Climate Protection program (1996)
- Surrey Energy Efficiency Workshop (2007)
- Grandview Heights Geo-Exchange 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)
- Climate Smart Training for Business (2010-12)
- 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 (2011-13)
- Surrey Walking Plan (2011)
- West Clayton Neighbourhood Energy Study (2011)
- Rethink Waste Program (2012-)
- Surrey Cycling Plan (2012)
- City Centre District Energy Development (2013-)
- Student Climate Change Outreach & Education (Ongoing)
- Official Community Plan Update (In Progress)
- Rapid Transit Planning (In Progress)
- Surrey City Centre Plan Update (In Progress)
- Community Energy & Emissions Plan Implementation (In Progress)

3.6 THE ROLE OF LOCAL & SENIOR GOVERNMENT

While local governments have limited direct control over most community energy and emissions activity, municipal decisions can influence almost half of GHG emissions in Canada. This influence is most apparent in land use planning, urban and building design, transportation planning, local energy infrastructure, and waste management.

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 of effort on energy and carbon management should be informed by the spheres of influence that different levels of government have 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 impact. Key areas of senior government primary influence include:

- Regulatory authority over building codes and automobile efficiency standards, which has huge influence over community energy and emission activity; and
- Greater financial authority, which 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 that 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 by preparing the local development sector for change, facilitating market transformation, experimenting with innovation in modest but important ways, and enhancing local capacity to meet building standards.

Nevertheless, achieving the magnitude of emission reductions necessary to avoid the most serious climate change consequences and building prosperous, resilient, and sustainable communities fundamentally require collaboration among municipalities, utilities, transit authorities, and senior governments.

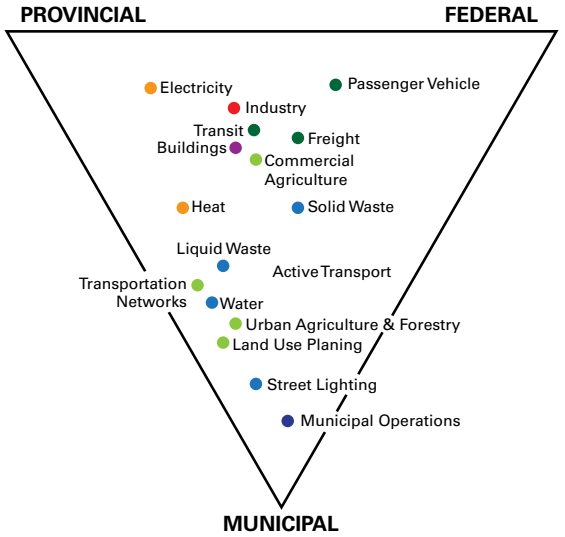


Figure 11: Government Spheres of Influence: Different levels of government share influence over energy and emission activity. One level typically has greater influence over some sectors. This figure makes generalizations that do not hold true in all contexts.

4. CLIMATE CHANGE MITIGATION & ADAPTATION INTEGRATION

Reducing the magnitude and 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 such that we will experience some climate change impacts. Adaptation measures allow impacts to be managed, reducing vulnerability for human and natural systems.

Taking action on climate change 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 to plan for anticipated impacts is fiscally prudent and more cost effective than taking no action.

4.1 ADAPTATION & MITIGATION STRATEGY LINKAGES

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

To maximize beneficial linkages between mitigation and adaptation, the City developed a Climate Adaptation Strategy in tandem with the Community Energy & Emissions Plan. The Climate Adaptation Strategy identifies actions to increase resilience in six sectors: infrastructure; flood management and drainage; ecosystems and natural areas; urban trees and landscaping; human health and safety; and agriculture and food security. Some of these sectors provide co-benefits for land use, buildings, energy supply, transportation, and solid waste, the sectors identified in the CEEP for reducing emissions.

As both plans took shape, three areas were identified where mitigation strategies have adaptation benefits:

- Compact Land Use, Ecosystem Protection, & Hazard Avoidance: Compact land-use and transit-oriented development reduce transportation and building emissions. Focusing growth into compact development patterns also supports the retention of green space, which can strengthen ecosystem protection and improve stormwater management. Directing growth away from hazardous areas like floodplains and steep slopes promotes hazard avoidance by reducing exposure to climate change impacts.
- Passive Solar Design & Heat Management: Passive solar design reduces building-related energy consumption and GHG emissions by improving insulation, lighting, heating, cooling, and ventilation without mechanical or electrical systems. Passive design strategies such as landscaping, site and building material and colour selection, and green and white roofs also help with heat management by reducing the urban heat island effect and reducing health risks during heat waves,
- Community-Based Energy Supply & Energy Self-Sufficiency: District energy and building energy efficiency limit GHGs by displacing or reducing energy from fossil fuel combustion. 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 energy systems such as district energy and decreasing demand for electricity through building energy efficiency increase resilience to a fluctuating energy supply by increasing energy self-sufficiency.

Mitigation strategies within these three areas were crafted to simultaneously reduce GHG emissions and increase resilience to impacts. Part 2 lists the CEEP strategies and identifies how they support adaptation.

5. ENERGY & EMISSIONS PROFILE

This section provides an overview of energy use and greenhouse gas emissions in the City of Surrey for the base year of 2007. An enhanced energy use and emissions profile was developed for the CEEP based on data from the BC Ministry of Environment's Community Energy and Emission Inventory (CEEI). The first year for which the CEEI has data is 2007, which also serves as the base year for the Community Energy & Emissions Plan.

Table 1: 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)	**42,450,00**	**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] *Similar to the Province's CEEI, energy and emissions from large industrial buildings are not included in a community's profile for privacy reasons.*

[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.*

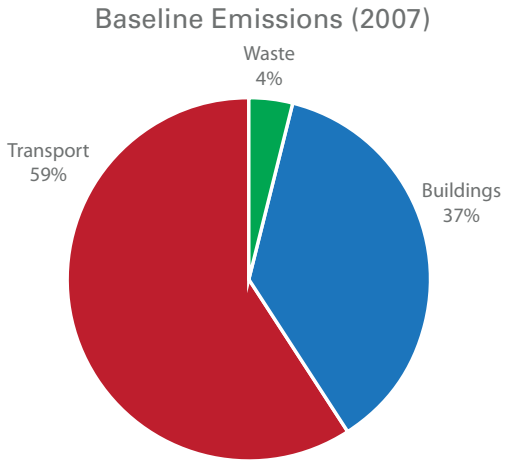


Figure 12: As with most communities in BC, transportation is responsible for a majority (59%) of GHG emissions in Surrey. Buildings constitute a substantial portion (37%) of community emissions while solid waste is a relatively small contributor (4%).

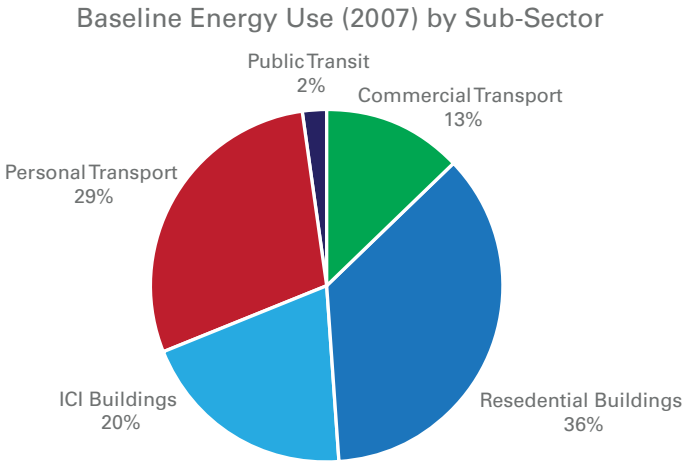


Figure 13: Energy Use by Sector and Sub-Sector
The building sector uses the majority of energy in Surrey. Energy use for ICI (industrial, commercial, and institutional) buildings excludes those from large industrial facilities.

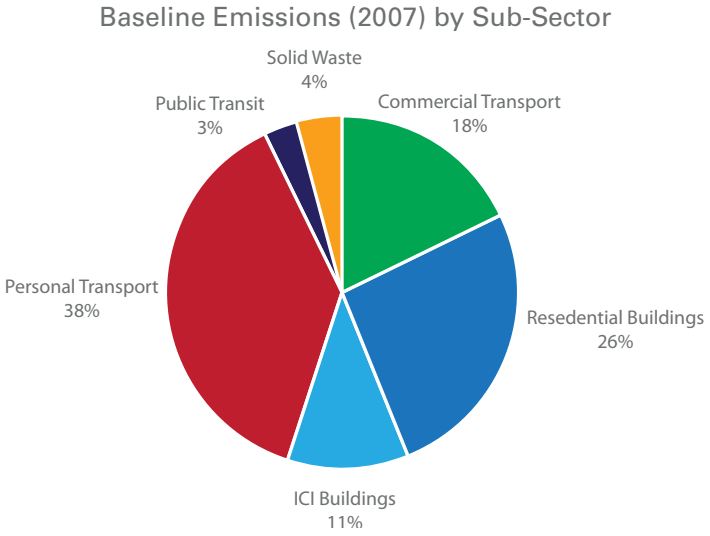


Figure 14: Emissions by Sector and Sub-Sector
Emissions are not proportionate to energy use as different fuel sources and types have different emissions factors. Buildings are responsible for a smaller share of emissions than energy use in part due to their use of electricity from BC's grid, which has an extremely small emissions footprint.

5.1 ENERGY COSTS & 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 spending is from the residential sector while the other one third is from the industrial, commercial, and institutional (ICI) sector.

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, energy utilities charge fixed fees as well. These fixed fees are included in the analysis below. These fixed fees may be excluded in future analysis as they will likely not be affected by policy changes. Excluding fixed costs from buildings would make energy costs more consistent and comparable with the transportation sector, which does not have fixed energy service costs.

Table 2: Energy Consumption and Spending in Surrey in 2007

Sector	Energy Consumption in Baseline Year (GJ)	Total Spending in Baseline Year	Per Capita Spending In Baseline Year
Residential	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

5.2 HIGH LEVEL COMPARISON WITH METRO VANCOUVER

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 per capita are slightly lower that the regional average.

Table 3: Surrey Comparison with Metro Vancouver

Emissions Indicator	Notes	Surrey	Metro
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
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
Proportion of Building Stock that is Single Detached Homes (% of all buildings that is single-detached dwellings)	Single-family detached dwellings generally use more energy per occupant than multi-family dwellings. Neighbourhoods with lower density (e.g. more single-family homes) are generally characterized by more driving than neighbourhoods with higher density (e.g. more multi-family units).	43% Single Detached	35% Single Detached
Transportation Emissions (Tonnes CO_2e per capita per year)	The difference between Surrey and regional per capita emissions can be attributed to higher tractor-trailer ownership and use and more vehicle kilometres travelled (see below) in Surrey.	2.9[y]	2.1

[x] The Community Energy and Emissions Inventory value for Surrey's per capita total emissions is 5.0 Tonnes of CO^2e. The enhanced inventory developed for this Plan has a value of 4.9 Tonnes of CO2e/annum.

[y] The Community Energy and Emissions Inventory value for Surrey's per capita transportation emissions is 2.9 Tonnes of CO2e. The enhanced inventory developed for this Plan has a value of 3.0 Tonnes of CO2e/annum.

[z] Data is from TransLink's Trip Diaries, a study conducted every few years to understand where people are going and how they get there.

Table 3: Surrey Comparison with Metro Vancouver (continued)

Emissions Indicator	Notes	Surrey	Metro
Average Passenger Vehicle Driving Distance[z] (Vehicle kilometres travelled per capita per year)	This is measured in annual total kilometres travelled by passenger vehicles (cars and light trucks). This higher value is due to proximity to jobs and local services within the region and high quality transit access.	7,400	6,000
Transportation Modal Split [z] (% of trips by mode)	Share of trips based on mode of transportation, including driving, public transit, school bus, bicycle, walk, and other modes. (This measure does not account for distance travelled by mode.)	Drive: 80.5% Transit: 10% School: 0.7% Bike: 0.5% Walk: 7.7% Other: 0.6%	Drive: 72.6% Transit: 14% School: 0.7% Bike: 1.5% Walk: 10.3% Other: 0.9%
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 the baseline year.	0.2	0.2

5.3 BASELINE ENERGY & EMISSIONS MAPS

Many indicators affecting energy supply and energy and emissions in transportation and buildings are influenced by location. CEEMAP was used in combination with Geographic Information Systems (GIS) to generate maps that show the current and future conditions of energy and emissions drivers (e.g. employment density) and location-sensitive indicators (e.g. vehicle kilometers traveled, building energy consumption, etc.). These maps are included in the appendices.

PART 2: TAKING ACTION

Part 2 details the CEEP strategies, which are organized by the following sectors:

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

An additional section on institutional strategies to support implementation is defined as "Cross-Cutting Strategies".

Each section includes key targets and indicators along with essential background analysis, strategies, and additional opportunities. In addition to reducing energy and emissions, strategies in all sectors support core community priorities. The following icons are also included in each section to identify which of the eight core community priorities are addressed by the strategies in each sector:

The penultimate section in Part 2 analyzes the potential energy and emissions impacts and energy savings from implementing the Community Energy and Emissions Pan. The last section details how specific CEEP strategies support adaptation.

1. LAND USE

Relative to most other sectors where senior governments have significant authority, local governments have substantial authority and influence over urban land use.

Land use planning plays an important role in managing energy and emissions by influencing where Surrey residents live, and to a certain extent, where they and many others in the region work, shop, and recreate. Land use profoundly influences how people get to and from places, which has significant implications for energy and carbon. And while carbon and energy in buildings is fundamentally influenced by building type and design, the degree to which buildings are organized into complete and compact neighbourhoods influences potential for efficient, low carbon district energy.

The land use strategies presented here aim to focus growth in Town Centres and transportation corridors, diversify the building stock, and contribute to the public realm. The objective of these strategies is to set the foundation for sustainable land use that supports and enables strategies in the Plan's other sectors.

Strategies

A. Focused Growth
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
G. Grid Scale Energy Infrastructure Planning & Coordination

Key Indicators & Targets	2007	2020	2040
Population (people)	447,300	562,400 | +25%	739,000 | +65%
Employment (jobs)	141,000	213,000 | +51%	286,000 | +102%
Proportion of Housing Stock by Building Type (Single Family Homes | Townhouses & Rowhouses | High and Low Rise Apartments)	67%|17%|16%	58%| 21%| 21%	49%| 24%| 27%
⊙ Proportion of Residents Within 5 minute Walk (400 m) to Frequent Transit Stations (%)	51%	61% | +10%	72% | +21%
Average Resident Distance to Employment in Region	17.5km	16.6km | -5%	15.5km | -11%

Annual performance relative to 2007 unless indicated. ⊙ Key Targets

A. FOCUSED GROWTH

BACKGROUND

This strategy focuses employment and residential growth in transportation corridors and mixed-use nodes so that residents and workers are located closer to transit and services. 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.

This land use strategy assumes that a full light rail and bus rapid transit network will be available by 2020. A full network includes:

- Light Rapid Transit (LRT) on King George Boulevard linking City Centre to South Newton and terminating at Highway 10; with Bus Rapid Transit (BRT) connecting at Highway 10 down King George Boulevard and 152 St. to White Rock Centre;
- LRT on 104 Avenue linking City Centre to Guildford Town Centre and terminating at 156 Street; and
- LRT on Fraser Highway linking City Centre with Fleetwood Town Centre and Clayton to a terminus at Langley City.

It is possible that more growth than expected will locate close to attractive, convenient, fast rapid transit service, which would further reduce energy demand and GHGs.

Focused Growth & Rapid Transit

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

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 transit use and active transportation. This linkage is explored further in the Transportation strategies.

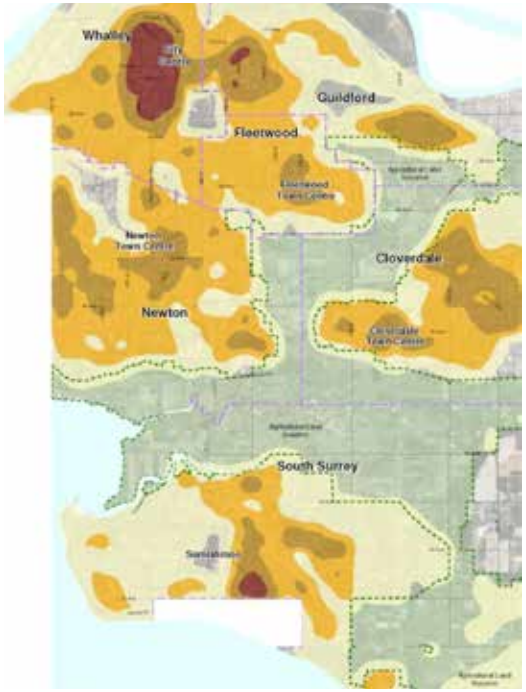


Figure 15: Population Distribution in 2040: Population will be concentrated in Surrey City Centre, Town Centres, and transportation corridors.

RECOMMENDATIONS

Use the Official Community Plan and secondary plans to shape growth that supports 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 to encourage 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 on pg. 45) to support medium to high density residential and commercial growth to strengthen 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 with "invisible density" such as secondary suites, coach/laneway/garden houses, townhouses, and ground-oriented multiplexes (2-5 units).

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.

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 NCPs.
   - 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 integrating 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 and Town Centres or in Frequent Transit Development Areas.
- Encourage large employers interested in business parks and industrial lands to locate in northwest Surrey close to transit and higher residential populations. Encourage less employment-intensive development in southern Surrey business parks and industrial lands.

Table 4: Key Growth Assumptions by Major Land Use Type

Planning Area	Indicator	Base Year 2007	2040
Surrey City Centre	Housing and Employment Density (Dwelling Units per Hectare | Employees Per Hectare)	20 UPH | 20 EPH	97 UPH | 92 EPH
	Share of New Residential Growth (% of New Dwellings | % of New Population)	5% | 4%	21% | 18%
	Share of Total Residential Population (% of Total Surrey Population)	6%	10%
	Proportion of Housing by Building Type (% Multi-Family | % Single Family)	100% MF	100% MF
Town Centres	Housing and Employment Density (Dwelling Units per Hectare | Employees Per Hectare)	15 UPH | 21 EPH	64 UPH | 65 EPH
	Share of New Residential Growth (% of New Dwellings | % of New Population)	12% | 11%	10% | 8%
	Share of Total Residential Population (% of Total Surrey Population)	9%	8%
	Proportion of Housing by Building Type (% Multi-Family | % Single Family)	96% MF | 4% SF	100% MF
Greenfield Neighbourhoods	Housing and Employment Density (Dwelling Units per Hectare | Employees Per Hectare)	5 UPH | 2 EPH	21 UPH | 8 EPH
	Share of New Residential Growth (% of New Dwellings | % of New Population)	8% | 11%	17% | 18%
	Share of Total Residential Population (% of Total Surrey Population)	5%	9%
	Proportion of Housing by Building Type (% Multi-Family | % Single Family)	42% MF | 58% SF	63% MF | 37% SF
Frequent Transit Network Corridors	Housing and Employment Density (Dwelling Units per Hectare | Employees Per Hectare)	20 UPH | 21 EPH	55 UPH | 33 EPH
	Share of New Residential Growth (% of New Dwellings | % of New Population)	7% | 6%	17% | 15%
	Share of Total Residential Population (% of Total Surrey Population)	16 %	12 %
	Proportion of Housing by Building Type (% Multi-Family | % Single Family)	54% MF | 46% SF	100% MF

UPH: Units per Hectare | EPH: Employees Per Hectare | MF: Multi-Family | SF: Single Family.
**Population does not add up to 100% as some parts of the City do not fall under these major planning areas. [1]2007 new dwellings is based on 2001-2007 data.*

B. COMPLETE, COMPACT, CONNECTED CORRIDORS

BACKGROUND

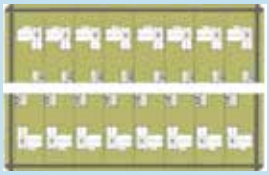
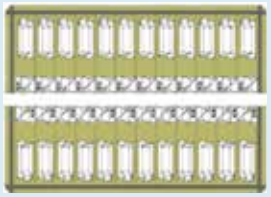
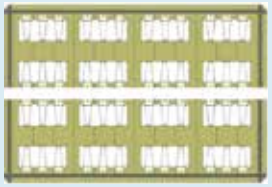
Reducing dependence on carbon-based transportation requires the integration of land use, transportation, and infrastructure planning. High speed, convenient, low carbon mobility across large regions necessitates rapid transit. Rapid transit success is correlated with higher densities of jobs and residents within walking distance to transit.

Where employers choose to locate is also strongly influenced by high quality transit. According to Jones Lang LaSalle, office space within 500 metres of SkyTrain stations has a 3% vacancy rate in Surrey while office space more than 500 metres from SkyTrain has a 25% vacancy rate. A strong district energy network, and the energy security that it provides, also requires higher high residential density.

Attracting residential density and diversity requires diverse housing tenures, types, sizes, and costs. It also requires the availability of attractive amenities and places such as parks, plazas, and community centres. Land use planning, growth management, and urban design are key to fostering housing diversity and vibrant places. Aligning all of these elements also requires significant collaboration between the development community, TransLink, senior governments, diverse community organizations, and others.

Table 5: 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	UHP[x]	Distribution	Aesthetic	Transit Type[Y]
Single Family	• Single detached dwellings	10-20 SF density			Basic Services
"Hidden Density"	• Compact single detached houses • Single family houses with suites • Laneway homes • Larger Single family houses with 3-4 units	20-86 ~3x SF density			Rapid Transit Services
Semi-Detached	• Duplex, Rowhouse, Townhouse	40-125 ~5x SF density			
Low Rise Apartments	• Low rise apartments of up to 4 stories • Stacked townhouses	40-300 ~10x SF density			Typical continuum for service type by residential density
Mid to High Rise Apartments	• Mid and high rise apartments 5-50 stories	250-800 ~25x SF 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 Frequent Transit Network (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 to optimize development patterns that strengthen the success of rapid transit and district energy.
    - Encourage complete, compact, connected development up to 400 metres on either side of proposed rapid transit lines. 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.

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 and 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 and Surrey's Official Community Plan and Regional Context Statement for higher density residential, commercial, and mixed use locations along TransLink's Frequent Transit Network.

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). Support appropriate single family home-like amenities such as safe play areas and food growing opportunities within or nearby developments.
- Focus highest residential densities adjacent to transit stations, reducing densities as distance from stations grows. Provide a diversity of housing types, such as apartment buildings close to stations and townhouses, multiplexes duplexes and single-family homes with suites farther away from stations.
- 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 buildings in their present forms or allow new developments with a requirement to build 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 mixed-use nodes and then transportation corridors.

- Encourage mixed-use buildings with retail, office, and residential uses.

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

- Continue City-led upgrades to street design and public amenities (e.g. parks and community centres) along priority corridors and in priority areas to attract residents, businesses, developers, and senior government investments.
- 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 dwellings smaller than conventional large-lot single detached houses and includes secondary or basement suites, garden suites, and coach houses. In multi-family buildings, policies typically focus on less conventional and 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 also 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, 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, and 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. see Local Incentive strategy 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.

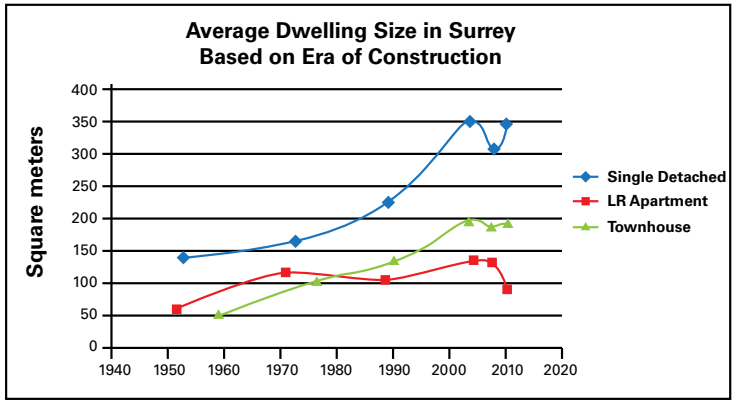


Figure 16: Average Dwelling Size in Surrey has risen since the 1950s, like most of Canada. Reduction in family size is also driving energy demand. Surrey's average family size has stabilized over the last decade and is higher than the Canadian average.

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.

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 suite for a renter.

D. LOW CARBON DEVELOPMENT PERMIT AREAS

BACKGROUND

Development Permit Areas (DPAs) have significant potential for managing carbon and energy in buildings as well as considerations for transportation, waste, and exterior lighting. Many measures can provide energy savings for owners and can be implemented with low to no construction cost.

RECOMMENDATIONS

1. Create Low Carbon Development Permit Area guidelines.
    - Develop passive guidelines to advance building efficiency (see next page).
    - Include guidelines to support high efficiency exterior lighting for buildings, private streets, and parking areas.
    - Include sustainable transportation guidelines such as bike parking, bike and pedestrian pathways, 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 this is addressed by other bylaws).
    - Consider developing neighbourhood-specific guidelines to address unique opportunities. Focus in particular on high growth neighbourhoods.
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 training support.
3. Integrate Low Carbon Development Permit Area guidelines into the Sustainable Development Checklist Update strategy (below in this section) and Capacity Building strategy for builders, developers, and key staff (in the Buildings section).

Development Permit Areas

A Development Permit Area (DPA) is a land use implementation tool that applies to a specific area in a community.

DPAs lay out specific objectives that developments must achieve and flexible guidelines to achieve them.
DPAs address a number of legislatively defined purposes such as safety, walkability, and farmland protection. The Local Government Act was recently amended so that DPAs cover energy and water conservation and GHG reduction. While DPAs can apply specific objectives for elements on the exterior of buildings, they cannot regulate elements inside buildings.

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 for developers and can even be cost saving measures.
DPAs can also address important site-level sustainable transportation opportunities such as pedestrian and bike infrastructure and network design considerations.

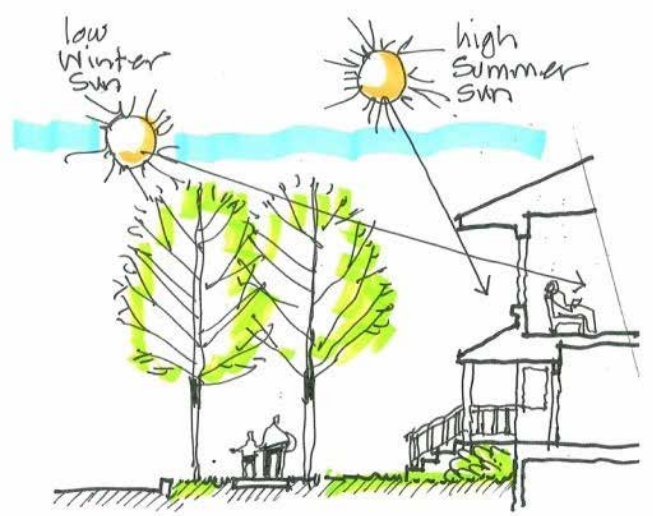


Figure 17: Solar access: Use shading and deciduous trees to maximize solar access for light and heat in winter and minimize in summer. (Illustration credit: Golder)

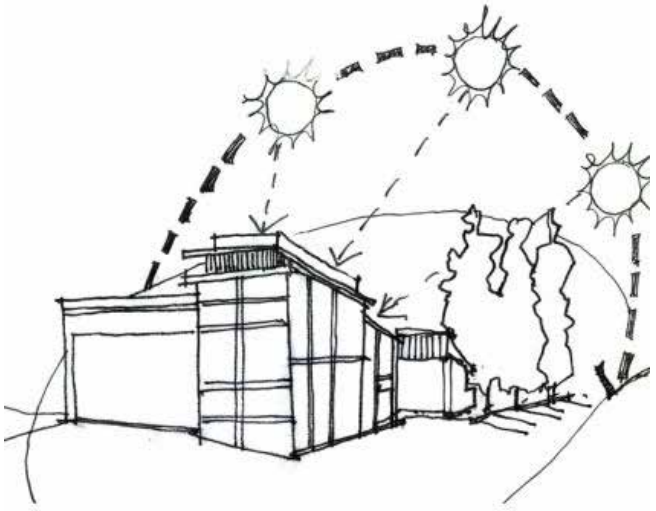


Figure 18: Solar orientation: Orient buildings to maximize solar access for heating and lighting. (Illustration credit: Golder)

E. NEIGHBOURHOOD SUSTAINABLE ENERGY PILOT

BACKGROUND

Neighbourhoods can be a good 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 help stakeholders develop understanding and acceptance of new strategies as well as provide information for refining and more broadly applying strategies. Neighbourhoods with higher real estate demand can offer unique opportunities for innovation and monitoring. East Clayton was a neighbourhood-scale urban design pilot that experimented with new housing forms, street designs, and stormwater management. The experimentation yielded many lessons and some of these innovations have been applied 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. Many strategies from various sectors in this Plan are good candidates for pilot projects.
    - Collaborate with appropriate strategic partners to implement pilot projects, such as builder and developer industry associations, financial institutions, utilities, and 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 Integrated District Energy Policy & Planning Actions
Solid Waste	Zero Waste Residents, Businesses, & Institutions Zero Waste Construction & Deconstruction

F. SUSTAINABLE DEVELOPMENT CHECKLIST UPDATE

BACKGROUND

Surrey's existing Sustainable Development Checklist (SDC) provides a solid foundation for guiding sustainable practices in development and design. Integrating capacity building, financial, and regulatory strategies from the transportation, building, and waste sectors into future SDC updates 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 to identify sustainability practices that could be considered. It also gives opportunities for staff and Council to recommend additional measures. A second SDC stage focused on Building Permit applications is in development. This strategy encourages a third stage during the Occupancy Permit. One of the unique opportunities at this stage is to encourage building commissioning. Commissioning is a post-construction inspection that verifies and documents that buildings are performing to defined objectives and criteria. According to ASHRAE, an organization that produces energy standards for large buildings, the inspection typically finds $4 of operational savings for every $1 invested in the inspection.

RECOMMENDATIONS

The SDC could be used as a high level guide to assist developers and builders integrate carbon and energy management strategies as well as broader sustainability priorities into their projects. The checklist could follow the developer or builder through the development process and provide appropriate guidance by building type (e.g. wood frame buildings or large residential and commercial concrete buildings) and specific area (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 development beyond business as usual, for setting realistic targets, and for tracking progress. The current SDC asks which standards are being pursued. An updated SDC would quantify some actions to provide a performance-based assessment of applications. This assessment can also provide a basis for discussing improvements. SDC updates should also consider upcoming changes to the BC Building Code to help developers prepare.

Key actions in the SDC update include:

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 project cycle of the construction process. Provide accurate and compelling information on the benefits of building commissioning.

3. Update the SDC to include key performance benchmarks, guidance on suggested targets, references to appropriate certification programs, and information on incentives (e.g. BC Hydro's PowerSmart for New Homes program) that will help builders and developers meet these targets.

4. Evaluate the opportunity for implementing Stage 2 (Building Permit Application) and Stage 3 (Occupancy Permit) of the SDC to provide guidance through the entire development process.

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 at least once per year.

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

Stage 1

Land use Development Application

Currently Required

Carbon & energy update proposed

Stage 2

Building Permit Application

In Development

Proposed carbon & energy content

Stage 3

Occupancy Permit

Proposed addition focussing on carbon & energy

G. GRID SCALE ENERGY INFRASTRUCTURE PLANNING & COORDINATION

BACKGROUND

The City can facilitate infrastructure coordination and planning with energy utilities and other related stakeholders, such as property developers, on municipal and energy infrastructure maintenance and construction projects. This can reduce customer disruptions and improve cost effective and timely delivery of energy and municipal services to households and businesses.

While this Plan and senior government and utility action will lead to more efficient energy use in buildings, energy demand will still grow 50% due to the City's substantial population and employment growth (see Table 6). Growth in energy demand will require expansion of local energy infrastructure, such as pipes and compressor stations for natural gas and distribution lines and substations for electricity.

Table 6: Energy Demand (GJ) in Buildings

Sector & Sub-Sector	Energy Demand (GJ)		
	2007	2020	2040
Total Buildings	23,617,000	29,200,000	35,310,000
Residential Buildings	15,327,000	18,781,000	22,065,000
ICI Buildings	8,290,000	10,419,000	13,245,000

Table 6: Energy Demand (GJ) in Buildings includes natural gas and electricity, and excludes local renewable energy (notably disttrict energy)

Efficient Infrastructure Utilization and Infrastructure Coordination

Coordinating maintenance and construction of infrastructure can minimize costs and disruptions as well as enable the City and energy utility companies to more effectively meet the demands of existing and new residential and commercial customers. Focusing residential and employment growth in areas currently served by energy infrastructure also improves infrastructure utilization and reduces service costs.

RECOMMENDATIONS

1. Liaise with energy utility companies on major land use decisions, real estate developments, and municipal infrastructure projects to support effective long- and short-term planning and coordination; to minimize disruption; to support cost-effective maintenance and upgrades of existing energy infrastructure; and to efficiently deploy new infrastructure, including Rights-of-Way to service new development.
    - Convene a regular meeting with energy utilities for planning and coordination.

2. Focus growth around lands serviced by existing power and natural gas distribution networks to maximize infrastructure utilization and help manage service delivery costs.

From the Columbia to the Kettle: BC's Power System

When a Surrey household plugs in a kettle, chances are that the power has travelled thousands of kilometers through an extensive power system that includes generation, transmission, substations, and local distribution.

Generation: Some power used in Surrey is generated in Southwestern BC in small hydroelectric projects. Most is generated from hydroelectric dams along the Peace and Columbia Rivers.

Transmission: Transmission lines move high voltage electricity from generating stations to distribution substations, where electricity is transformed to lower voltages for customers. BC Hydro has 18,000 kilometres of transmission lines, enough to go from the West coast to the coast of Labrador and back and up to the Arctic coast.

Substations: Substations reduce high voltage power from the transmission system to lower voltage power suitable in a local area for homes, businesses, and industrial uses.

Distribution: Electricity that is at a safe and usable voltage is carried through distribution lines into meters in homes, businesses, and other buildings.

Power for the People, Power for the Plug: Population and EVs Drive Local Electricity Demand

Despite efficiency measures and fuel switching, total building electricity demand grows due to massive growth in buildings and floor space in residential and commercial sectors. Another contributor to growing electricity demand is transportation electrification. Today transportation accounts for almost no electricity demand but by 2040, it will grow to 10% of the community's total consumption (see Figure 19).

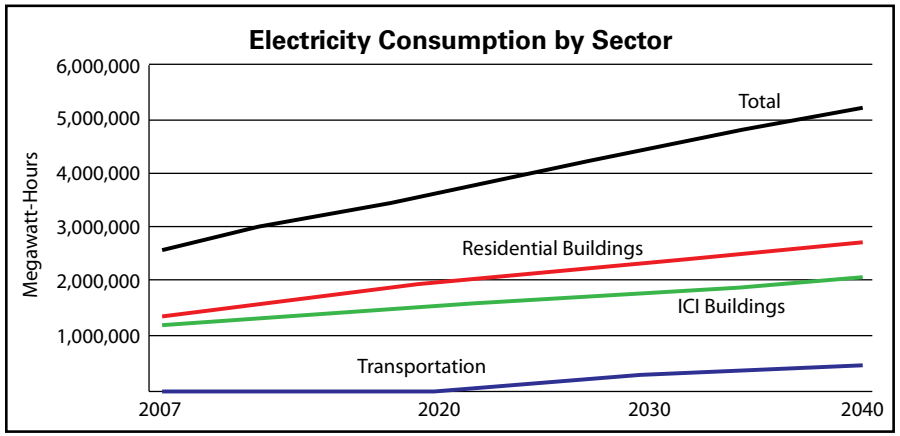


Fig 19: Electricity Consumption by Sector With CEEP Implementation

ADDITIONAL LAND USE OPPORTUNITIES

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

- Growth Management Plan Continuous Optimization: There is an opportunity to strengthen GHG and energy management in the building and transportation sectors by further focusing residential and commercial growth.
- These opportunities could come in the form of real estate market shifts, gasoline price increases, or major rapid transit investment decisions. On a continual basis, assess opportunities to re-direct residential growth from outside major corridors and nodes to inside corridors and nodes. Further focused growth can support transit ridership, active transportation, congestion management, job creation, and transportation affordability.

2. TRANSPORTATION

In 2007, transportation accounted for 59% of Surrey's GHGs and 44% 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 (in the above Land Use section).

Transportation strategies build on land use strategies to support a high quality rapid transit network, extensive active transportation infrastructure, and diverse low emission vehicle opportunities for residents and businesses. The objective of these strategies is to accelerate a transition to attractive, low carbon transportation options.

These strategies also support other regional transportation plans, such as TransLink's Regional Transportation Strategy – Strategic Framework and Transit Oriented Communities Design Guidelines.

Key Indicators & Targets	2007	2020	2040
Per Resident Tonnes of Personal Transportation GHGs (tonnes/person)	2.1	1.5 | -29%	0.7 | -67%
Transportation Fuel Savings per Household Relative to Business As Usual ($/household)[x]	-	$230	$880
⊙ Household Vehicle KM Travelled (km)[y]	20,800 km	20,000 km | -4%	19,000 km | -9%
Household Transit KM Travelled (km)[z]	3,700km	4,000km | +8%	5,000km | +33%
Proportion of Trips Taken by Transit (% of all trips)	9%	17%*	50%*
Transit Route Network Length (km)	286	324 | +13%	382 | +34%
Arterial Road Network Length (km)	583	624 | +7%	673 | +15%
Average Intersection Density Per Road KM (# of intersections per one way road)	7	8.9 | +27%	11.7 | +67%
⊙ Bicycle Route Kilometres (km)	286km	450km | +57%	710kmx | +148

Key Indicators & Targets (continued)	2007	2020	2040
Proportion of Residential Population within 400 m of Bike Routes (%)	67%	78% | +16%	97% | +44%
Passenger Vehicle Ownership Per Capita (cars/person)	0.5	0.47 | -6%	0.37 | -26%

- All % changes are annual performance relative to 2007. - ⊙ Key Targets [x] See Energy and Emissions Forecast section for explanation of Business As Usual.

[y] This includes emissions from personal vehicles as well as public transit

[z] 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.

** The 2020 and 2040 targets are based on regional targets, as Surrey-specific targets are not available for this indicator. These targets are included as information and will change in the future as Surrey-specific transit targets become available. The 2020 target is the region-wide transit target in the Province's 2020 Transit Plan. The 2040 target is the region-wide target for walking, cycling, and transit trips in TransLink's 2045 Regional Transportation Strategy, since no modal breakdown is available. Hence it is much higher than it should be.*

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 & 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. Several key assumptions influenced strategy development:

- 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

COMMUNITY CO-BENEFITS

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

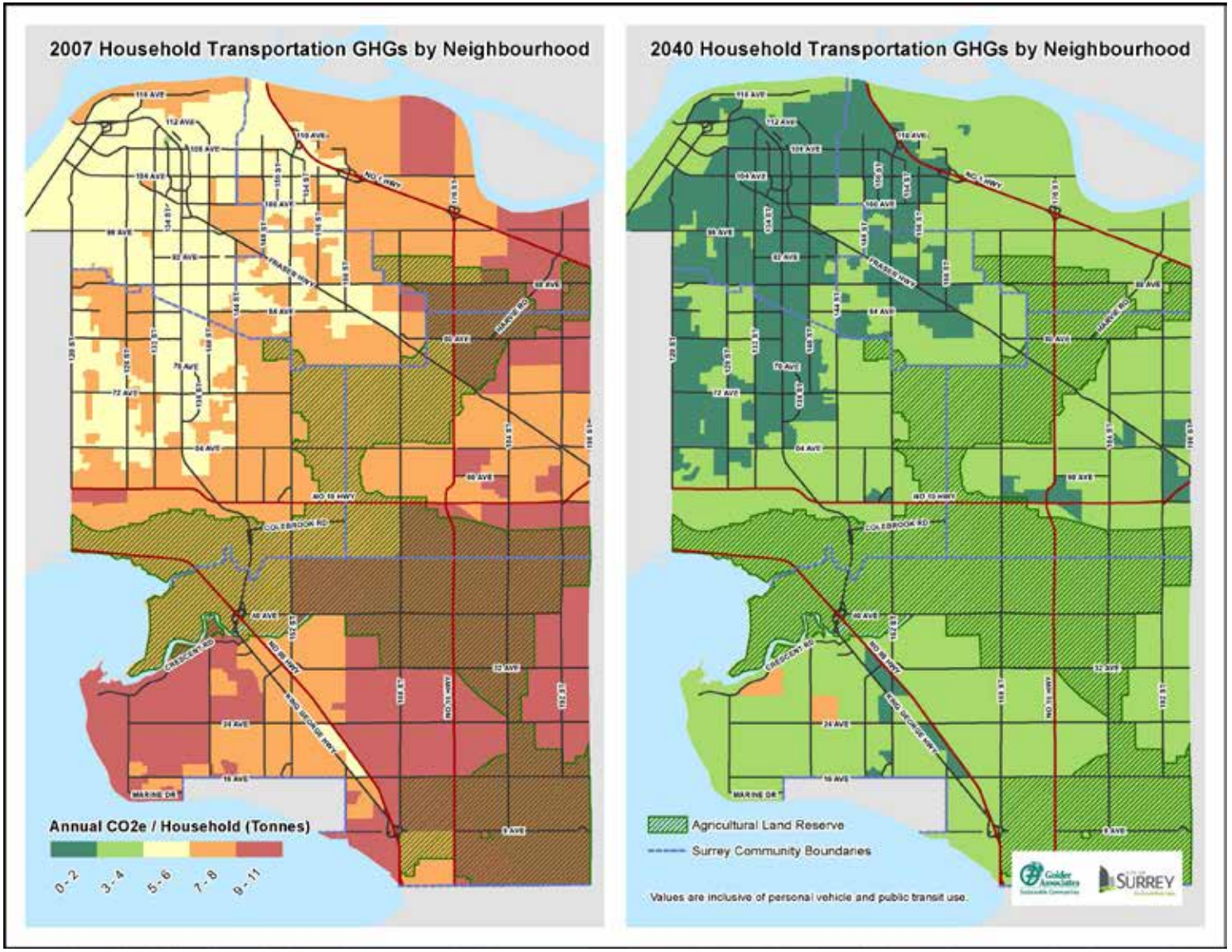


Figure 20: Annual Household Transportation GHGs drop 27% due to increased vehicle efficiency and electrification, shifts to lower carbon transportation modes (transit, walking, cycling) and more residential and commercial development along transit corridors, The lowest emissions are in higher density areas well served by high quality transit and located close to employment and local services.

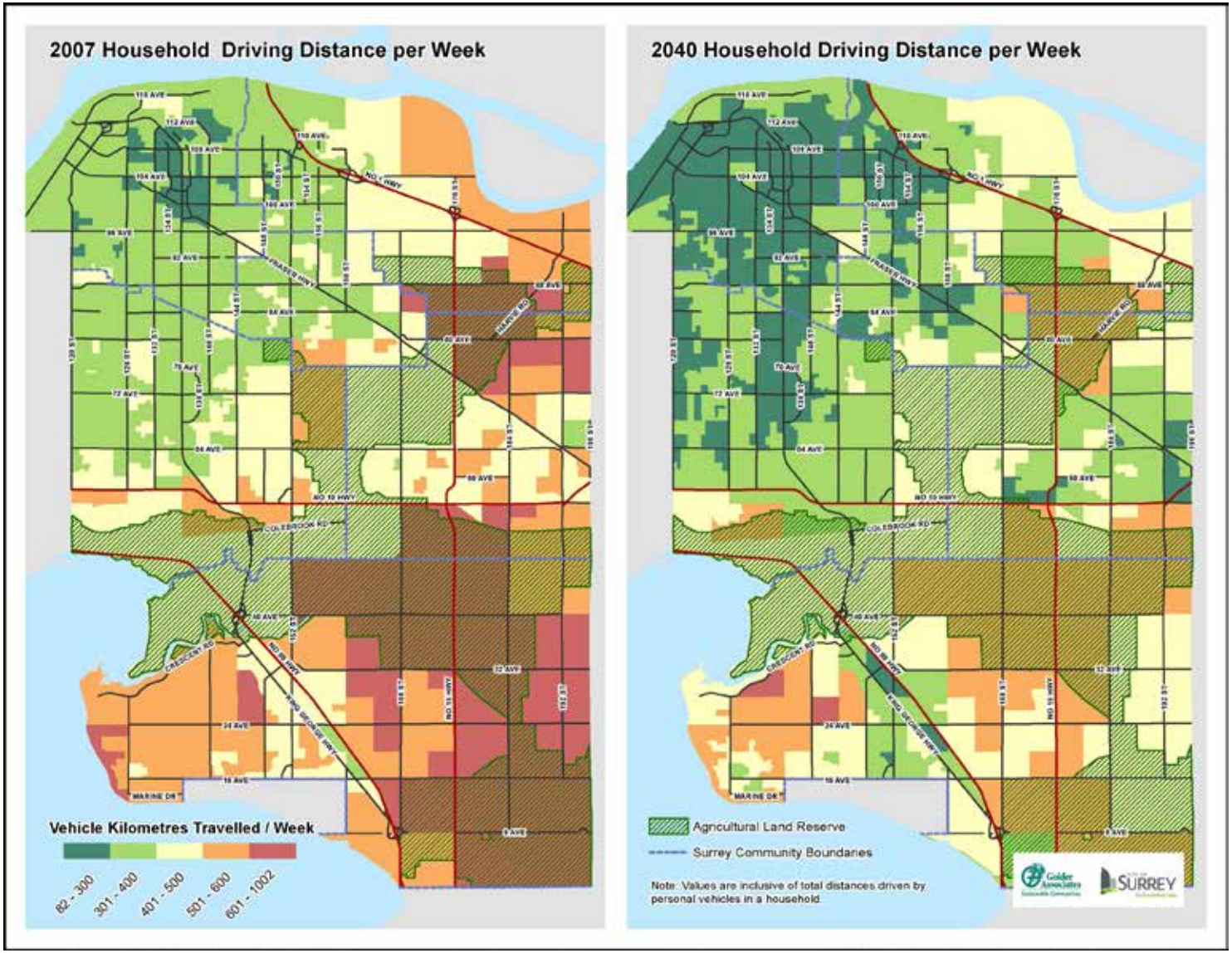


Figure 21: Weekly Driving Distance Per Household drops 7% due to more transit use and more walking and cycling. The lowest emissions are in higher density areas well served by high quality transit and located close to employment and local services.

2.1 TRANSIT STRATEGIES

In 2007, personal transportation was Surrey's largest source of GHGs, accounting for 38% of the City's emissions. The following strategies focus on shifting trips made by cars to transit. 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's vision for Light Rapid Transit (LRT) supports significant modal shift toward transit, which will play a key role in achieving significant GHG reductions.

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

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. According to Jones Lang LaSalle, 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.

Transit & Household Spending

After housing, transportation is the largest household expense. An average BC household spends more than $10,000 annually on transportation. Gasoline prices are projected to increase 220% from 2007 to 2020, which will measurably impact 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 complete and compact neighbourhoods well served by transit are estimated at an average of $1,400 – 1,800 per household per year in Surrey. Savings rise with increased density.

RECOMMENDATIONS

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:
   - 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; and
   - Fraser Highway from City Centre through Fleetwood Town Centre to Langley City.

Figure 22: 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)

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. Focus on LRT from City Centre to Guildford, Langley City, and South Newton; and Bus Rapid Transit from South Newton to White Rock City Centre. (See Figure 22 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. Tools could include one or more of the following options (also see the Carbon Pricing Revitalization & Clean Air and Healthy Communities Fund strategy in Cross Cutting Strategies section, below):
   - An equitable, regional road pricing regime;
   - An updated provincial carbon tax that would fund low carbon priorities such as public transit in Greater Vancouver;
   - A special transportation sales tax;
   - A vehicle registration surcharge;
   - An expanded regional parking tax to include parking spaces;
   - Balanced provincial and regional spending on public transit and active transportation relative to road, bridge, and tunnel spending; and
   - A "Prosperity" Fund for Low Carbon Community Development established using Liquefied Natural Gas Royalties.

B. BUS SERVICE IMPROVEMENTS

BACKGROUND

While rapid transit will provide significant benefits, improving the quality and extent of bus services is critical for enhancing mobility for residents and employers in Surrey and to reducing greenhouse gas emissions in the transportation sector.

RECOMMENDATIONS

1. Work with TransLink to increase bus service outside rapid transit corridors 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 Frequent Transit Development Areas (FTDA) designation (see sidebar) and Frequent Transit Network corridors to support increased transit mode share. (See rapid transit and secondary corridor recommendations in the Complete, Compact, Connected Corridor strategy in Land Use section, above.)

Bus Service & Infrastructure in Surrey

As of the end of 2012, the City had 1,332 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); and
- White Rock Centre (10 routes).

Bus stop accessibility and amenities - 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 an FTDA may make new development more desirable and easier to market.

2.2 ACTIVE TRANSPORTATION & TRANSPORTATION DEMAND MANAGEMENT

Active transportation covers all forms 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 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.

Table 7: Select Health Indicators for Surrey

	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%	21%	Equal
Dementia	5.4%	7%	Lower

While the major imperative of this Plan is carbon and energy management, public health is a key motivation for expanding active transportation. Obesity increases 6 percent for every hour of driving per day. Walking and cycling for transportation reduces obesity risk.

Table 7 shows select health indicators for Surrey in 2010. While overall life expectancy in Surrey is similar to the BC average, the prevalence of some key health issues, including diabetes and cardiovascular disease, are higher. Street and neighbourhood design and infrastructure, such as proximity to key destinations that make walking and cycling easy and safe lead to more exercise and help reduce the rates of these diseases.

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

Active Transportation and Affordability

The most cost effective modes for transportation are walking and cycling. It is estimated that households can save over $5,000 a year by owning one less vehicle. For households that purchase new vehicles, this figure jumps to between $11,000 and $14,000 annually

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 cycling targets are:

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

C. INTEGRATED ACTIVE TRANSPORTATION IMPROVEMENTS

BACKGROUND

Active transportation has significant potential for reducing greenhouse gas emissions, protecting residents from rising transportation prices, and increasing health benefits. Good cycling and walking infrastructure also supports access to public transportation and increases transit use. Lastly, more people getting around by foot and bicycle can help ease traffic congestion.

RECOMMENDATIONS

1. Build on the existing Walking and Cycling Plans' strategies for education and outreach to promote interest in and awareness of pedestrian and cycling networks, health and consumer benefits, and City cost savings from reduced traffic congestion.

2. Build on the existing Walking and Cycling Plans' strategies for enhancing pedestrian and bicycle connectivity through existing suburban streets and cul-de-sacs.

3. Increase active transportation connectivity in new greenfield developments through the use of grid pattern street networks and connections through large individual developments.

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 such as neighbourhood routes, greenways where appropriate, and separated bike paths; and end-of-trip facilities for key commercial, institutional, and transit destinations.

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 the Low Carbon Development Permit Areas strategy under Land Use, above.)

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

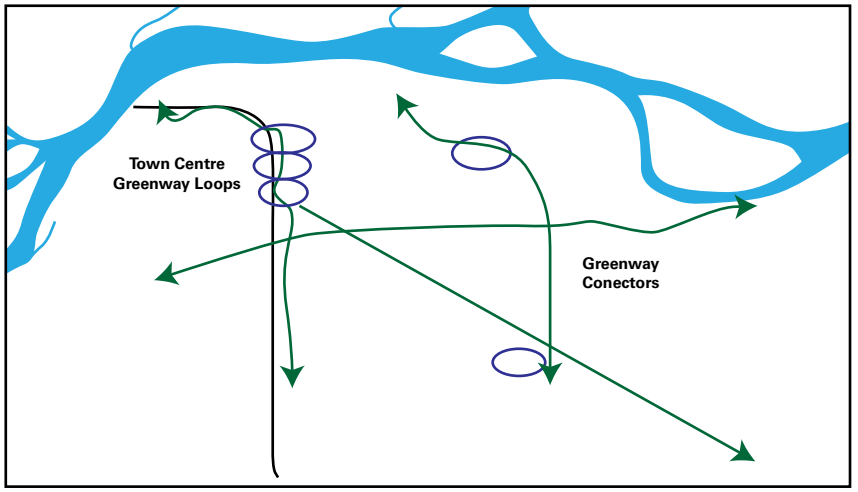


Figure 23: Major Greenways in Surrey (Image: City of Surrey)

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 kilometers of a Town Centre - a 20 minute trip for cyclists in average conditions.

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, and high-density bike route network with good connectivity supported with good end-of-trip facilities. Integrating electric bike (E 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 below). This Plan aims to provide facilities for the "interested cyclist," representing 40% of the population, and the "regular cyclist," representing 25% of cyclists.

RECOMMENDATIONS

1. Strengthen diversity, density, and quality of the bicycle network, including a system and design to support All Ages and Abilities (Triple A) routes.
    - Increase and improve the bicycle network along all major corridors in the 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 and from and within City Centre and Town Centres, prioritizing segregated facilities (e.g. separated bike paths, cycle tracks, and greenways).
    - Prioritize network and design improvements for accessing major 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 as well as shower and change room facilities for employees in commercial buildings) and access to basic 110 volt electrical outlets for E Bike charging.

   - Amend the Zoning Bylaw to require end-of-trip facilities and some allocation of electrical outlets for E Bike charging in new multi-unit residential buildings for residents and visitors, and in commercial buildings for employees and visitors.
   - Establish end-of-trip bike facilities and electrical outlets for E Bike charging in all public buildings for employees and visitors where appropriate.
   - Increase the density of safe, weather-protected end-of-trip bike facilities in City Centre and Town Centres and near 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 walking and cycling networks and end-of-trip facilities at transit hubs and providing bike racks on all buses.

3. Working with the School District, improve safe cycling and walking access to schools and end-of-trip facilities for students and staff.

4. Establish a consistent and clear bicycle wayfinding system that is integrated with the public transit system and supported by digital tools and physical maps.

Cycling Plan

The Plan (2012) has an ambitious vision for a bicycle network:

- 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.

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 encourage people to live and work closer to key destinations and high quality transit and that establish high-quality transit and key destinations closer to more people create 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 where many neighbourhoods were built without sidewalks or consideration for walking.

Pedestrian infrastructure in Surrey is delivered mainly through land development projects as well as a variety of capital projects. The City's Walking Plan creates a more coordinated approach between the different delivery systems to add value for projects.

RECOMMENDATIONS

1. Focus walking infrastructure improvements in higher density mixed-use areas, especially in areas adjacent to the Frequent Transit Network.
    - Phase in sidewalk coverage within 400 m of key destinations, transit stations, and the Frequent Transit Network.
    - Create more pedestrian crossings and signals in City Centre and Town Centres.
    - Enhance the quality of sidewalk treatments within pedestrian precincts.

2. Update the Sustainable Development Checklist and use Development Permit Areas to promote active transportation infrastructure and network design in the private realm. (See the Low Carbon Development Permit Areas strategy under Land Use, above).

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 (TDM) 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. In combination with other strategies that increase convenience and reduce relative cost, better information can increase the use of transit, walking, cycling, and carpooling.

Price signals also 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 made optional (for example, by unbundling parking costs in developments) consumer decisions change. Measureable changes can only be expected when good alternatives are readily available.

TravelSmart

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

For businesses, TravelSmart offers site audits, company presentations, employee engagement, and telework support. (travelsmart.ca for more information)

Carpooling and Ride Sharing

Jack Bell Rideshare is a registered charity funded by TransLink and BC Transit. It provides 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 preferred parking for carpool groups (i.e. two or more passengers). Some employers also offer reserved or discounted carpool parking.

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, for example, with anti-idling outreach in schools.
    - Encourage transportation demand management policies for large employers and explore how to require these policies as a rezoning condition when large employers relocate. TDM policies and plans should be comprehensive (e.g. include 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. Pricing and supply should be sensitive to cost-effective, safe, convenient options.
    - Evaluate opportunities to adjust parking prices in City Centre 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 and provincial price tools. (See the Rapid Transit Development strategy, above.)

2.3 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 (LEV) 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 for 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 the unique needs of these diverse groups.

G. GREEN FLEET MANAGEMENT & 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 that 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 that 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.

Low Emission Vehicles

Low Emission Vehicles (LEVs) 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.

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.

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 significant shares of their budgets. 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.

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:
   - Businesses with fleets or professional drivers 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 programs.
   - Incentives could be a rebate or time saver that involves extending the period of a license. A fee reduction could be revenue neutral by modestly increasing other fees.

Green Fleet Management and Training Programs

FleetSmart

FleetSmart, a program offered by Natural Resources Canada, offers free advising 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)

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

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).

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. 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 and 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 and emissions. 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 to facilitate discussions around the uptake of car sharing within the City.

2. Encourage car sharing by including dedicated on-street parking for car share vehicles in key neighbourhoods across the City, and by protecting 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 and 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 for owning a vehicle. Since ownership and insurance costs account for a majority of annual vehicle expenses, the marginal cost of driving encourages lots of trips and long distances by car.

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

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 and passing cost savings on to the developer and to condo owners.

Modo Co-op Car in Surrey
(Photo credit: City of Surrey)

I. LOW EMISSION VEHICLE INFRASTRUCTURE DEVELOPMENT

BACKGROUND

Although strategies that reduce automobile dependence are higher on the sustainable transportation hierarchy, the significant reductions in GHGs and air pollutants associated with new Low Emission Vehicles (LEVs) affords them a place in GHG reduction efforts. 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 materials, and natural gas.

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.

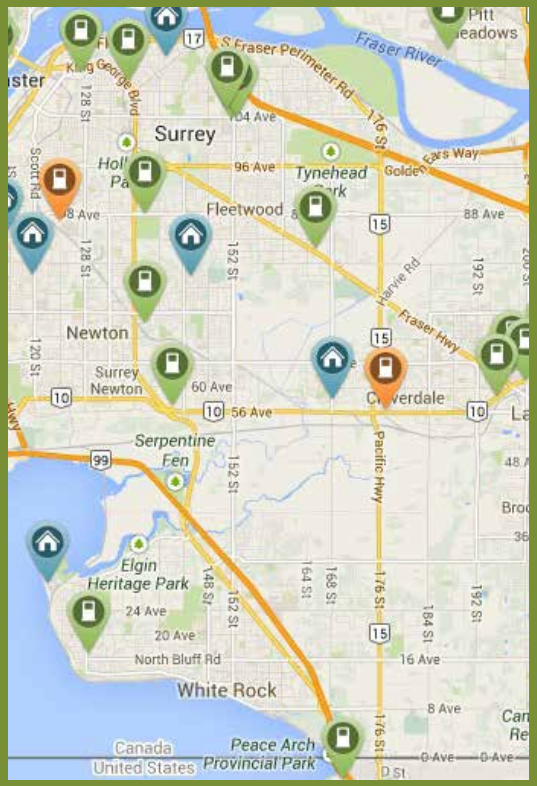
Surrey was also the first major city in Canada to host a free, publically accessible EV charging station at City Hall. There are also 14 new charging stations across the community.

Charging Station Network

Surrey has a growing network of level 2 charging stations installed by the City, by service stations, and by other businesses. 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.



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 practices 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.
- Consider a requirement for large new commercial and mixed-used developments with significant projected vehicle volumes 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.
- Consider a requirement for new multi-unit residential developments to have a combination of Level 1 charging outlets and conduit ready Level 2 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 as some accommodation for electric bike charging. These requirements could be met through an update to the Zoning Bylaw.

Electric Vehicles (EVs)

While they do not reduce congestion or the cost of supporting automobile transportation, vehicle electrification (e.g. plug-in hybrid electric vehicles – PHEVs – 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. 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.

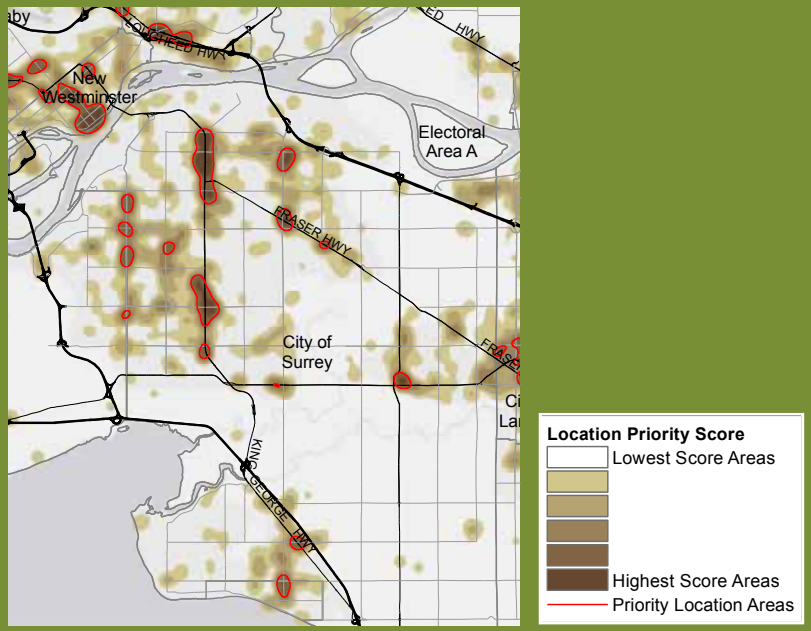
Efficiency and Emissions

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. 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 more effiecient 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 1,000 charging locations 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 directly installing Level 3 rapid charging stations.

Table 8: Charging Infrastructure Types

Charger Level	Rate (range per hour of charging)*	Electrical Requirements	Unit Cost	Electricity Cost (per hour)
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

Source: US Department of Energy, 2013

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 in 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 of fuel. Reducing idling is a win-win scenario for reducing energy use, local air pollution, and global greenhouse gases and for saving money.
- Focus on major opportunities where there is significant idling as well as high potential to engage target audiences with partners. For example, schools can engage school boards as well as youth ambassadors and parents. Efforts can be enforced at strategic locations such as school drop-off and pick-up areas.

3. BUILDINGS SECTOR

In 2007, buildings were responsible for approximately 37% of Surrey's total greenhouse gas emissions and 56% of energy use. Most GHG emissions from buildings are from natural gas combustion for space and water heating. More efficient buildings reduce energy use and GHG emissions as well as cut energy spending costs for residents and businesses.

The buildings strategies presented here aim to enhance the capacity of City staff and the construction industry to meet steadily rising building standards and to increase energy retrofit rates in residential, commercial, industrial, and institutional buildings. The objective of these strategies is to improve the energy and GHG emissions performance of new and existing buildings.

With appropriate policy and program design, energy retrofits in rental and social housing 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, constructing more efficient new buildings enables local developers and builders to meet higher standards driven by senior governments and keep up with technological innovations, competition, and consumer demand.

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. Basic Building Standards Strategy

Key Senior Government & Energy Utility Assumptions

Senior government and energy utility actions have a significant impact on GHGs and energy in buildings. The following key assumptions underpin strategies in this sector:

- The BC Building Code continues to increase energy requirements
- BC Hydro and FortisBC continue to provide incentives for energy efficiency and renewable energy, including community energy management
- Electricity prices and natural gas prices rise

Key Indicators & Targets	2007	2020	2040
Average Per Resident Tonnes of Personal Building GHGs (tonnes/person)	1.29	1.1 | -15%[X]	0.9 | -31%[X]
Average Per Resident Gigajoules of Building Energy Use (GJ/person)	35	33 | -6%[X]	30 | -14%[X]
Average Household Building Energy Savings Relative to Business As Usual[Y] ($/Household)	-	$40	$200
Community-Wide Building Power Conservation Relative to Business As Usual[Y] (GWh)	-	41GWh	434 GWh
⊙ Local Action Building Energy Retrofit Rate (% of all households)	1%	2.00%[Z]	2.00%[Z]
⊙ Energy Performance Beyond Typical New Construction in Milestone Year (% efficiency beyond typical new construction) [z]	-	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.*

[z] *This indicator refers to the actual energy performance of typical new construction and not to the energy requirements in the BC Buildings Code. Research shows that currently more than half of new buildings in the Lower Mainland are not meeting the Building Code. By improving average performance 10% beyond typical new construction, average building performance is assumed to meet projected improvements to energy requirements in the BC Building Code.*

- ⊙ *Key Targets*

COMMUNITY CO-BENEFITS

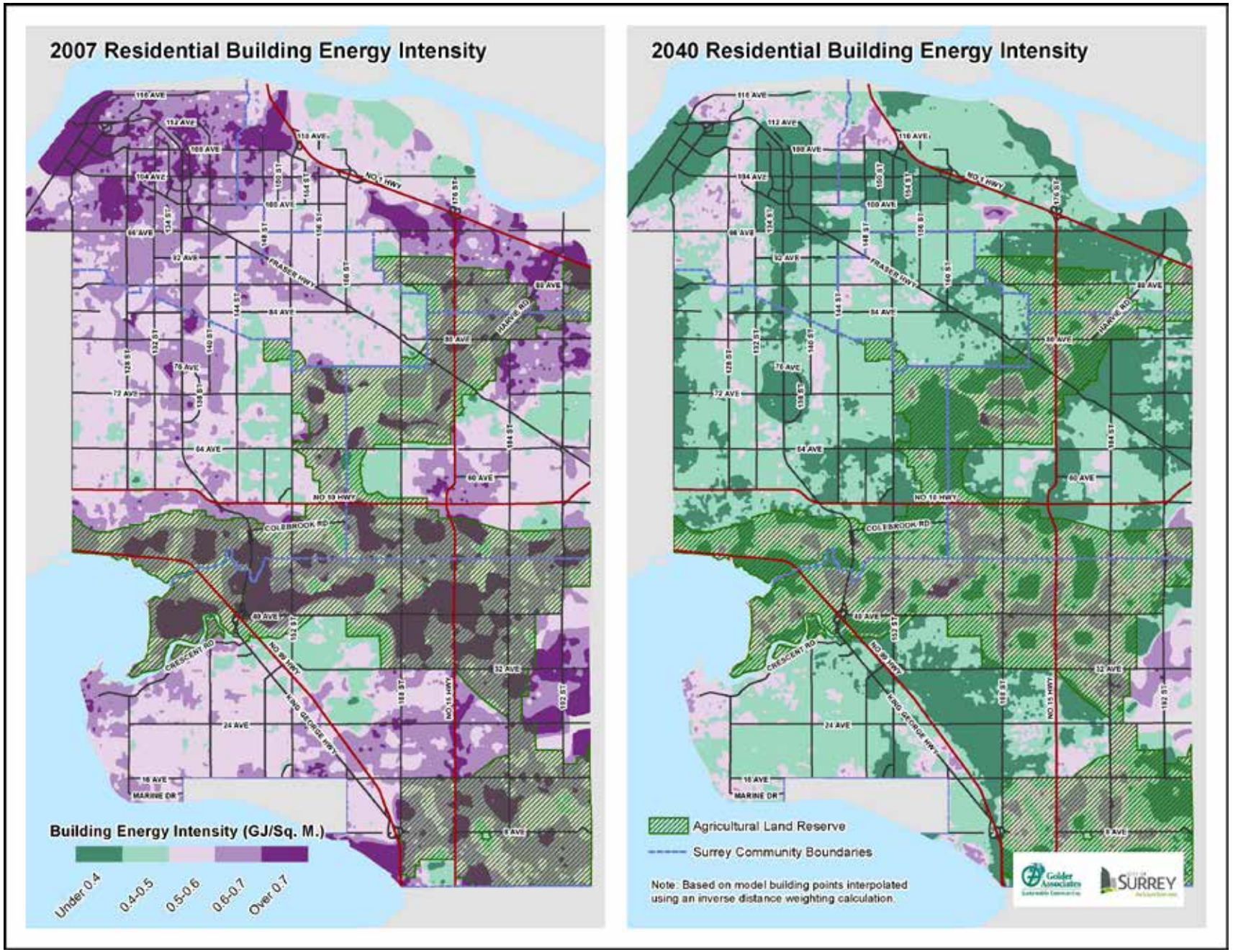


Figure 24: Building Energy Intensity: Intensity (measured in gigajoules per square metre of floor area) drops by 1/3 due to higher standards in senior government building codes, capacity building, local building retrofit programs, and incentives.

3.1 CROSS-CUTTING BUILDING STRATEGIES

A. CAPACITY BUILDING FOR LOW CARBON, HIGH EFFICIENCY BUILDINGS

Many barriers exist for constructing high efficiency, low carbon buildings and lack of knowledge is an important one. Capacity building is aimed at strengthening information, knowledge, and skills. Capacity building is a cross-cutting strategy that supports 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.

Primary Audiences

- Builders, Developers, Tradespeople, Designers, City Staff

Secondary Audiences

- Residential and Commercial Building Owners, Prospective Buyers and Renters, Building Managers, and Realtors (Residential and Commercial)

RECOMMENDATIONS

1. Raise awareness and support training and institution building for energy efficiency in new and existing buildings:
    - For builders, developers, tradespeople, and designers: Collaborate with energy utilities and construction, developer, and builder industry associations to deliver training programs. Fill key skill and knowledge gaps for improving energy and carbon management with a particular focus on complementing strategies in this Plan. Cooperating at the regional scale with Metro Vancouver could economize efforts. Consider diverse players in program design such as architects, engineers, and entry-level sub-trades such as crews installing air barriers and insulation. Delivery can include workshops, information sessions, promotion of third party educational programs, and incorporating relevant information in development and building 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.
    - For City staff: Coordinate with energy utilities, key construction, developer, builder industry associations, and City department heads to develop internal training for select staff groups on specific practice knowledge. Foster awareness of educational programs to promote to builders, developers, trades, and design teams. Avoid duplication and coordinate with the training efforts of related networks, such as the Building Inspectors.
    - Job creation: Evaluate the potential of working in partnership with social organizations and job creation agencies to develop a local job and skills development program for unemployed, underemployed, entry-level, and 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 leading builders, developers, architects, and engineers as well as leading businesses, home owners, and the public sector. The exercise would help normalize these best practices.

3. Explore opportunities for encouraging building owners and managers to benchmark the energy performance of their buildings. Benchmarking can help owners and managers understand building energy use, prioritize poorly performing buildings, and cut costs by making improvements.

3.2 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 depends on taking action to retrofit the existing building stock.

Retrofits can create local jobs, which is a major City priority. These jobs would be in construction and the building materials retail sector. Furthermore, insulation upgrades and window replacements for reducing drafts and water leaks can improve health, safety, and comfort in residential and commercial buildings.

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

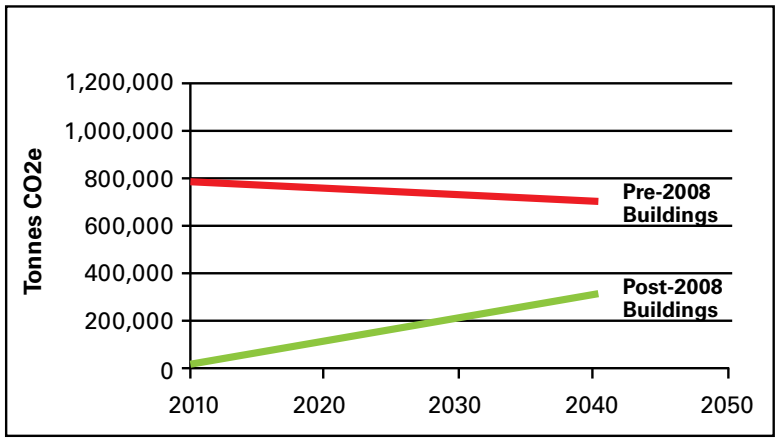


Figure 25: Surrey Community Annual Building Emissions Assuming No Municipal Action (Source: Golder)

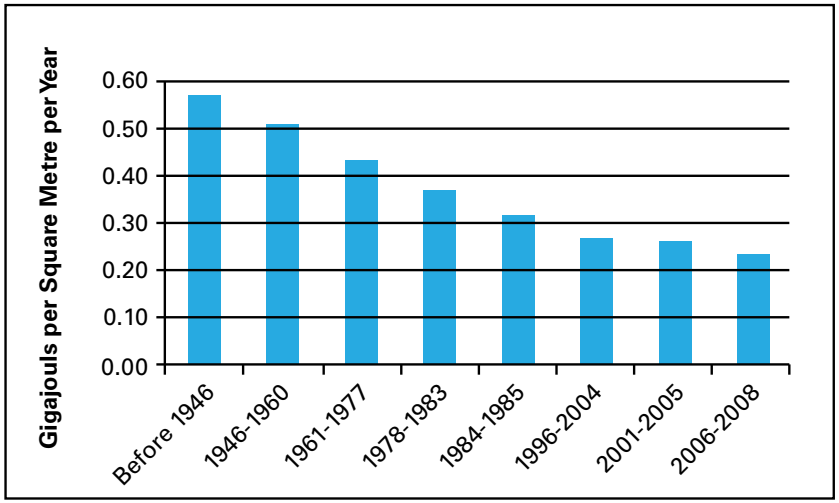


Figure 26: Heating Requirements for BC Single Detached Houses by Era of Construction (Source: Natural Resources Canada)

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 pilot programs for single family homes and program design consultation with rental and strata buildings in 2013.

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 them in distinct sectors (e.g. purpose-built rental buildings), or collaborating with energy utilities to develop similar initiatives that will generate significant savings and meet a community's unique needs.

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

The Efficiency Incentive Program offers incentives for audits and efficient or renewable energy equipment. The program is available to single family homes, townhouses, and rowhouses.

The LiveSmart BC Small Business Program currently provides small and medium-sized businesses with free energy efficiency audits, on-going support with upgrades, assistance with applying for rebates, and a recognition program for being improving energy efficiency.

B. THIRD PARTY RETROFIT PROGRAM INTEGRATION

BACKGROUND

Numerous efficiency retrofit programs are currently available and new ones are being developed. The City has significant potential to increase the uptake of existing programs due to low awareness in many markets and the City's unique access to builders, developers, and home and business owners through the Buildings Division.

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 with the Planning & Development Department to promote retrofits. Enable City staff to connect applicants with appropriate energy efficiency retrofit information and programs, optimizing efforts based on knowledge of building types and uses 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. Surrey Board of Trade, Chambers of Commerce, Business Improvement Associations, and other key organizations) to develop workshops, lunch and learns, and campaigns. Liaise with third-party organizations for funding and training opportunities.

3. Consider using business licenses to target retrofit program promotion for more energy intensive sectors (e.g. grocery stores, 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 improve 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 as well as training for building managers.

Commercial and Industrial Building Efficiency Incentives

BC Hydro and FortisBC offer programs for a range of commercial and industrial businesses. They provide free online tools to help businesses understand their energy use as well as funding for training staff, auditing facilities, and implementing more efficient technologies.

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

FortisBC Rebates:
fortisbc.com/Rebates

Business Area Campaigns

BC Hydro, FortisBC, and LiveSmart BC are partnering on a pilot project to assess the effectiveness of focusing on a single area and conducting door-to-door canvassing for incentive programs. The project 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. Energy retrofits can reduce energy costs and improve comfort, health, and safety for building residents. They also help maintain this building stock.

Affordable housing has less extensive incentive programs for energy improvements and a lower retrofit rate compared with single family homes. While third party promotion and modest capacity building strategies can augment single family retrofit rates, they are less effective for multi-unit rental buildings because of unique retrofit challenges such as split incentives between landlords and tenants, multiple decision makers, and more complex building technology. Focused efforts can help overcome these barriers to improving energy efficiency in affordable housing.

Figure 35: Rental Costs in Surrey in Fall, 2010

	Bachelor	1 Bed	2 Bed	3 Bed +	Average
Surrey	$589	$724	$881	$1,106	$832
Vancouver	$811	$940	$1,202	$1,410	$1,006

While purpose-built rental and non-profit housing comprise only

Energy Conservation Assistance Program (ECAP)

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 in 2012 included:

- Giving away over 4,000 basic take-home energy savings kits;
- Providing approximately 700 free energy audits and retrofits; and
- Installing over 130 Energy Star fridges.

Most of this occurred in multi-unit residential buildings. Key partners included:

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

This type of outreach can be extended 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).

12 percent of the City's total dwelling units, they 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 has a much larger share than most municipalities – 9,000 units in 150 buildings. A sizable share of this housing may be at significant risk of redevelopment, since potential redevelopment value is much higher than 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 non-profit housing units (6,500 units) in Metro Vancouver. While third-party financing for energy retrofits in non-profit housing is cyclical, it is often available and frequently underused and undersubscribed. Fostering awareness of senior government and energy utility programs and providing support with program applications, including identification of of opportunities, can increase the take-up rate.

RECOMMENDATIONS

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

- Better understand the energy performance of these buildings and potential energy retrofit measures and savings with superior data and analysis that could include random audits. Investigate the energy implications of broader building deficiencies such as moisture ingress.
- Enhance understanding of building energy performance by analyzing linkages between typical energy consumption estimates and building type, age, size, redevelopment risk, presence of common areas, and proximity to the frequent transit network.
- Engage key constituencies to shape the framework. These include the local energy service sector, renters, other municipalities that are developing similar programs (e.g. City of Vancouver and City of North Vancouver), BC Hydro, FortisBC, and Metro Vancouver. Consider landlord barriers and motivations, building retrofit opportunities, effective financing, tenant participation opportunities, and administrative support for landlords in the framework.
- Consider how the framework can optimize existing programs offered by BC Hydro and FortisBC as well as emerging programs like the BC government's on-bill financing initiative. Identify other support mechanisms. Consider how the framework can effectively integrate the ECAP program (see sidebar above).
- Establish a retrofit pilot for purpose-built rental multi-unit residential buildings to test and refine the approach and to make a Go/No Go decision on fuller program development.
- Explore partnerships with energy utilities and community organizations such as faith-based groups and social service organizations for delivering retrofits.
- Develop a communications and outreach strategy for the retrofit framework.

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

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

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

3.3 NEW CONSTRUCTION STRATEGIES

Since buildings often have a lifespan of between 50 and 100 years, small improvements at the time of construction can have significant and long-term impacts on the overall building stock. The need to get new buildings right is particularly important in Surrey due to the rapid rate of growth.

Building energy efficiency has gradually improved over time due to technological innovation, regulation, and market demand. However, evidence shows that energy performance in new buildings across BC is not as high as originally assumed. In some areas, building thermal performance has not changed in four decades (see Basic Building Standards strategy below for evidence).

This is partially the result of construction practices such as curtain walls (comprised largely of windows), unmetered gas fireplaces, and improperly designed common area heating and ventilation systems. Additionally, a large percentage of buildings need to do more to meet the BC Building Code.

Constructing more energy efficient buildings will reduce emissions and residential and commercial energy spending. It will also prepare builders and developers to meet rising building energy standards driven by the Provincial government and keep up with consumer demand and technological innovation.

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.

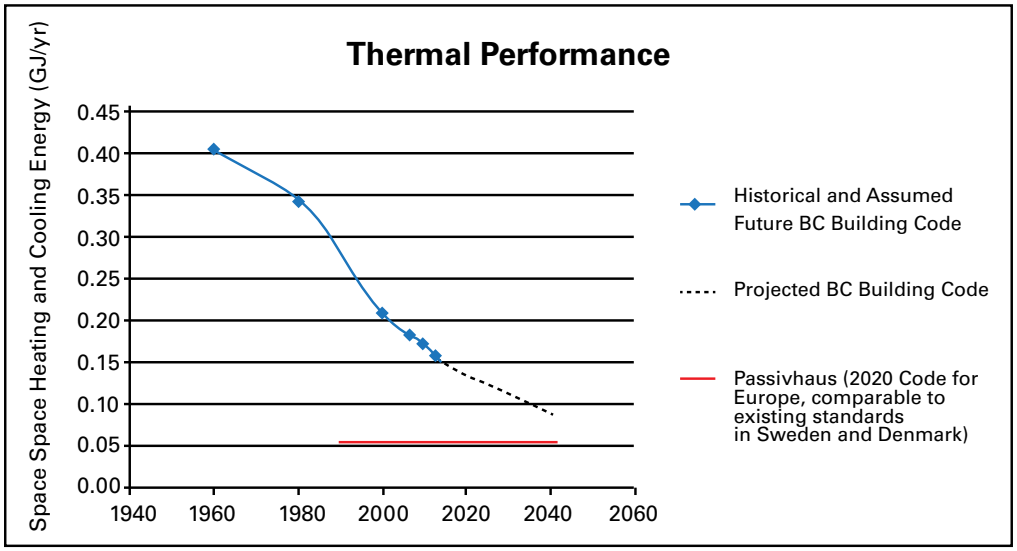


Figure 27: Energy Performance of Single Detached Homes (Only for Space Heating and Cooling)

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 BC Hydro and FortisBC have indicated that many more are not. The City is in a strong position to integrate third-party incentives into the development process.

RECOMMENDATIONS

1. Increase awareness of incentives and key best practices by hosting workshops and info sessions in collaboration with energy utilities, building associations, LiveSmart BC, and other third parties. The Sustainability Office and/or the Planning & Development Department can host workshops.
    - Pay particular attention to small and medium-sized builders and developers who may not have the resources to stay on top of incentives and best practices.

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

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

Third Party Incentives and Training for New Construction

Houses

BC Hydro's Power Smart New Home Program provides incentives for building new houses to be more energy efficient (currently EnerGuide 80 or higher) than Building Code requirements or include Energy Star certified products. Single detached houses, duplexes, and row houses are eligible.

Apartments and Commercial Buildings

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

BC Hydro's Lighting Efficiency Study incentive is available for lighting designs that exceed Building Code requirements by 10%. This program is suitable for smaller multi-unit residential buildings and commercial buildings. Completed studies often lead to significant capital incentives from BC Hydro and FortisBC.

E. LOCAL INCENTIVE PROGRAM DEVELOPMENT

BACKGROUND

BC consumers pay electricity and natural gas prices that 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:

- Density bonusing could provide density beyond existing zoning in exchange for higher energy performance. Density bonusing is often selectively applied in neighbourhoods where there is clear demand for higher density. 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 corporation) rather than remain with the developer. Payments 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. There would be a measureable drop in monthly strata fees once the loan is paid off.

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 that virtually all new buildings – large and small, residential and commercial – achieve better energy performance than the BC Building Code.

For large (Part 3) buildings, additional floor area over a base threshold and 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 is 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.

The City could facilitate financial institution interest in the opportunity and then encourage the market to take advantage of the opportunity.

It may be possible to arrange financing through BC Hydro or FortisBC as an alternative to a financial institution. 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 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). The Fund could be structured to provide developers with an opportunity to contribute to the fund in lieu of on-site green building features. It could be used to provide incentives for cutting-edge building techniques or technologies.

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 as effective in areas where there is low demand for higher density buildings.

Surrey currently has an interim Density Bonusing policy 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 parks 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 the BC Building Code to supplement existing programs offered by energy utilities and senior governments. Instrument selection would require further research and analysis.

1. Determine the 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 for 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 should be 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 the Neighbourhood Sustainable Energy Pilot strategy in the Land Use section, above) to evaluate its broader application.

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

F. BASIC BUILDING STANDARDS STRATEGY

BACKGROUND

There is considerable variability in new construction. Many builders and developers exceed the Building Code for diverse reasons: sustainability, commitment to excellence, or marketing advantage. However, many buildings must perform better to meet basic Code requirements.

Code non-compliance is prevalent across BC and more broadly in North America (see sidebar on next page). It should be noted that Surrey is one of only three jurisdictions in BC to take a leadership position in compliance management. The City adopted legislation in 2011 that can compel applicants to submit additional documentation where required to verify compliance in commercial construction. This tool is used with discretion and only where needed on projects where more evidence of compliance is required.

Compliance can be further improved through capacity building for builders, developers, trades, sub-trades, and key City staff as well as through 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 and can cut demand by 1-14%. Improving air barriers costs several hundred dollars and can decrease energy demand, reduce heating and cooling system size requirements, and increase heat recovery ventilator effectiveness.

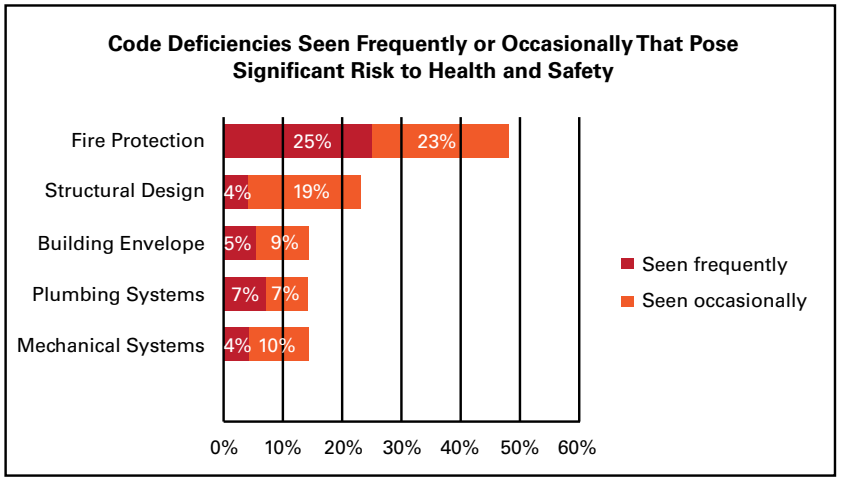


Figure 28: Survey on Code Deficiencies in BC (Province of BC, 2012). Many health and safety standards have energy efficiency implications.

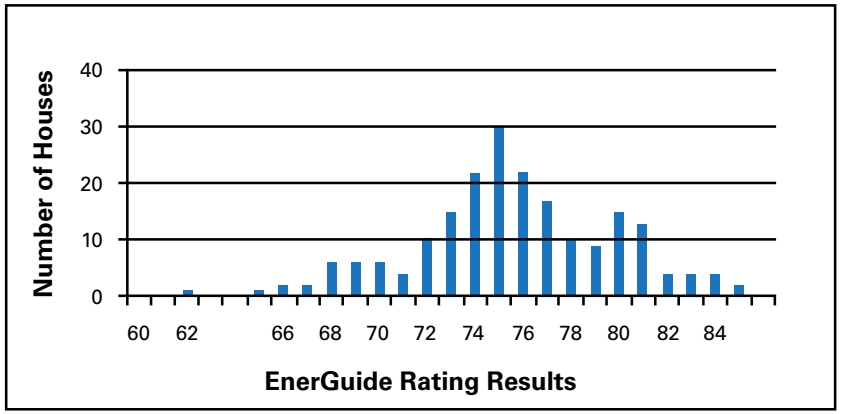


Figure 29: Measured EnerGuide Rating of Homes Targeting EnerGuide 80 in a Metro Vancouver Municipality

Non-Compliance Analysis

There is growing evidence that many new buildings perform below the Building Code.

- A random survey by the BC Government found that a large share of buildings is not meeting basic health and safety requirements (see Figure 28). Many of these Code deficincies also have implications for energy performance.
- Spot-checks around the Lower Mainland found that most new buildings do not have properly installed insulation on pipes and mechanical equipment, an issue which has deteriorated since the 1980s.
- Energy evaluations in one BC municipality for homes aiming to meet EnerGuide (EG) 80 found that they were performing even lower than Code (i.e. approximately EG 77). (See Figure 29)
- Research by Natural Resources Canada shows that air tightness performance in BC homes is the lowest in the country
- US studies show code compliance rates range from 0% - 73% for new buildings, with significant variability by jurisdiction and research methodology.
- Audits of new wood-frame residential buildings in BC found that one-third did not meet attic insulation requirements.
- Industry professionals and building officials estimate 42 percent of large buildings comply with ASHRAE 90.1 2004 and Part 10 of the Building Code, according to a recent survey.

RECOMMENDATIONS

Improve Code compliance in new construction through a combination of training for builders, registered professionals, developers, and City staff and fine tuning the permitting and inspection process.

1. Offer capacity building opportunities on key practices for improving building energy performance that focus on low cost, high impact, and easily enforceable opportunities. Adjust training by audience, including builders, registered professionals, developers, construction trades, and City staff. Use workshops, pamphlets, info sessions, and site briefings and collaborate with other interested parties (e.g. energy utilities and construction, developer, and builder industry associations) on program delivery. (See the Capacity Building strategy in the Cross-Cutting Building Strategies section, below)

2. Identify and consider implementing 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.
    - For Part 10 of the Building Code related to energy efficiency, explore setting a minimum target for spot checking and auditing compliance (e.g. 10%). Consider tracking the trends in compliance pathway choice and energy over time, especially modeled energy performance (e.g. energy intensity) and EnerGuide ratings. This is valuable data for tracking progress.

3. Evaluate opportunities for testing compliance with minimum energy performance ratings.

   - Explore requiring or reserving the right to randomly require Part 9 wood frame buildings to do a blower door energy performance evaluation. Reduce costs for townhouses and row houses by only testing a small sample of units rather than testing all units.
   - Explore requiring 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 the 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 (fewer than 25 units) need significant support to undertake retrofits 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 the design of a strata strategy.

  Building Owners and Managers Association (BOMA), Condominium Home Owners Association (CHOA), and parties involved in the purpose-built rental housing retrofit strategy (above) could be key stakeholders.

- **Energy Retrofit Renovation Standard:** Evaluate the 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. RCx leads to average energy savings of 16%, with a typical payback of just over one year.

  Evaluate the potential of using business licenses or building renovation 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 H_2O. Provide ambassadors with materials and guidance for encouraging building residents to be more energy efficient. 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.

Communicate the following opportunities to senior governments and energy 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.

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. Explore opportunities to link building commissioning to performance bonds. This would complement the Code compliance strategies outlined above for capacity building for Part 9 wood frame buildings involving blower door testing and the posting of a performance bond.

Encourage senior governments and utilities to address the following opportunities:

Senior Government & Utility Policy & Program Development: The following actions 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 for new construction.
- Work with municipalities and builder and developer industry associations (including sub-trades) to support audience-specific capacity building aimed at increasing compliance with the BC Building Code.
- Investigate Code non-compliance related to energy efficiency, healthy, safety, and material durability through third party audits.

Building Strategies in Land Use Sector

The following building energy efficiency strategies are more fully addressed in the Land Use section.

- 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.
- Low Carbon Development Permit Areas: Development Permit Area (DPA) Guidelines are a soft regulatory tool that can be effectively used to support low carbon, energy efficient buildings as well as site level transportation considerations. DPAs are particularly effective in advancing passive design in buildings.
- Pilot Sustainable Energy Neighbourhood: The neighbourhood can be a good scale to test innovative high efficiency and low carbon strategies in buildings as well as in land use and transportation.
- Sustainable Development Checklist Update: Surrey's existing Sustainable Development Checklist (SDC) provides a solid foundation for guiding sustainable practices in development and design. Integrating capacity building, financial, and regulatory strategies from the transportation, building, and waste sectors into future SDC updates builds on this foundation to support clear and measureable carbon and energy management practices.

4. DISTRICT ENERGY

District energy (DE) can provide efficient, cost effective, and low carbon energy to higher density areas. The City has recently established a district energy utility and commenced construction of its first district energy system in City Centre. 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** that are already collaborating on agendas like transportation and land use planning can build on this foundation to support district energy; and

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.

District Energy strategies build on the corridor and node focused land use development strategies to support the extension of City district energy (DE) utility services within City Centre and to contiguous high potential areas; and evaluates opportunities in other higher density nodes for diverse business models. The objective of these strategies is to increase local, low-carbon energy generation.

These strategies reinforce the City's work in City Centre and provide guidance for evaluating and extending district energy in key areas across the community. These strategies are supported by preliminary screening based on this Plan's preferred land use future, summarized in this section.

COMMUNITY CO-BENEFITS

Strategies

A. City Centre District Energy Extension
B. New District Energy Node & Corridor Evaluation
C. Integrated District Energy Policy & Planning

Key Senior Government and Energy Utility Assumptions

Senior government and energy utility actions have a significant impact on GHGs and energy in building performance and energy supply. The following key assumptions underpin strategies in this section:

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

Key Indicators & Targets*	2007	2020	2040
Square Metres of District Energy Connected Floor Space (m^2)	-	820,000[X]	4,025,000
GHG Intensity Per m2 Relative to Current BAU Buildings (kg CO_2e/m^2)	-	8kg | -35%[Y]	4kg | -70%
⊙ Share of Renewable Heat** in DE Service Areas (% of all heat in DE service areas)	-	40%[Y]	75%

** Indicators & Targets are a function of the pace and geographical distribution of development, for which the City does not have full control. Therefore, the dates by which these indicators and targets will be met are for illustrative and modeling purposes only.*

*** Renewable Heat includes low-carbon sources such as biomass, geoexchange, solar, sewer heat and other forms of waste heat recovery. It does not include direct use of hydroelectricity (e.g. electric baseboard heaters).*

[X] *This value assumes linear growth in floor space between 2013 and 2040 and 3 DE nodes operational across City Centre and in Semiahmoo Town Centre. There are additional service areas in 2040 (i.e. Guildford, Newton, and 104th Avenue). Only DE service areas with a business case better than BAU were included in calculating the floor space. Several other areas within 10% of BAU could become feasible.*

[Y] *There is a business case for a larger share of renewable energy systems to be in place by 2020. This value was assumed due to the level of effort and time associated with transitioning natural gas DE system base loads to renewables.*

- ⊙ *Key Targets*

District Energy Thermal Demand Opportunity Assessment Summary

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.

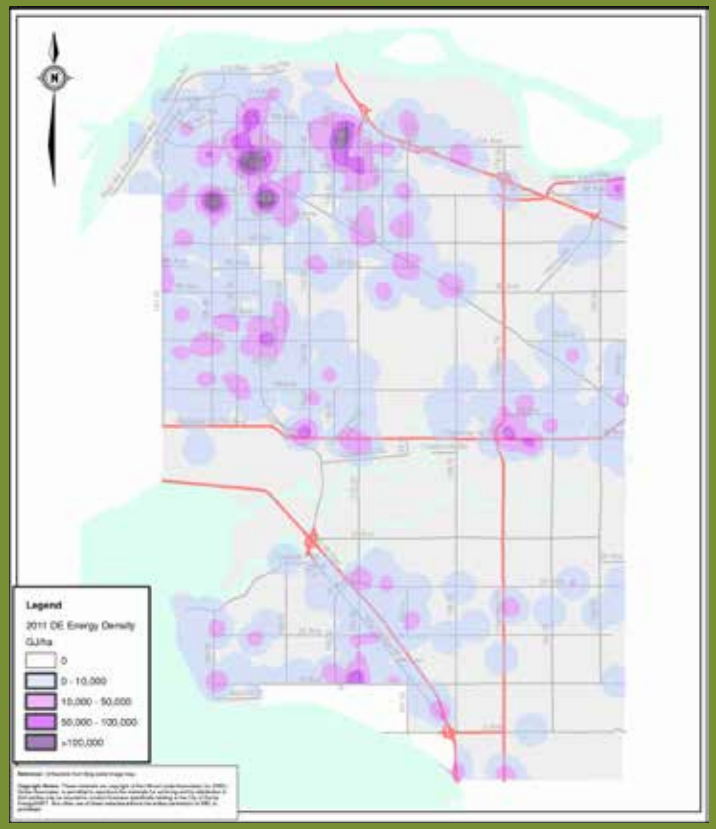


Figure 30: 2011 Thermal Energy Density (Map: Kerr Wood Leidal)

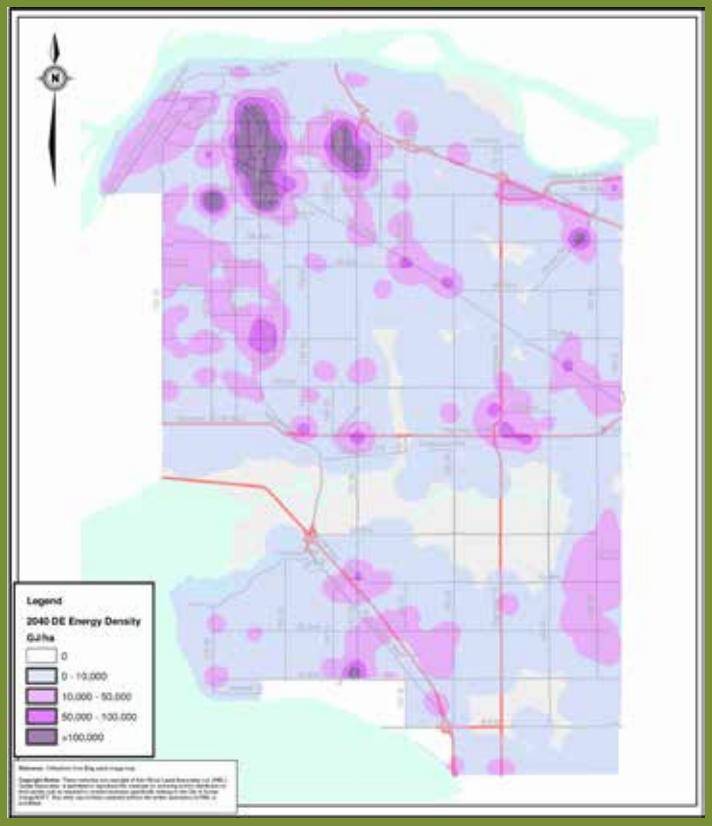


Figure 31: 2040 Thermal Energy Density (Map: Kerr Wood Leidal)

Table 9: Summary of District Energy Supply Opportunity Assessment

	Natural Gas	Wood Biomass	Municipal Solid Waste (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 waste-to-energy	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	Low	Moderate	High	High	Moderate	Low	Moderate
Cost	Low	Moderate	Varies by design and location	Varies by design and location	High	Moderate to high	Very high

Table 9: Summary of District Energy Supply Opportunity Assessment (continued)

Comments	Commonly a transition technology to other district energy technologies. GHGs depend on BAU heat supply system efficiency and gas or electricity supply.	Many DE systems in SW BC are planning to use wood biomass. Break point between large custom and small off-the-shelf systems. GHGs and feasibility depend on transportation ofbiomass.	If a Metro Van facility is sited in or near an industrial area and proximate to a 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 technology, 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. Drilling required to assess feasibility.	Prohibitive capital cost as base load. May be used in moderation as an educational tool.
Further Analysis by Location	City Centre WR/ Semiahmoo Guildford TC 104th Ave Newton TC Cloverdale TC Panorama Village Claytons Scott Road	City Centre-Lrg WR/ Semiahmoo-Sm Guildford TC-Lrg 104th Ave-Sm Newton TC-Sm Cloverdale TC-Sm Panorama Village-Sm Claytons-Sm Scott Road-Sm	City Centre 104th Ave Newton TC Scott Road	City Centre Guildford TC 104th Newton TC Scott Road	City Centre WR/ Semiahmoo Newton TC Cloverdale TC E Panorama TC	City Centre (Civic Only) WR/Semiahmoo 104th Ave Newton TC Cloverdale TC Panorama Village Claytons Scott Road	None – except for educational purposes
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

Potential District Energy Service Areas

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 due to factors such as changes in the location and speed of growth from real estate market changes or rapid transit projects, or changes in energy commodity changes due to changes in global demand. These changes would alter this assessment.

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

Table 10: 2040 DE Potential Areas & Technologies

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	
Newton 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	

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 growing area, Surrey City Centre.

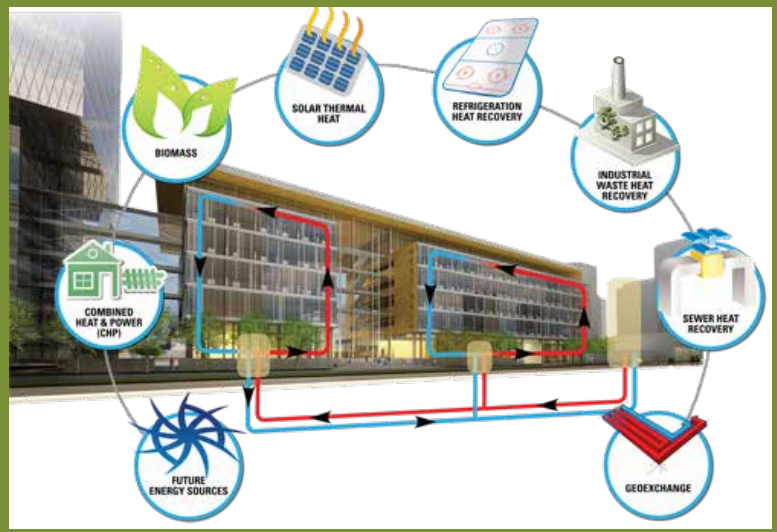
At the heart of City Centre is Surrey's first DE system, consisting of a geoexchange (GHX) field to serve the new City Hall and library. Surrey is also advancing a larger DE network in City Centre around three high-density nodes, centered on the King George, Surrey Central, and Gateway Skytrain stations.

To facilitate successful development of the DE systems and level the playing field for all new high density developments, Surrey has passed a bylaw and related financial assistance policy. The bylaw mandates compatible hydronic systems throughout City Centre while also mandating connection to the City's DE system within a core service area. The financial assistance policy helps the development community offset the additional cost of hydronic systems.

The City's methodical approach, developer engagement, clarity, incentives, and competitive business model provide a solid foundation for success.

District Energy System Technology

District energy systems 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. 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 by conventional individual boilers or baseboard electric heating.
(image: City of Surrey)



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 (dependent on the pace of development).
    - 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 Integrated DE Policy and Planning strategy in this section, below.)

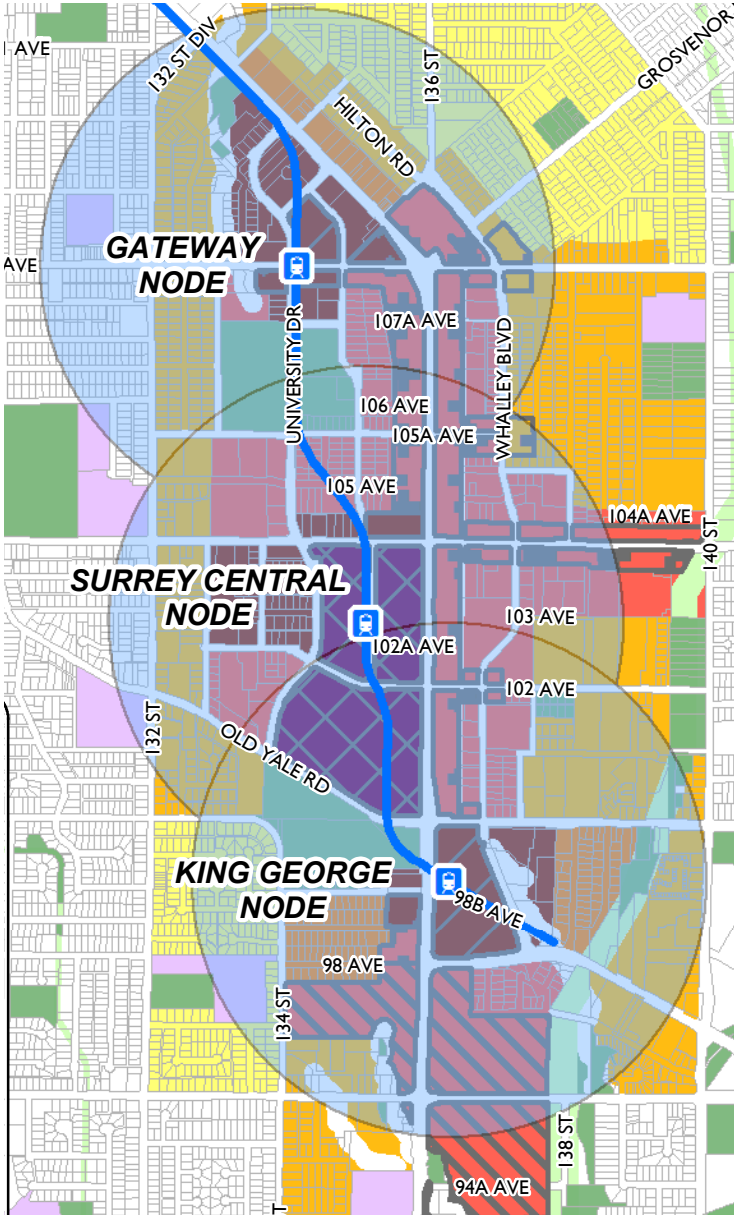


Figure 32: City Centre DE Nodes (Map: City of Surrey)

B. NEW DISTRICT ENERGY NODE & CORRIDOR EVALUATION

BACKGROUND

For district energy to be extended beyond City Centre, further analysis and policy and planning are necessary to determine specific locational feasibility, governance, and business model. A strategic pathway is outlined (Figure 33) and Table 10 (above) identifies higher potential areas.

RECOMMENDATIONS

1. Conduct planning area district energy opportunity assessments. Use screening analysis from this Plan 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, 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.

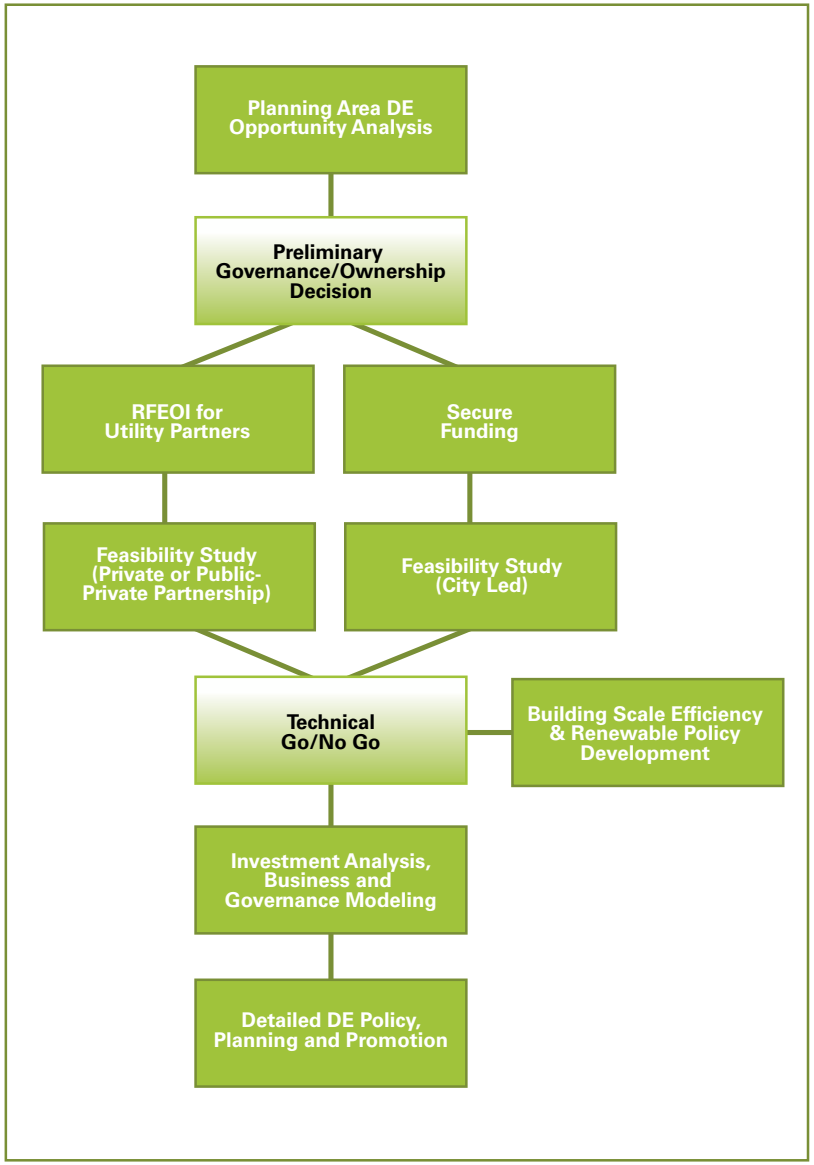


Figure 33: DE Policy, Planning & Governance Pathway (Flow Chart: Golder Sustainable Communities)

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.

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. Building 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.)

5. Carry out integrated policy and planning. Building on the actions to support the business case outlined above, flesh out policies, plans, and promotional activities. (See Integrated DE Policy and Planning strategy below.)

C. INTEGRATED DE POLICY & PLANNING

BACKGROUND

Integrated policy and planning build on business case development in the New DE Node and Corridor Evaluation strategy. It also aims to strengthen integration among big planning agendas and diverse departments and divisions.

RECOMMENDATIONS

1. Integrate district energy and rapid transit agendas. Use both to help focus growth and reinforce the success of each of these important initiatives. (See the 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 as 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 and district energy to attract senior government interest to these opportunities.

2. 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 and the 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 or 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.) Consider 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 DE connection as well as compatible building design.
- Require large new developments (e.g. 2,000 square meters or greater) within feasible service areas but prior to DE 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.

3. 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.

4. 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 formalize this system into policy, planning, and development.

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.

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 or ownership decisions and feasibility analysis is required in other areas.

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.

In Progress
Surrey Central City Centre
Gateway City Centre
King George City Centre
High Potential
Semiahmoo Town Centre
Guildford Town Centre
Newton Town Centre
104th Avenue Corridor
Moderate Potential
Cloverdale Town Centre
Clayton Village
Low to Moderate Potential
Panorama Village
Clayton Village South
Scott Road Corridor
Low Potential
152 Street Corridor
Bear Creek Village
Fleetwood Town Centre
Grandview #2
Guildford East
King George Corridor
Kwantlen
Old Civic Centre
West Clayton

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 system highly reduce 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 have a relatively low GHG intensity.

Biomass combustion systems can have the lowest GHG and electricity intensities, but those intensities are largely contingent on transportation distances.

The modeling undertaken for this Plan assumes DE systems use peaking natural gas boilers, accounting for 25% of heat.

5. 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. Emissions from solid waste result from the anaerobic decomposition (i.e. without oxygen) of organic waste in landfills.

Reducing waste GHGs will mainly be accomplished by diverting solid waste from landfills. Reducing, reusing, and recycling inorganic waste can also avoid significant emissions 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 pick-up of organic waste from single detached homes and some ground-oriented complexes and the development of a biofuel facility to process organic waste. The strategies outlined below continue existing policies and programs to reduce total waste, increase recycling rates and virtually eliminate organics from landfills with specific strategies for residential, commercial, institutional, and construction sector markets. The objective of these strategies is to reduce landfill waste. These strategies are aligned with Metro Vancouver's Integrated Solid Waste and Materials Management Plan.

Strategies

A. Zero Waste Residents, Businesses, & Institutions
B. Zero Waste Construction & Deconstruction
C. Senior Government Sustainable Packaging & Extended Producer Responsibility
D. 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.
- Extended Producer Responsibility expands to include new waste and packaging types.
- The land fill gas capture rate reaches 75 by 2016 in accordance with Provincial Landfill Gas Management Regulation.

2007 Waste Profile

In 2007, this Plan's base year for analysis, around 50% (215,000 tonnes) of Surrey's waste went to a landfill. 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 pick-up for single family homes.

Key Indicators & Targets*	2007	2020	2040
⊙ Share of Waste Diverted to Recycling and Composting (% of total waste)	~50%	75%	85%
GHG Intensity Per m^2 Relative to Current BAU Buildings (kg CO_2e/m^2)[X]	0.94	0.86 | -8.5%	0.80 | -15%
⊙ Per Capita Tonnes of GHG from Waste (tonnes CO_2e/person)[Y]	0.18	0.1 | -44%	0.07 | -61%

[X] While the 2020 value is below Metro Vancouver's aspirational target, it is ambitious given the enormity of the challenge and level of plans.

[Y] Annual performance relative to 2007.

⊙ Key Target

COMMUNITY CO-BENEFITS

Economic Development

Energy Resilience

Zero Waste

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

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.

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] Figures are from the 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.

Table 11: 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

Table 12: GHGs by Waste Management Practice

Tonnes of CO2e 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

STRATEGIES

A. ZERO WASTE RESIDENTS, BUSINESSES, & INSTITUTIONS

BACKGROUND

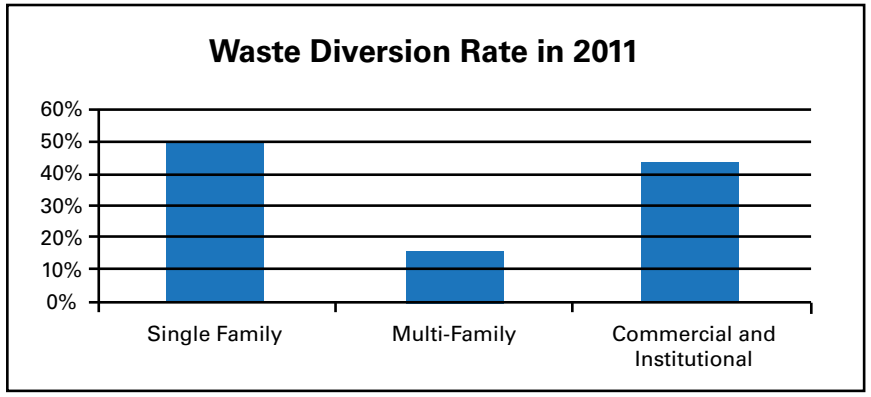


Figure 34: Waste Diversion Rate 2011 (Single family data: City of Surrey. Multi-family and commercial/institutional data: Metro Vancouver, 2011

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 pick-up for single family homes and recycling and organics pick-up for many 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.

Landfill waste diversion 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 drive increased diversion, recycling, and reuse rates of organic materials.

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.

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. This is a consistent challenge across Metro Vancouver. Data specific to Surrey is not available. For the region, multi-family diversion is around 16%, which is less than 1/3rd 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 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 businesses and institutions, diversion rates are 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. Commercial and institutional waste collection services are contracted directly with the private sector, making it more challenging for the City to directly strengthen compliance.

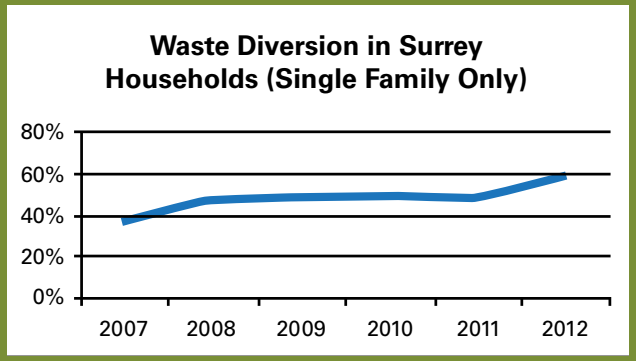


Figure 35: Waste Diversion in Single Family Households (City of Surrey)

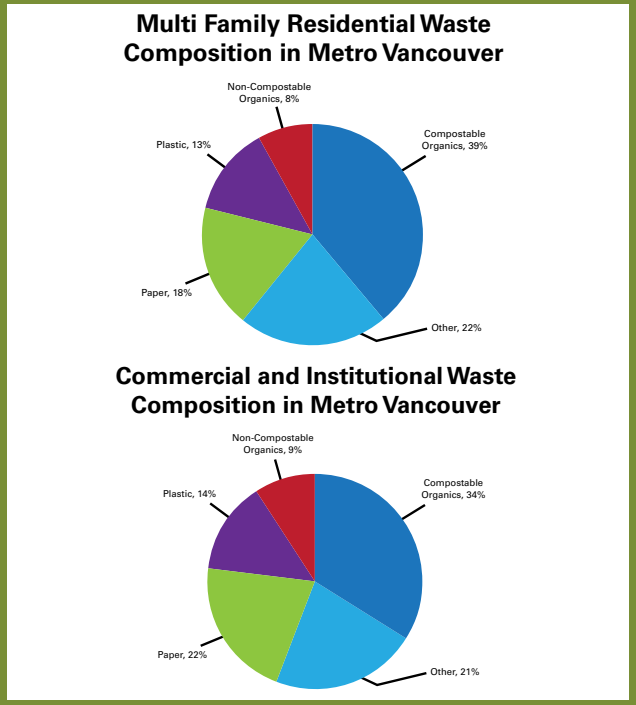


Figure 36: Waste Composition in Multi-Family and Commercial/ Institutional Buildings (TRI Environmental Consulting Inc. 2012)

RECOMMENDATIONS

1. Continue to extend outreach on organics pick-up in single detached homes.

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

2. Work with partners to develop targeted outreach for additional 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 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 increasing organics and recycling diversion in multi-unit residential buildings and beginning these services in large commercial and institutional buildings, with consideration to the unique opportunities in new and existing buildings.

    - Examine the need to update the City bylaw to require more space for recycling carts in 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, comprising 15% of the total regional waste stream. Given the City's rate of development, 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-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, the regional and 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 (e.g. education, program development, partnerships, regulation, fiscal tools, and enforcement).

Deconstruction and Demolition

Deconstruction is the practice of systematically disassembling a building in order to maximize the reuse, recycling, or recovery of building materials. It can achieve diversion rates of 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, compared to one to two days for conventional demolition.

Pilot deconstruction projects carried out in the Lower Mainland have resulted in high diversion rates of over 80%. Where reported in one case study, the cost premium over conventional demolition only increased overall project costs by around 1%. These costs are sensitive to the price of labour and to 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.

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 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, the phasing out of non-recyclable packaging, and the 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 and municipalities around the region 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. Careful planning and design principles are necessary to ensure energy recovery from waste is a strong sustainability solution.

To maximize sustainability objectives and alignment with Metro Vancouver, the City, 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, maximizes energy and waste management sustainability, and minimizes GHGs and criteria air contaminants.

2. The City should ensure that 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. Principles could include:

   - **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 11 and Table 12)
   - **Maximize Energy Potential:** Ensure the design of biomass combustion systems use heat energy generated from combustion to provide space heat, hot water, or industrial heat, or to provide heat and power.
   - **Adaptive Management:** Engineer systems to accommodate changes in energy commodity markets and changing waste management practices, permitting diverse feedstocks.
   - **Air Quality Excellence:** Ensure a system exceeds regulatory standards.

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.

6. CROSS CUTTING STRATEGIES

These measures cut across traditional energy and emission sectors and municipal 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 and among 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 support 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 to address broader sustainability priorities. Carbon and energy management should, nevertheless, be linked to other critical community priorities like affordability, mobility, and job creation.

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 investment 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 budgeting;
- Capital planning; and
- Procurement

RECOMMENDATIONS

1. Develop a decision-making lens to support staff, Council, and potentially private, public, and social sector players in the community in evaluating impact and providing guidance for managing energy, emissions and, if desired, broader sustainability objectives. A straightforward, qualitative scoring tool could help optimize key decisions.
    - Engage Council, staff, and community stakeholders in developing the sustainability lens to increase the potential for its application inside the City and in the broader community.
    - Use the tool during the annual budget process to qualitatively understand and manage the long term energy, emissions, and cost implications of decisions, including implications for in energy spending by residents and businesses.
    - Use the tool to support and strengthen major land use and infrastructure decisions.
    - 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, and public sector organizations.

B. CARBON PRICING REVITALIZATION & CLEAN AIR & HEALTHY COMMUNITIES FUND

BACKGROUND

Two significant opportunities are available 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 such as the $30/tonne freeze made by the current Provincial government would be maintained, redesign opportunities could include:
    - Phasing in a portion of revenue to be recycled into a Clean Air and Healthy Communities Fund that would invest in priorities such as transit and active transportation that improve air quality and physical fitness and reduce GHGs and air pollution;
    - Formally engaging local governments in determining investments with advisory input from key players such as public health officers and major community emitters;
    - Amending carbon tax coverage to increase equity and fairness from demographic and sectoral perspectives; and
    - Considering extending carbon tax coverage to include other air pollutants generated from fossil fuel combustion to also manage those pollutants.

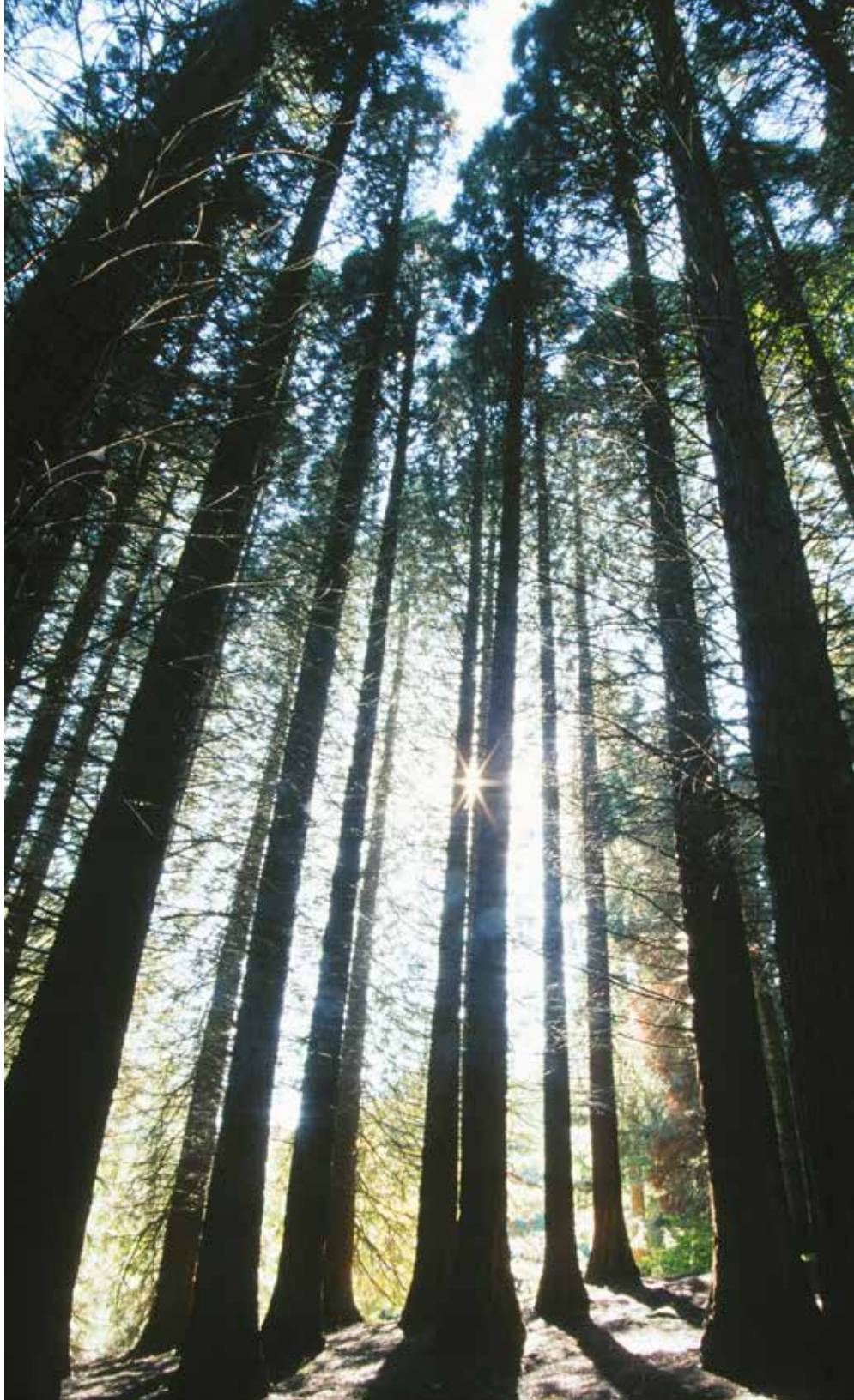
2. Prosperity Fund for Low Carbon Community Development: The Provincial Government has announced the development of a Prosperity Fund that will be financed through liquefied natural gas (LNG) exports. Little is confirmed about this Fund. If LNG exports are as significant as the Province expects, pressure will grow to effectively mitigate the environmental and human health risks and notably manage the growth of provincial greenhouse gas emissions. There could be opportunity to 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 such as physical health (e.g. walk and 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), and affordability (e.g. energy/location efficient affordable housing) would tend to have higher support.

RECOMMENDATIONS

1. Create a dialogue with the Provincial Government to establish a Clean Air and Healthy Communities Fund to build a legacy of deep carbon reduction and 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 and that have less 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 reduction projects with significant community co-benefits;
- Help achieve carbon neutrality in municipal operations while keeping expenditures local; and
- Contribute to emission reduction efforts provincially and specifically for BC municipalities.

Project Requirements

To be considered eligible, emissions reductions must be:

- Additional to those possible without financial, technical, and/or coordination contributions of the City.
- Real and Permanent: the reductions need to meet minimum standards that prevent leakage (i.e. 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 or 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 remain aware of criticisms of 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 or generated from a natural gas power plant). PSOs do not have to offset scope 3 emissions (e.g. emissions from employee and student travel to and from work and school). Many PSOs have significant influence over some scope 3 emissions and could contribute to project development by financial contributions from offset spending.

Costs and Benefits

The costs associated with developing many local 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 of local projects may be justified because of the value they provide to the community.

C. COMMUNITY & CORPORATE CARBON MANAGEMENT INTEGRATION

BACKGROUND

The "carbon neutral" agenda has 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; and 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), which are legislatively-bound to be carbon neutral; than local governments that voluntarily committed to becoming carbon neutral through the Climate Action Charter.

If the carbon neutral agenda continues as expected, there are opportunities to support high integrity offset projects that provide significant benefits 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 authorities, TransLink, the School Board, or post-secondary institutions).

Activity for this strategy 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 the Community Carbon Offsets discussion box, above).

RECOMMENDATION

1. If BC's Carbon Neutral Agenda continues and the City aims to work towards 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 the Community Carbon Offsets discussion box, above). Use existing Green Communities Committee project methodologies and protocols for calculating the value of these projects or develop new methodologies and 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 the Ministry of Community Development in project development.
    - Work with key PSOs to identify carbon-offset projects within their scope 3 emissions that are of high community value. Public schools, school boards, post-secondary institutions, 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 development projects, walk and bike to school programs, employee and student travel demand management, and innovative transit. The broader community benefit derived from these programs may justify active City involvement. Emission reductions from these projects could be used to reduce corporate carbon liability for these institutions or for the City. Liaise with the Climate Action Secretariat and Pacific Carbon Trust in project development.

7 ENERGY & EMISSIONS FORECAST

Energy and emissions changes are evaluated from the base year 2007, to both 2020 and 2040. 2007 is the base year because it is the first year for which robust and reliable data is available from the BC Government's Community Energy and Emissions Inventory (CEEI) initiative, which aggregates energy and emissions data for all communities in the Province. It is also the year that the BC Government announced its ambitious climate action agenda and as a result, most communities and institutions in the Province use 2007 as the base year against which to measure emission reductions. The CEEP's final milestone of 2040 aligns with the 30-year outlook in PlanSurrey2013, the City's Official Community Plan, as well as Metro Vancouver's Regional Growth Strategy; 2020 is an interim milestone that supports medium term detailed implementation planning, monitoring, and evaluation.

7.1 TOTAL COMMUNITY-WIDE ENERGY & EMISSIONS SYNOPSIS

Implementing the strategies in this Plan will reduce greenhouse gas emissions by almost half on a per capita basis and by 13% on a total community-wide basis by 2040 relative to 2007 levels. The greatest emission reductions are forecasted for the transportation sector: -60% on a per capita basis and -30% on a community-wide basis relative to 2007 levels.

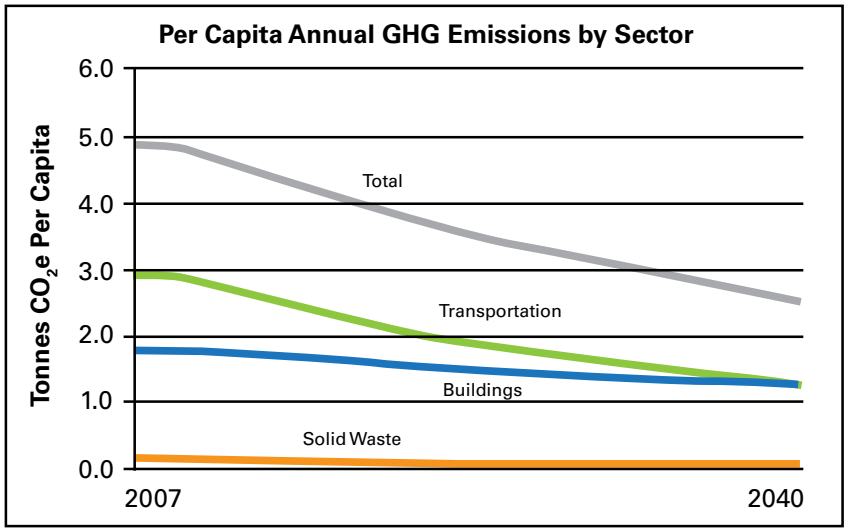


Figure 37: Per Capita CO_2e Reductions by Sector: Per capita GHG reductions are most dramatic in the transportation sector, driven by a combination of smart land use, rapid transit, active transportation, local green car strategies, and very strong senior government vehicle efficiency standards.

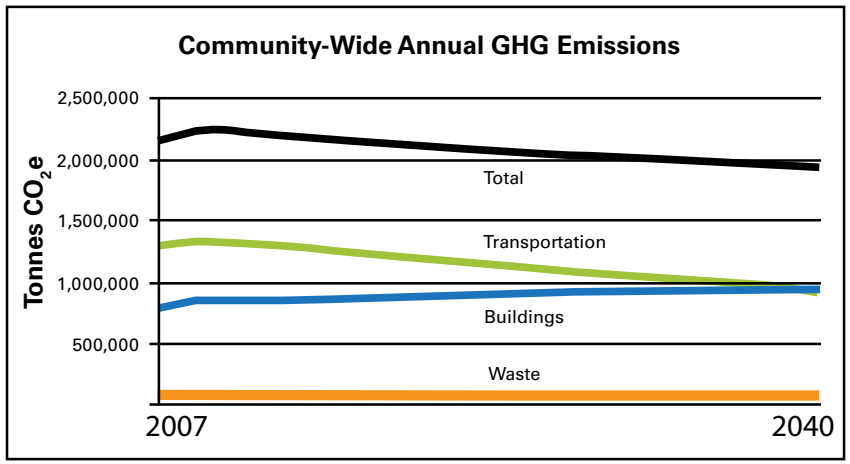


Figure 38: Total Community-Wide CO2e Emissions: Across the entire community, transportation GHGs drop most significantly (30%) due to growth in low carbon cars, transit use, walking and cycling, and more services closer to residents. Building GHGs grow 20% due to rapid residential and commercial growth. Waste GHGs shrink by a third.

7.2 ENERGY & EMISSIONS BY SECTOR

Personal transportation is the largest share of all transportation-related emissions in Surrey and will be the most dramatically reduced by local and senior government action. Transportation emission reductions will be 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 is projected to improve by almost 30% in per capita performance. Reductions should be greatest in the residential sector, where building GHGs are most concentrated. The drivers for this improvement will be 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 will both be required to deliver these strategies. Due to sizeable population and employment growth, nevertheless, there will be significantly more dwellings and commercial floor space built in Surrey, resulting in overall building sector emission growth on a community-wide basis.

Waste GHGs are projected to drop almost 60% on a per capita basis and approximately 40% overall by 2040 relative to 2007, due to significant recycling and composting and reduction in waste volumes through the City's Rethink Waste Program.

The extent and location of population and employment growth will be the community's biggest GHG and energy management challenges. The best performing neighbourhoods, analyzed on a household basis, will be complete, compact, and connected to good transit and district energy (see Figure 20).

Table 13: Total Community-Wide & Per Capita CO_2e Emissions by Sector and by Milestone

Sector & Sub-Sector	GHG Emissions (tonnes CO_{2e})					
	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	1.5	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	**78,000**	**0.2**	**62,000 -21%**	**0.1 -30%**	**54,000 -31%**	**0.1 -59%**
Total Community-Wide GHGs	**2,158,000**	**4.9**	**2,141,000 -1%**	**3.8 -22%**	**1,932,000 -13%**	**2.6 -47%**
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 residential waste*

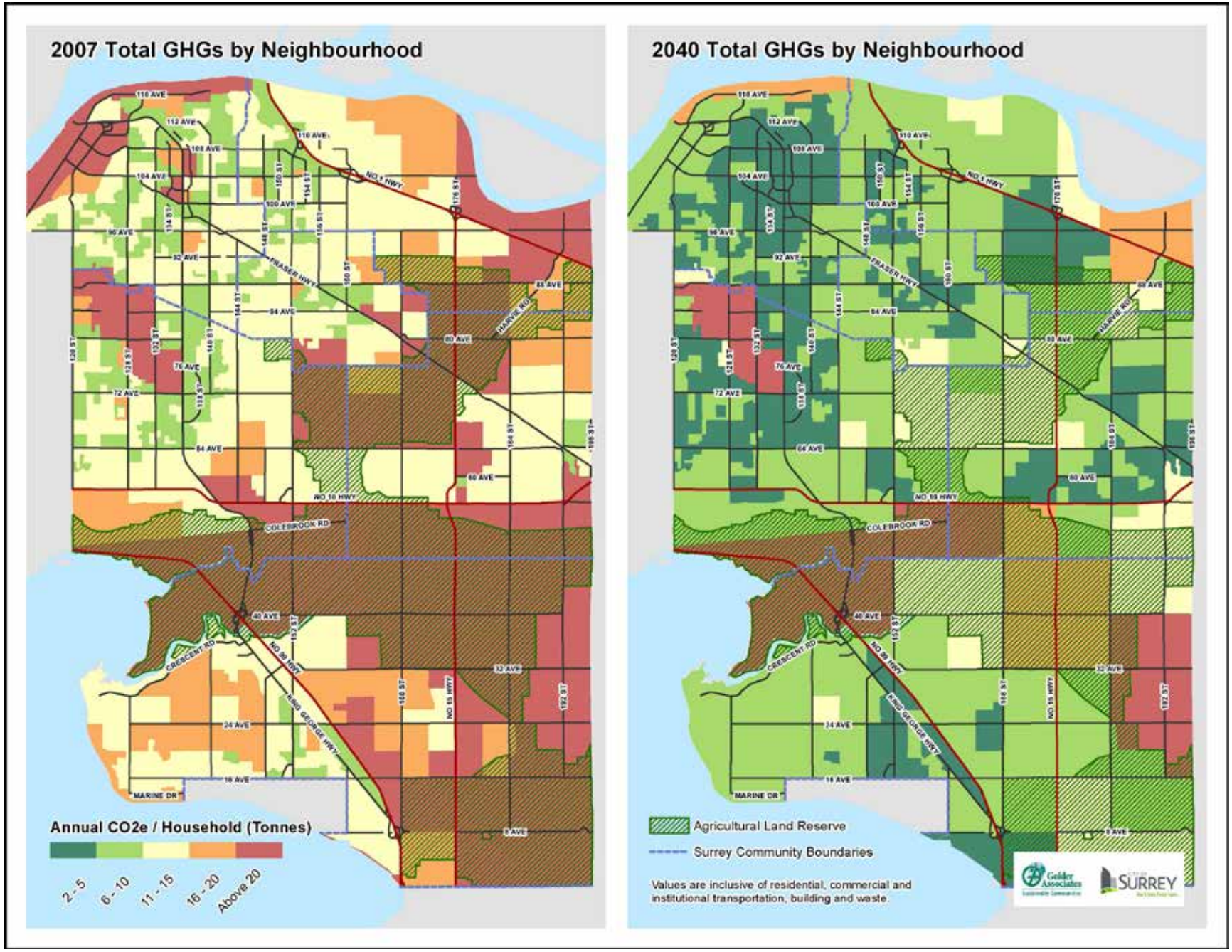


Figure 39: Total GHGs by Neighbourhood, inclusive of residential, commercial and institutional activity, is reduced by half measured on a household basis

7.3 COMPARISON TO BUSINESS AS USUAL

The emissions reduction potential of this Plan is most meaningful when energy and emissions forecasts are compared to Business As Usual (BAU) as a baseline case. The BAU scenario represents a future in which no further action is taken by the City or senior-level governments to manage energy and GHGs beyond current City plans and policies and currently legislated senior government commitments up to 2015 (notably BC Building Code updates and federal vehicle emission standards scheduled to take effect between 2012 and 2015).

Under the BAU scenario, total community emissions would rise 28% by 2040 relative to 2007 levels. It should be noted that a "true" BAU that assumes no action at all would see emissions rise even higher.

Compared to the BAU, community-wide emissions could drop by 41% with continued senior government action on improving building performance and vehicle emission standards, continued utility support of energy conservation programs, and implementation of the CEEP. Of this 41% reduction, continued senior government and utilities action beyond 2015 would be responsible for 23%, and CEEP implementation would achieve 18% in emission reductions. These reductions are even more significant when taking into account the rapid employment and residential growth expected in Surrey in the same period (see figure on following page).

Many strategies within and between sectors are mutually reinforcing. To quantify their energy and emissions impact, related strategies are aggregated into emissions reduction wedges (see figures on following pages). Most strategies and, in turn, emissions reduction wedges are influenced by 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.

Community-wide strategy wedges and per capita wedges as shown on Figure 20 illustrate significant emissions reductions from City-led (i.e. local) action, as well as from senior government action. The magnitude of these emission reductions is shown in comparison to the Business as Usual scenario. The "wedges" in these diagrams are simply a visual way of quantifying and showing the relative impact of various GHG reduction strategies.

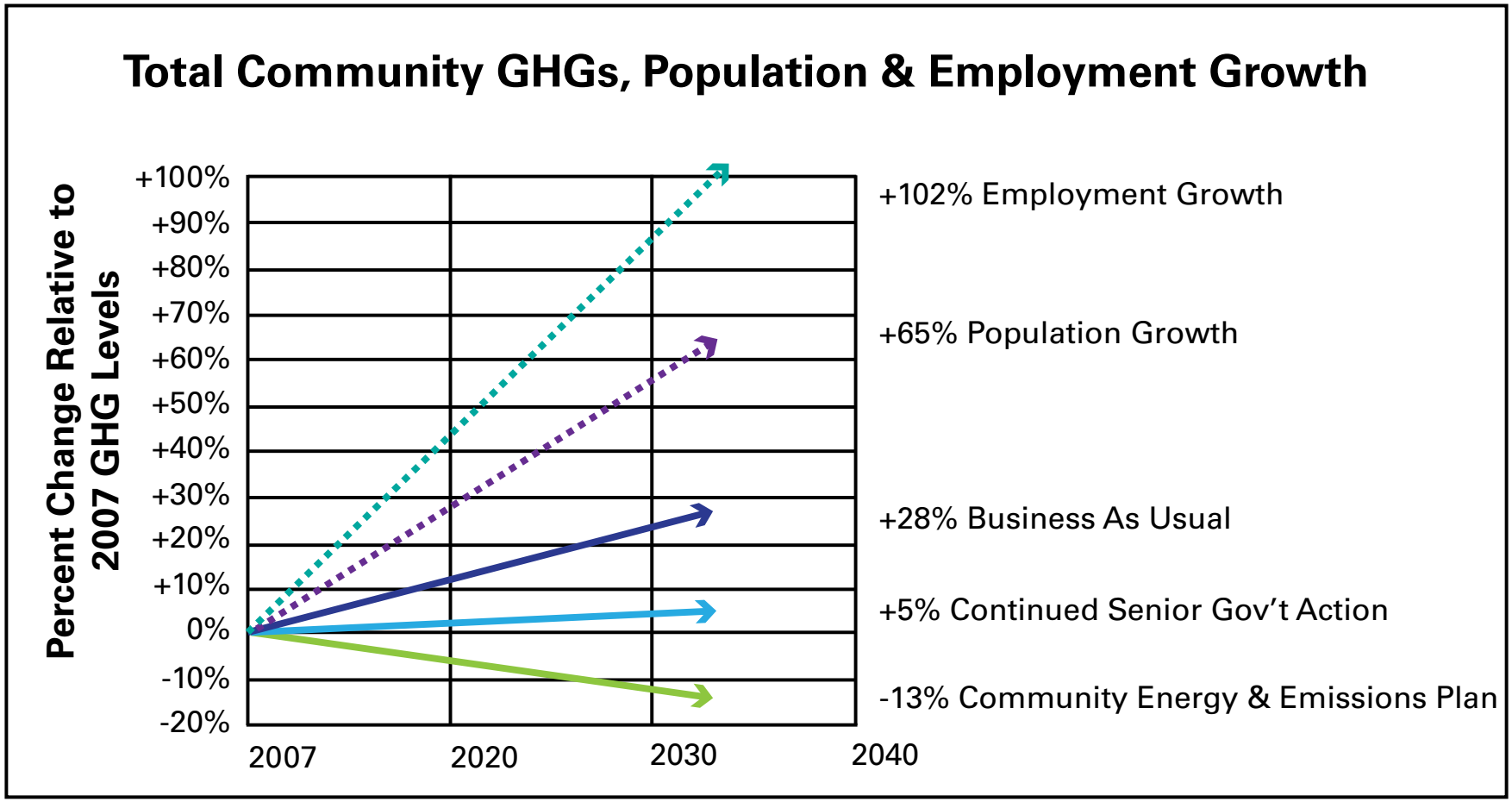


Figure 40: Total Community CO_2e & Population & Employment Growth: The City makes sizeable community-wide emissions reductions in the face of rapid employment and population and employment growth.

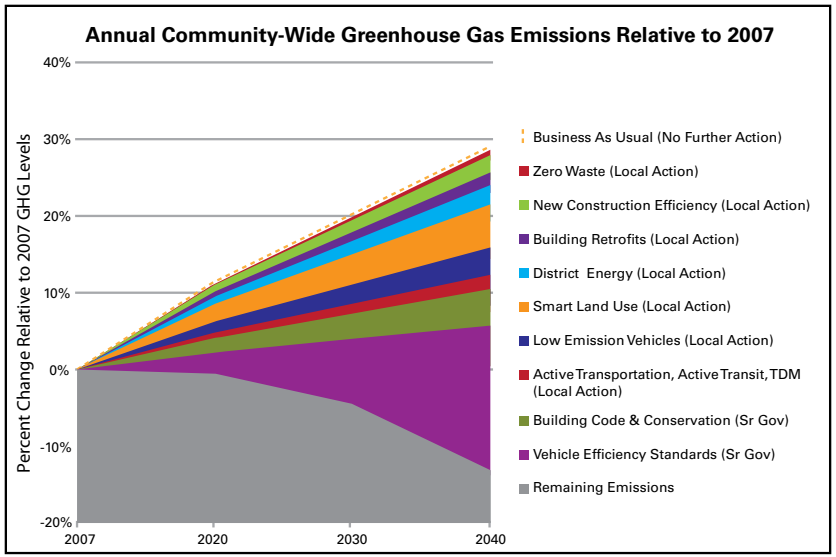


Figure 41: Community-Wide CO2e Emission Reduction Wedges

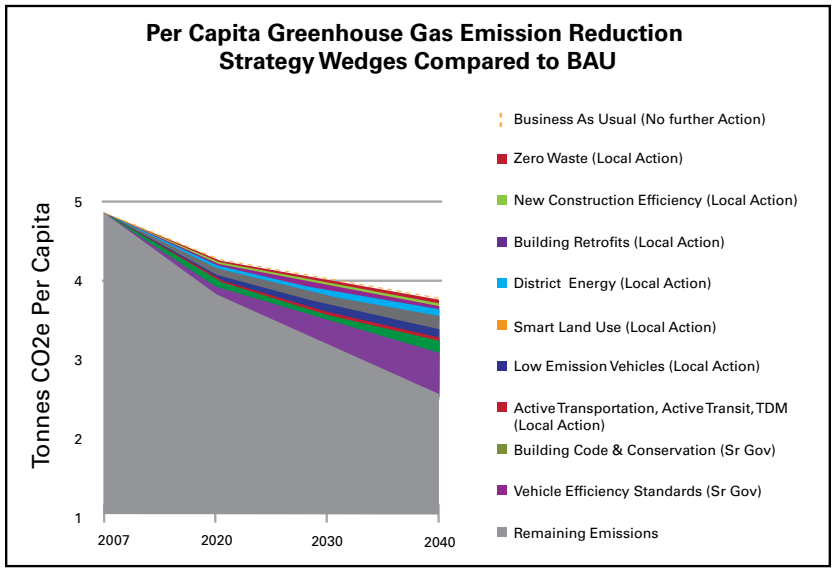


Figure 42: Per Capita CO2e Emission Reduction Wedges

Smart Land Use
- Focus Growth
- Complete, Compact, Connected Corridors
- Compact & Live/Work Housing
- Low Carbon Development Permit Areas
- Neighbourhood Sustainable Energy Pilot
- Sustainable Development Checklist Update

Transit Active Transportation, TDM
- Rapid Transit Development
- Bus Service Improvements
- Integrated Active Transportation Improvements
- Bicycle Infrastructure Improvements
- Pedestrian Infrastructure Improvements
- Transportation Demand Management

Low Emission Vehicles
- Green Fleet Management & Efficiency Support
- Car Sharing Promotion
- LEV Infrastructure Development

Building Retrofits
- Capacity Building for High Efficiency Buildings
- Third Party Retrofit Program Integration
- Affordable Housing Energy Retrofit Strategy

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

District Energy
- City Centre District Energy Extension
- New Node & Corridor Evaluation
- Integrated District Energy Policy & Planning

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

Building Code & Conservation
- BC & Federal Government Building Code

Vehicle Efficiency Standards
- Federal Government Vehicle Efficiency

Figure 43: Emission Reduction Wedges - green wedges are local action; blue wedges are senior government action

Combined City-driven GHG reductions amount to almost 400,000 tonnes CO_2e, 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 amount to almost 900,000 tonnes, roughly equivalent to cutting all of Richmond's current emissions (BC's 4th largest municipality).

Table 14: Emissions Reductions by Wedge

Per capita and total reductions of CO_2e tonnes relative to BAU. These totals are reflected in the above wedge charts

Strategy Wedge	Emissions Reductions (tonnes CO_2e)			
	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 Transportation, TDM	0.03	16,000	0.06	41,000
Low Emission Vehicles	0.06	31,000	0.11	78,000
Building 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**

7.4 ENERGY DEMAND REDUCTIONS & ENERGY SAVINGS

Energy demand drops by 29% on a per capita basis but rises 20% on a total community-wide basis by 2040 relative to 2007 levels, due to rapid population and employment growth in the same time period. 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 11% 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.

Energy savings are compared to Business As Usual. Total community-wide energy savings that could be delivered by the CEEP and senior government action are 31% relative to BAU or $832 million annually. These savings are concentrated in the transportation sector, which contributes a reduction of 47% or $679 million annually by 2040 relative to BAU (see Table 16).

Table 15: Total Community-Wide & Per Capita Energy Demand (GJ) by Sector and Milestone

Sector & Sub-Sector	Energy Demand (GJ)					
	2007		2020		2040	
	Total	Per Capita	Total	Per Capita	Total	Per Capita
Total Buildings	**23,617,000**	**54**	**29,200,000 +24%**	**52 +4%**	**35,310,000 +50%**	**48 - 11%**
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	**18,815,000**	**43**	**17,570,000 -7%**	**31 -28%**	**15,569,000 -17%**	**21 -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	**42,432,000**	**97**	**46,770,000 +10%**	**83 -14%**	**50,879,000 +20%**	**69 -29%**

*Excludes large industrial buildings

Table 16: Community Wide Annual Energy Savings Relative to Business as Usual

Sector and Sub-Sector	Annual Energy Savings					
	2020		2030		2040	
Total Buildings Savings	**$23,890,000**	**2%**	**$87,490,000**	**4%**	**$153,000,000**	**7%**
Residential Buildings	$17,490,000	2%	$68,320,000	4%	$118,650,000	8%
ICI Buildings	$6,400,000	3%	$19,170,000	4%	$34,350,000	5%
Total Transportation Savings	**$185,470,000**	**20%**	**$332,840,000**	**31%**	**$679,280,000**	**47%**
Personal Transportation	$48,110,000	8%	$130,020,000	21%	$237,820,000	34%
Public Transportation	$8,190,000	20%	$3,550,000	11%	$17,190,000	46%
Commercial Transportation	$129,170,000	38%	$199,270,000	45%	$424,270,000	60%
Total Community-Wide Savings	**$209,360,000**	**12%**	**$420,330,000**	**20%**	**$832,280,000**	**31%**

8. CLIMATE CHANGE MITIGATION & ADAPTATION INTEGRATION

Many strategies in the Community Energy & Emissions Plan have adaptation benefits. Compact land use and transit-oriented strategies support ecosystem protection and hazard avoidance. Passive design actions contribute to heat management. District energy and building energy efficiency increase energy self-sufficiency and security. The following table identifies how CEEP strategies support adaptation.

Integration between Surrey's Community Energy & Emissions Plan and Climate Adaptation Strategy is discussed more fully in the Community Climate Action Strategy, a separate and overarching document that integrates the two Plans. As detailed implementation planning for both Plans moves forward, other opportunities to maximize these synergies will become apparent

Table 17: CEEP Strategies Supporting Adaptation

CEEP Strategies by Sector	Adaptation Benefits		
	Ecosystem Protection & Hazard Avoidance	Heat Management	Energy Self-Sufficiency & Security
Land Use			
A. Focused Growth	✓		
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	✓	✓	✓
G. Grid Scale Energy Infrastructure Planning & Coordination			

Table 17: CEEP Strategies Supporting Adaptation (continued)

CEEP Strategies by Sector	Adaptation Benefits		
	Ecosystem Protection & Hazard Avoidance	Heat Management	Energy Self-Sufficiency & Security
Transportation			
Public Transit Strategies			
A. Rapid Transit Development	✓		✓
B. Bus Service Improvements	✓		✓
Active Transportation & Transportation Demand Management			
C. Integrated Active Transportation Improvements	✓		✓
D. Bicycle Infrastructure Improvements	✓		✓
E. Pedestrian Infrastructure Improvements	✓		✓
F. Active Transportation and Transportation Demand Management	✓		✓
Low Emission Vehicle Strategies			
G. Green Fleet Management & Vehicle Efficiency Support			✓
H. Car Sharing Promotion			✓
I. Low Emission Vehicle Infrastructure Development			✓

Table 17: CEEP Strategies Supporting Adaptation (continued)

CEEP Strategies by Sector	Adaptation Benefits		
	Ecosystem Protection & Hazard Avoidance	Heat Management	Energy Self-Sufficiency & Security
Buildings			
Cross-Cutting 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. Basic Building Standards Strategy		✓	✓
District Energy			
A. City Centre District Energy Extension			✓
B. New District Energy Node & Corridor Evaluation			✓
C. Integrated DE Policy & Planning			✓
Solid Waste			
A. Zero Waste Residents, Businesses and & Institutions			
B. Zero Waste Construction & Deconstruction			
C. Senior Government Sustainable Packaging & Extended Producer Responsibility			
D. Sustainable Planning and& Design for Energy Recovery from waste			✓
Cross Cutting Strategies			
A. Low Carbon Sustainability Lens			
B. Carbon Pricing Revitalization & Clean Air & Healthy Communities Fund	✓		
C. Community & Corporate Carbon Management Integration	✓		

PART 3: IMPLEMENTATION & MONITORING

The Community Energy & Emissions Plan identifies 32 strategies that help Surrey create a future that is increasingly low carbon and energy resilient. The CEEP supports the vision and goals in Surrey's Sustainability Charter. These strategies also support core community priorities in many ways (see following page).

1.1 PRIORITY ACTION OPPORTUNITIES

Ten strategies from the CEEP have been identified as priority action opportunities to explore. These strategies have been selected according to the following set of decision-making criteria:

- GHG Reductions: Contribution to GHG reductions across the entire community;
- Energy Savings: Contribution to reduced energy use across the entire community;
- Incremental City Cost: Cost to the City to develop and administer the strategy over and above what would be undertaken in the absence of this Plan;
- Ease of Implementation: Consideration of diverse factors influencing success (e.g. fundability, complexity, political feasibility, partnership opportunities); and
- Community Co-Benefits: Contribution to the eight core community priorities described above.

Based on these criteria, the top priority action opportunities to explore are:

- Focused Growth
- Complete, Compact, Connected Corridors
- Low Carbon Development Permit Areas
- Rapid Transit Development
- Bus Service Improvements
- Low Emission Vehicle Infrastructure Advancement
- Third Party Building Retrofit Program Integration
- Basic Building Standards
- City Centre District Energy Extension
- Integrated District Energy Policy & Planning

1.2 ROLES AND RESPONSIBILITIES

Each CEEP strategy has been assigned to a lead City department responsible for implementation, the Sustainability Office's role will be to coordinate where appropriate and to monitor overall implementation status.

Economic Development: Building energy retrofits and local, low-carbon generation reduce energy costs for residents, increasing the amount that can be spent in the local economy. These strategies also create 'green collar' jobs that contribute to green development and sustainability.

Energy Resilience: Lower transportation costs from reduced vehicle use and ownership, more efficient housing from energy retrofits and more efficient new construction, and smart neighbourhood energy systems increase resilience to changing energy supplies and prices.

Healthy Living: Land use and transportation strategies create walkable neighbourhoods that improve health outcomes. Low emission vehicles and reduced car dependency can improve air quality.

Affordability: Lower transportation costs and energy efficient homes reduce long-term household expenditures.

Community Livability: Complete, compact development and good design can strengthen the social and economic vitality of neighbourhoods.

Smart Mobility: Quality transit, good walking, cycling and road network design, green cars, and focused commercial and residential growth support efficient transportation.

Zero Waste: A sustainable solid waste and resource management agenda complement GHG reduction and energy resilience.

Climate Protection: Low carbon land use, transportation, buildings, and waste management reduce climate change impacts locally, regionally, and globally.

In addition to focused City efforts, achieving the reductions in energy demand and GHG emissions outlined in this Plan will require the active participation of residents, businesses, and community organizations. Senior government partnerships and investment will also be critical to implement key strategies. In particular, senior government leadership is needed on continued improvements to vehicle efficiency standards and building codes, energy conservation commitments supported by BC Hydro and Fortis BC, and continued TransLink transit service expansion.

1.3 TARGETS, INDICATORS, AND MONITORING

The Community Energy and Emissions Plan proposes the following two community-wide targets:

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

These targets are based on the City's efforts in this Plan to quantify emissions and energy reductions from changing land use, transportation systems and networks, building performance, energy supply, and waste management practices. The targets were developed using a rigorous and methodical bottom-up approach that quantifies the emissions and energy impacts of specific policies and measures them against an empirically derived baseline; as such, they will help to define an assertive and pragmatic low-carbon path that will slow emissions growth. The targets will also move the City towards the aspirational GHG reduction targets currently in the Official Community Plan.

Exploring the additional opportunities identified in each sector of the CEEP could help to achieve greater emission reductions, and changes in technology, energy prices, and the implementation of senior government policies and actions will present other opportunities currently unavailable.

In addition to community-wide targets for energy and emissions reductions, the Plan identifies the following key targets for each sector:

- **Land Use:** Increase proportion of Surrey residents within a 5 minute walk to Frequent Transit Stations 10% by 2020 and 21% by 2040.
- **Transportation:** Reduce personal vehicle driving distances (vehicle kilometers traveled) 4% by 2020 and 9% by 2040.
- **Transportation:** Increase bicycle route kilometres 57% by 2020 and 148% by 2040.
- **Buildings:** Improve building energy performance 10% beyond typical new construction by 2040.
- **Buildings:** Increase the annual retrofit rate of existing buildings to 2% from 1% by 2040.
- **District Energy:** Meet City-owned DE energy requirements with 40% renewables by 2020 and 75% renewables by 2040 (illustrative and modeling purposes only; see section for notes).
- **Solid Waste:** Divert 75% of solid waste to recycling and composting by 2020 and 85% by 2040.

Plan implementation will be monitored by tracking progress toward achieving the community-wide and key sector targets as well as tracking trends over time through the indicators below. Many of these indicators are aligned with existing reporting efforts, so will be easy to track. With the assistance of relevant City departments, the Sustainability Office will collect data to monitor progress of these metrics and connect these efforts with the City's Sustainability Dashboard. City staff will convene as needed to monitor progress on strategy implementation and assess the indicator data as it is collected and as trends emerge.

1.4 CONCLUSION

Addressing climate change requires urgent and assertive action by all levels of government. By taking informed and proactive action guided by the Community Energy & Emissions Plan, the City of Surrey is positioned to create a low-carbon and energy resilient future that also ensures that Surrey continues to grow into a vibrant and livable community for decades to come. Together with the Climate Adaptation Strategy, the City of Surrey's comprehensive Community Climate Action Strategy is preparing the community for a new and better future.

Table 18: Sectoral Indicators

Sectoral Indicators	2007	2020	2040
Land Use			
Population (people)	447,300	562,400| +25%	739,000 | +65%
Employment (jobs)	141,000	213,000 | +51%	286,000 | +102%
Proportion of Housing Stock by Building Type (Single Family Homes | Townhouses & Rowhouses | High and Low Rise Apartments)	67% | 17% | 16%	58% | 21% | 21%	49% | 24% | 27%
Average Resident Distance to Employment in Region (km)	17.5km	16.6km | -5%	15.5km | -11%
Transportation			
Per Resident Tonnes of Personal Transportation GHGs[x] (tonnes/person)	2.1	1.5 | -29%	0.7 | -67%
Transportation Fuel Savings per Household Relative to Business As Usual ($/household)[x]	-	$230	$880
Household Transit KM Travelled (km) [z]	3,700km	4,000km | +8%	5,000km | +35%
Transit Route Network Length (km)	286	324 | +13%	382 | +34%

Table 18: Sectoral Indicators

Sectoral Indicators	2007	2020	2040
Transportation			
Arterial Road Network Length (km)	583	624 | +7%	673 | +15%
Average Intersection Density Per Road KM (# of intersections per one way road)	7	8.9 | +27%	11.7 | +67%
Proportion of Residential Population within 400 m of Bike Routes (%)	67%	78% | +16%	97% | +44%
Passenger Vehicle Ownership Per Capita (cars/person)	0.5	0.47 | -6%	0.37 | -26%
Buildings			
Average Per Resident Tonnes of Personal Building GHGs (tonnes/person)	1.29	1.1 | -15%	0.9 | -31%
Average Per Resident Gigajoules of Building Energy Use (GJ/person)	35	33 | -6%	30 | -14%
Average Household Building Energy Savings Relative to Business As Usual[Y] ($/Household)	-	$40	$200
Community-Wide Building Power Conservation Relative to Business As Usual[Y] (GWh)	-	41GWh	434 GWh
District Energy			
Square Metres of District Energy Connected Floor Space (m^2)	-	820,000	4,025,000
GHG Intensity Per m^2 Relative to Current BAU Buildings (kg CO_2e/m^2)	-	8kg | -35%[Y]	4kg | -70%
Solid Waste			
Total Tonnes of Waste Per Capita (including recyclables + compost) (tonnes CO_2e/person)	0.94	0.86 | -8.5%	0.80 | -15%
Per Capita Tonnes of GHG from Waste (tonnes CO_2e/person)[Y]	0.18	0.1 |-44%	0.07 | -61%
Community Wide Indicators			
Per Resident Tonnes of Personal GHGs (excludes institutional and commercial) (tonnes CO_2e/person)	3.4	2.6 | -23%	1.6 | -52%
Per Capita Tonnes of Community GHGs (includes residential, commercial, and institutional) (tonnes CO_2e/person)	4.9	3.8 | -22%	2.6 | -47%
Per Resident Personal Energy Use in Gigajoules (includes transportation and buildings) (GJ/person)	65	55 | -14%	43 | -33%
Total Community Wide GHG Reductions Relative to 2007 (%)	-	-1%	-13%
Total Community Wide Energy Savings Relative to BAU ($ millions)	-	209.4 | -12%	832.3 | -30%

PART 4: APPENDICES

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GLOSSARY

B. Glossary

Adaptation: Initiatives or measures to manage or reduce the impact of actual or anticipated effects of climate change. Adaptation 'manages the unavoidable' to reduce the vulnerability of human and natural systems. Local governments have a unique interest and opportunity in planning for adaptation, as they will bear the greatest impacts and are best situated to proactively respond to affected services at the local level.

Advisory Design Panel (ADP): A Panel of design, development, and other professionals appointed by the City Council to advise the General Manager of the Planning and Development Department on the quality of design of the built environment in the City, and specifically to provide comments and suggestions to improve the design quality of the development projects being reviewed by the City.

Agricultural Land Reserve (ALR): A provincial zone in which agriculture is recognized as the priority use. Farming is encouraged and non-agricultural uses are controlled. The ALR currently comprises 4.7 million hectares, which are those lands in BC that have the potential for agricultural production, and includes private and public lands that may be farmed, forested, or left vacant.

Alternative Fuels: Fuels other than conventional fossil fuels such as petroleum and propane. They generally have lower GHG emissions than fossil fuels and can include ethanol, biodiesel, natural gas, propane, electricity, and fuel cells and hydrogen. The City of Surrey has passed a bylaw requiring new gas stations and major gas station renovations to include alternative fuel sources, such as charging for electric vehicles, compressed natural gas, hydrogen or propane.

ASHRAE: Acronym for the American Society of Heating, Refrigerating, and Air-conditioning Engineers. ASHRAE produces widely-known standards for building systems and energy efficiency, as well as indoor air quality, refrigeration, and sustainability. ASHRAE 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings" is an internationally recognized standard for energy efficiency in large buildings. It is updated regularly by Society. The BC Building Code uses a version of the ASHRAE 90.1 Standard for large residential, industrial, commercial and institutional (Part 3) buildings.

Baseline: A set of metrics from a certain year that can be used for measuring change and progress. The Community Energy and Emissions Plan uses data on energy consumption, GHG emissions, and other indicators such as bicycle route kilometers from 2007 as its baseline. 2007 is the baseline for two reasons. It is the first year for which good data is available through the BC Government's Community Energy and Emissions Inventory Initiative. It is also the year that the BC Government announced its ambitious climate action agenda and most institutions in BC use 2007 as the base year for measuring emission reductions.

Blower Door Energy Performance Evaluation: Professional energy advisors use blower door tests to determine a building's airtightness and energy performance. The higher the airtightness of a house, the better its energy performance.

Building Code: A complete set of building regulations govern the design and construction of buildings and specify the minimum acceptable levels of building performance. As part of its commitment to reduce GHG emissions related to buildings and construction, the BC Government introduced a new Part 10 to the BC Building Code in 2008 that includes new requirements for energy and water efficiency.

Building Design: Architectural, engineering, and technical specifications that contribute to the look and function of a building. Many elements of building design, such as how a building is situated or oriented on its site, can reduce energy use by taking advantage of solar energy. This is referred to as passive or solar passive design.

Building Energy Retrofit: Measures that reduce energy use and improve the energy efficiency of an existing building. These measures can include replacing existing inefficient equipment, improving insulation, and plugging up air leads. Building energy retrofits reduce energy use and GHG emissions as well as reduce energy costs for building owners and tenants.

Building Orientation: How a building is positioned on its site to take advantage of views, solar access, and street access. Well-oriented buildings maximise opportunities to use natural light to reduce the need for artificial lighting and to use sunlight for warming a building to reduce the need for mechanical heating.

Bus Rapid Transit: A rapid transit options that provides faster, more frequent, and more reliable bus service than conventional bus service such as the B-Line or even frequent bus service. It typically operates in a separate, dedicated lane from traffic with moderately spaced stops and signal priority. It can be as frequent as every 2 minutes.

Business As Usual (BAU): A scenario of the future that assumes that future developments will be similar to past trends and no new policies or actions are introduced. Comparing an energy and emission forecast from implementing specific policies or actions against a BAU scenario reveals the full potential of those policies or actions to reduce energy and emissions.

Business Improvement Association (BIA): A membership-based organization of commercial property owners and business tenants whose goal is to promote and improve their business district.

Car Sharing: Business models that rent cars for short periods, and 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.

Carbon: Carbon dioxide is the primary greenhouse gas emitted through human activities. There are other types of greenhouse gases (e.g. methane) that also contribute to climate change. Different GHGs vary by how strongly they induce the greenhouse gas effect (i.e. global warming potential). When the emissions of all different types of greenhouse gases are reported together, it is expressed as the carbon dioxide equivalent or CO2e.

Carbon Neutral: In BC, all public sector organizations such as schools, hospitals, colleges, universities, and other institutions have to be carbon neutral, which entails reducing the GHG emissions from their buildings, vehicle fleets, and paper use as much as possible and purchasing offsets for their remaining emissions.

Climate Action Charter: A voluntary commitment that requires signatory local governments to achieve carbon neutral corporate operations by 2012; measure and report on community GHG emissions profiles; and create complete, compact, and more energy-efficient rural and urban communities.

Climate Adaptation Strategy: Surrey's Climate Adaptation Strategy identifies potential climate change impacts and recommends actions for improving preparedness for and resiliency against these impacts. The Strategy is integrated with the Community Energy and Emissions Plan in that it identifies adaptation actions that reduce greenhouse gas emissions. The two plans together form Surrey's Community Climate Action Strategy.

Climate Resilience: The capacity of an individual, community, or institution to dynamically and effectively respond to shifting climate impact circumstances while continuing to function and prosper. Simply, it is the ability to survive, recover from, and even thrive in changing climatic conditions.

Community Amenity Contribution: Voluntary in-kind or cash contributions from property developers to fund community facilities and services such as park development, police and fire services, and library materials.

Community Climate Action Strategy: An overarching document that integrates the Community Energy and Emissions Plan and the Climate Adaptation Strategy.

Community Energy and Emissions Inventory (CEEI): An initiative by the BC Ministry of Environment that provides all local governments in the province with profiles of the energy consumption and greenhouse gas emissions in their community. It helps local governments meet the Climate Action Charter commitment to measure and report on community GHG emissions profiles.

Community Energy and Emissions Modeling and Planning Tool (CEEMAP): A tool developed by HB Lanarc-Golder to model and map community-scale energy and emissions. The technical modeling for Surrey's Community Energy and Emissions Plan was accomplished using CEEMAP.

Community Energy and Emissions Plan (CEEP): A document for providing long-term direction and short-term actionable strategies for reducing energy and emissions in a community.

Community Energy and Emission Profile: An inventory of a community's energy use and greenhouse gas emissions. Profiles provided by the Province's CEEI initiative reports on energy and emissions from transportation, buildings, and solid waste.

Density Bonusing: An incentive that offers developments additional density in exchange for amenities such as parks, heritage preservation, and affordable housing. Some local governments have started to use density bonusing in exchange for greener development and higher energy efficiency.

Development Advisory Committee: A committee that establishes and maintains an effective channel of communications between City staff and members of the development industry in Surrey.

District Energy (DE): 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. Generally, buildings connected to DE require a hydronic (water-based) system to distribute heating and/or cooling. Heat exchangers in connected buildings transfer heat between DE piping and the building's hydronic piping. Connected buildings often do not need individual heating and cooling systems, since they get those services from the district energy system.

Emissions: A substance discharged into the air. In this plan, the term mainly refers to greenhouse gas emissions.
Emission Factor: Common units that allow different GHG emissions to be compared in terms of their global warming potential. Each greenhouse gas has a unique atmosphere heat-trapping potential. Emission factors are used to calculate how much equivalent CO2 (CO2e) would be required to produce a similar warming effect so that the impact of all greenhouse gases can be compared and expressed in a common unit.

Energy Intensity: Also known as energy use intensity, it expresses a building's energy use in relation to its size or other characteristics. Energy use intensity is often expressed as energy per unit area per year and is calculated by diving the total energy consumed by a building or a number of buildings in one year by the total gross floor area of the building or buildings.

Energy Resilience: The ability to withstand changing energy supplies and prices. Similar to energy security.

Energy Savings: Dollars saved by reducing current energy use and future energy demand.

Energy Security: The uninterrupted availability of energy sources at an affordable price. Energy security will be a challenge as the cost of most fuels are projected to increase due to the rising cost of production and growing demand. Energy security can be improved by reducing energy demand and establishing local sources of renewable energy.

Energy Vulnerability: Exposure to and the lack of ability to withstand changing energy supplies and prices. The opposite of energy resilience and energy security.

EnerGuide: A Government of Canada initiative that rates the energy consumption and efficiency of new and existing houses, as well as household appliances; heating, cooling, and ventilation equipment; and personal vehicles. The EnerGuide Rating System for homes

Federation of Canadian Municipalities (FCM): An organization that represents over 2,000 local governments and 20 provincial and territorial municipal associations across Canada. FCM advocates to have the needs of local governments and their citizens reflected in federal policies and programs.

Floor Space: The amount of area, measured as square feet or square meters, taken up by a building or part of a building.

Frequent Transit Network (FTN): A TransLink designation describing a network of corridors where transit service runs at least every 15 minutes in both directions throughout the day and into the evening, every day of the week. People traveling along FTN corridors can expect convenient, reliable, and easy-to-use services that are frequent enough that they do not need to refer to a schedule.

Geographic Information Systems (GIS): An information system that captures, stores, manipulates, analyzes, manages, and presents all types of geographical data. GIS is often used to generate maps.

Greenhouse Gas (GHG): Greenhouse gases including carbon dioxide, methane and even water vapour occur naturally in the atmosphere, maintaining a temperature through the natural greenhouse gas effect that has been conducive for ecosystems and human civilization to flourish for 10,000 years. Additional GHGs released from burning oil, coal and gas for energy and clearing forests for cities and agriculture has enhanced the greenhouse effect, leading to changes in climate.

Gigajoule (GJ): A metric unit for measuring energy. A Gigajoule of natural gas has the same amount of energy as 26 litres of gasoline or 277 kilowatt hours of electricity. According to Natural Resources Canada, toughly 100 GJs of energy is required to heat a new average-sized single detached home in Canada for one year.

Greenfield Development: Urban or industrial development on an undeveloped or agricultural tract of land.

Heat Management: Measures taken at the building, site, or neighbourhood scale to reduce the urban heat island effect, where an urban area is significantly warmer than surrounding less urban or non-urban areas. Increased summer temperatures combined with the heat island effect can lead to health problems such as heat stress. Heat management is an adaptive measure.

Hydronic Heating: A type of home heating system that uses piping or tubing to run a hot liquid such as water under the floor, along base board heaters, or through radiators to heat a home or apartment unit. Hydronic heating is usually needed to enable buildings to be connected to district energy systems, since DE often provides heating services via hot water.

Infill Development: Development that takes place on vacant or undeveloped land within an existing community where the existing land is mostly built out. Infill 'fills in' the gaps. Gentle infill can often increase density without changing neighbourhood character, such as allowing secondary suites and coach houses.

International Panel on Climate Change (IPCC): The leading global organization for assessing climate change. It was established by the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide the world with research on climate change and its potential environmental and socio-economic impacts.

Light Rail Transit (LRT): A transit technology that consists of electricity-powered vehicles that carry passengers on rails and often in dedicated lanes that are separate from motor vehicle traffic.

LiveSmart BC: An initiative of the BC Government that provides information, incentives, and programs to help residents and businesses reduce their energy and GHG emissions.

Local Government Act: Provincial legislation that provides local governments with a legal framework, powers, duties, and functions necessary for fulfilling their purpose.

Mitigation: Measures taken to reduce greenhouse gas emissions and to limit the magnitude and/or rate of long-term climate change.

Megawatt Hour (MWh): A unit to measure energy that is equal to 1,000 kilowatts of electricity use continuously for one hour. A kilowatt hour is commonly used as a billing unit for energy delivered to consumers by electric utilities. Megawatt hours are often used for metering large amounts of electricity to industrial customers and in power generation.

Mixed Use: A building, area, or neighbourhood that blends a combination of residential, commercial, cultural, institutional, and/or industrial uses. Mixed-use buildings and areas maximize location efficiency by providing more services and amenities closer together than single-use buildings and areas.

Multi Criteria Analysis: A decision making tool that defines multiple factors or criteria important to the user and ranks number of options based on how well each option scored for each criteria.

Multi-Modal Transportation: Using two or more different modes of transportation, such as commuting to work by bicycle and bus.

Official Community Plan (OCP): A plan that provides long-term vision for the community. Under the Local Government Act, an OCP is a statement of objectives and policies to guide decisions on planning and land use management, within the area covered by the plan, respecting the purposes of local government.

Offsets: Greenhouse gas reductions that are used to counterbalance greenhouse gas emissions elsewhere. A carbon offset occurs when an individual or organization emits a given amount of GHG emissions but invests in measures that permanently and verifiably remove the equivalent amount of GHG emissions from the atmosphere.

Part 3 Buildings: Refers to large multi-unit residential, industrial, commercial, and institutional buildings, which are regulated by Part 3 of the BC Building Code.

Part 9 Buildings: Refers to single-family detached homes, townhouses, rowhouses, and small buildings, which are regulated by Part 9 of the BC Building Code.

Partner for Climate Protection (PCP) Program: A network of Canadian municipal governments that have committed to acting on climate change. The program provides a five milestone framework that helps members to create GHG inventories, set realistic and achievable reduction targets, and develop and deliver location action plans along with measureable actions to reduce emissions.

Power Smart: A suite of BC Hydro programs and incentives that help residents, businesses, buildings and developers, and local governments save power and be more energy efficient.

Provincial Carbon Tax: A carbon tax is a tax based on greenhouse gas emissions generate from burning fuels. A carbon tax puts a prices on each tonne of GHG emitted, sending a price signal that, over time, is intended to produce the market response of reduced emissions. Introduced in 2008, BC's carbon tax is carbon neutral so that there is no net increase in taxes.

Public Sector Organization (PSO): Organizations such as schools, post-secondary institutions, provincial government offices, Crown corporations and hospitals. As of 2010, all public sector organizations in BC had to be carbon neutral or achieve net-zero greenhouse gas emissions.

Right-of-Way: A document in which a property owner permits the City or a public utility company such as BC Hydro the right to use a portion of the owner's property to install pipes or other infrastructure for the delivery of services.

Road Pricing: A concept in which motorists pay directly for using a road, bridge, or tunnel, or for driving into a defined part of a city. It can be used to generate revenue for transit, reduce congestion, encourage use of other transportation modes, and/or reduce vehicle emissions.

Sustainability Charter: The City of Surrey's comprehensive framework for implementing a progressive, long-term 50-year vision for a sustainable city. It was adopted unanimously by City Council in 2008.

Thermal Energy: The portion of the thermodynamic or internal energy of a system that is responsible for the temperature of the system.

Thermal Energy Density: The amount of thermal energy stored in a given system or region of space per unit volume or mass. Sufficient thermal energy density is important for determining whether a district energy system is feasible in a given area.

Transportation Corridor: A generally linear tract of land that contains lines of transportation like highways or railroads.

Units Per Hectare (UPH): A unit is a measure of housing equivalent to the living quarters of one household. UPH is a commonly-used measure of residential density.

Utility On-Bill Financing: Loans made by energy utilities to customers such as homeowners or commercial building owners to pay for energy efficiency improvements to the customer's house or building. The regular monthly loan payments are collected by the utility on the utility bill until the loan is repaid.

Vehicle Kilometers Traveled (VKT): The total in kilometers traveled by motor vehicles on any particular road systems during a given period in time. VKT is a common environmental indicator for transportation.

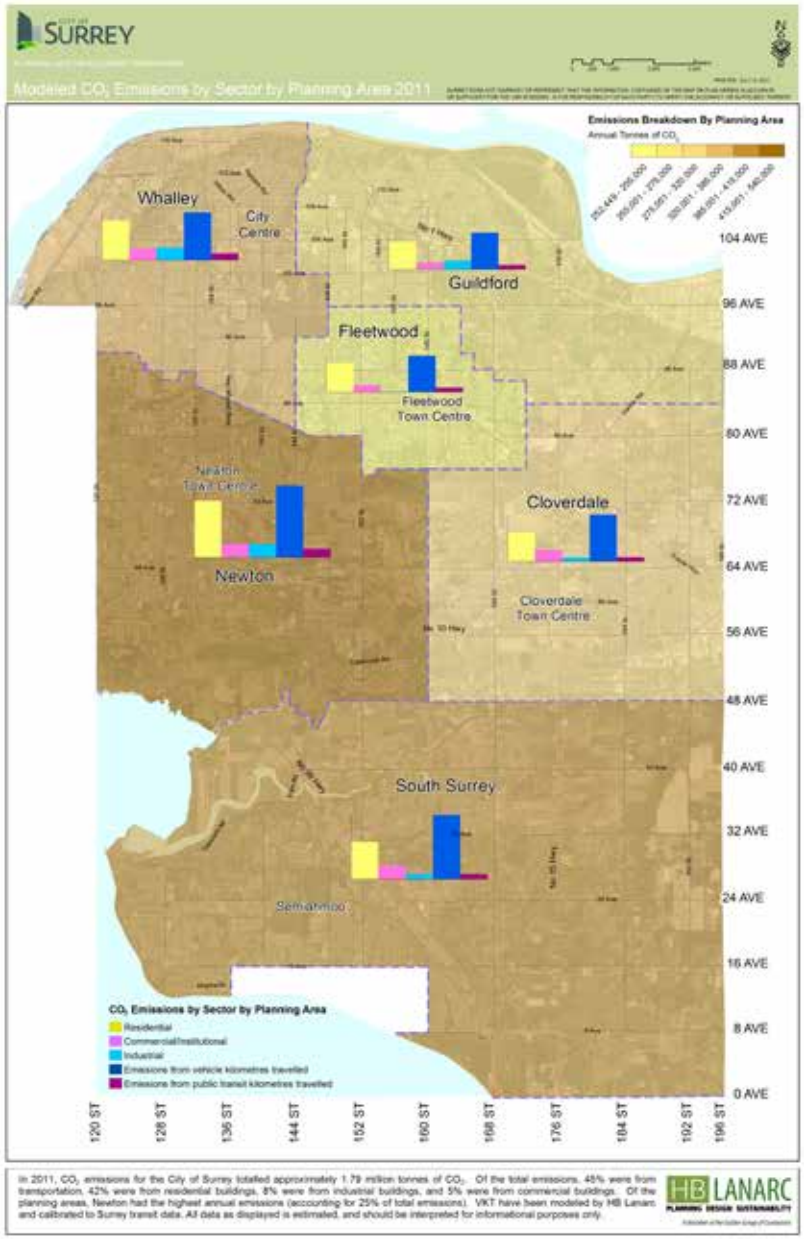
Wayfinding: All the ways in which people orient themselves in physical space and navigate from place to place. In an urban context, it refers to the natural and built environment and contributes to make a city more easily navigable for residents, commuters, and tourists.

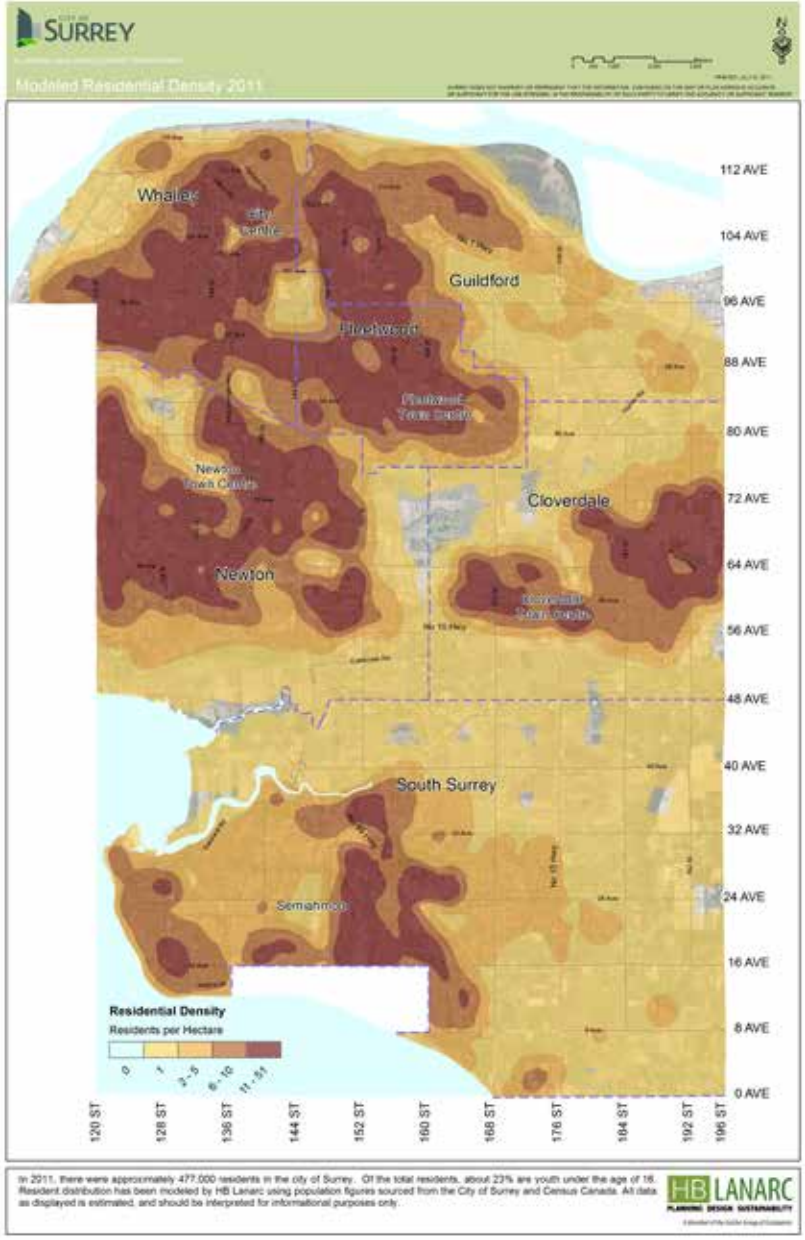
Zoning Bylaw: A bylaw that controls the use of land in a community. It specifics how land may be used; where buildings other structures can be located; the types of buildings that are permitted and how they may be used; lot sizes and dimensions; parking requirements; and building heights and setbacks.

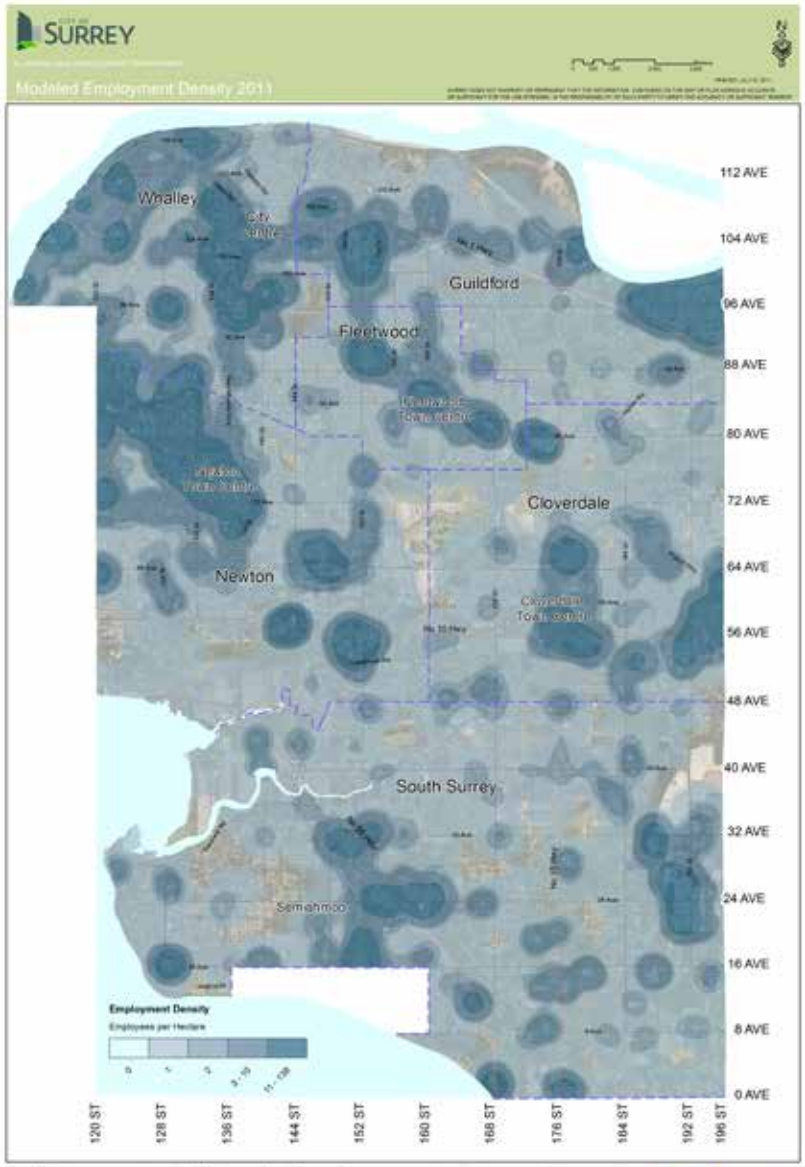
C. BASELINE ENERGY & EMISSIONS MAPS

Energy and emissions drivers and location-sensitive indicators influencing energy supply and energy and emissions in transportation and buildings were mapped to provide visual summaries of current conditions. The brief descriptions below explain the series of maps found on the following pages and summarize the key points of each map. See the Detailed Technical Modeling Methodology supporting document for a description of modeling and mapping.

Map Name	Map Purpose	Key Points
Modeled CO2 by Sector by Planning Area 2011	Summarizes community-wide energy and emissions by planning area	• Residential buildings and private transportation are leading sources of emissions. • Total CO2 city-wide (excluding commercial & freight transport) for 2011 is approximately 2,450,000 tonnes of CO2. • The mix of emissions in each planning area reflects differences in density, land use mix, age of housing, access to transportation, and other key locational factors.
Modeled Residential Density 2011	Shows geographic patterns of various energy and emission drivers	• Residential density is calculated as gross households per hectare by dissemination area. Residential density influences transportation emissions through relationships between land use and transportation. It also influences residential building emissions through occupancy. • The densest areas in Surrey are in older redeveloping neighbourhoods as well as in areas of new urban development.
Modeled Employment Density 2011		• Employment density is calculated as gross number of employees per hectare by dissemination area. Employment density drives down transportation emissions through land use mix (i.e. shorter commutes from access to local jobs) and through clustering of commercial activity. • The densest employment areas are currently in industrial office parks, along highways and in town centres.
Modeled Access to Grocery Stores 2011		• Walking distance to local services such as grocery stores 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. • Access to grocery stores is highest in and near town centres. • As mixed use development increases, the availability of local services for residents increases and residential transportation emissions go down.
Modeled Daily Per Capita Travel by Neighbourhood 2011	Shows geographical patterns of sectoral energy and emissions	• Higher residential and employment density is associated with fewer and shorter trips by car, measured in private vehicle kilometers traveled. • Higher density areas in Surrey, such as City Centre, have lower average private vehicle kilometers traveled per capita per day than other, less dense areas such as South Surrey
Modeled Building Energy Intensity 2011		• Energy intensity is a function of building 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.


SURREY
Modeled CO_2 Emissions by Sector by Planning Area 2011
Emissions Breakdown By Planning Area
Annual Tonnes of CO_2
Whalley
City Centre
Guildford
Fleetwood
Fleetwood Town Centre
Newton Town Centre
Newton
Cloverdale
Cloverdale Town Centre
South Surrey
Semiahmoo
104 AVE
96 AVE
88 AVE
80 AVE
72 AVE
64 AVE
56 AVE
48 AVE
40 AVE
32 AVE
24 AVE
16 AVE
8 AVE
0 AVE
120 ST
128 ST
136 ST
144 ST
152 ST
160 ST
168 ST
176 ST
184 ST
192 ST
196 ST
CO_2 Emissions by Sector by Planning Area
Residential
Commercial/Institutional
Industrial
Emissions from vehicle kilometres travelled
Emissions from public transit kilometres travelled
In 2011, CO_2 emissions for the City of Surrey totalled approximately 1.79 million tonnes of CO_2. Of the total emissions, 46% 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.
HB LANARC
PLANNING DESIGN SUSTAINABILITY


SURREY
Modeled Residential Density 2011
Whalley
City Centre
Guildford
Fleetwood
Fleetwood Town Centre
Newton Town Centre
Newton
Cloverdale
Cloverdale Town Centre
South Surrey
Semiahmoo
112 AVE
104 AVE
96 AVE
88 AVE
80 AVE
72 AVE
64 AVE
56 AVE
48 AVE
40 AVE
32 AVE
24 AVE
16 AVE
8 AVE
0 AVE
120 ST
128 ST
136 ST
144 ST
152 ST
160 ST
168 ST
176 ST
184 ST
192 ST
196 ST
Residential Density
Residents per Hectare
0
1
3 - 5
6 - 10
11 - 51
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 18. 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.
HB LANARC
PLANNING DESIGN SUSTAINABILITY



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.

HB LANARC
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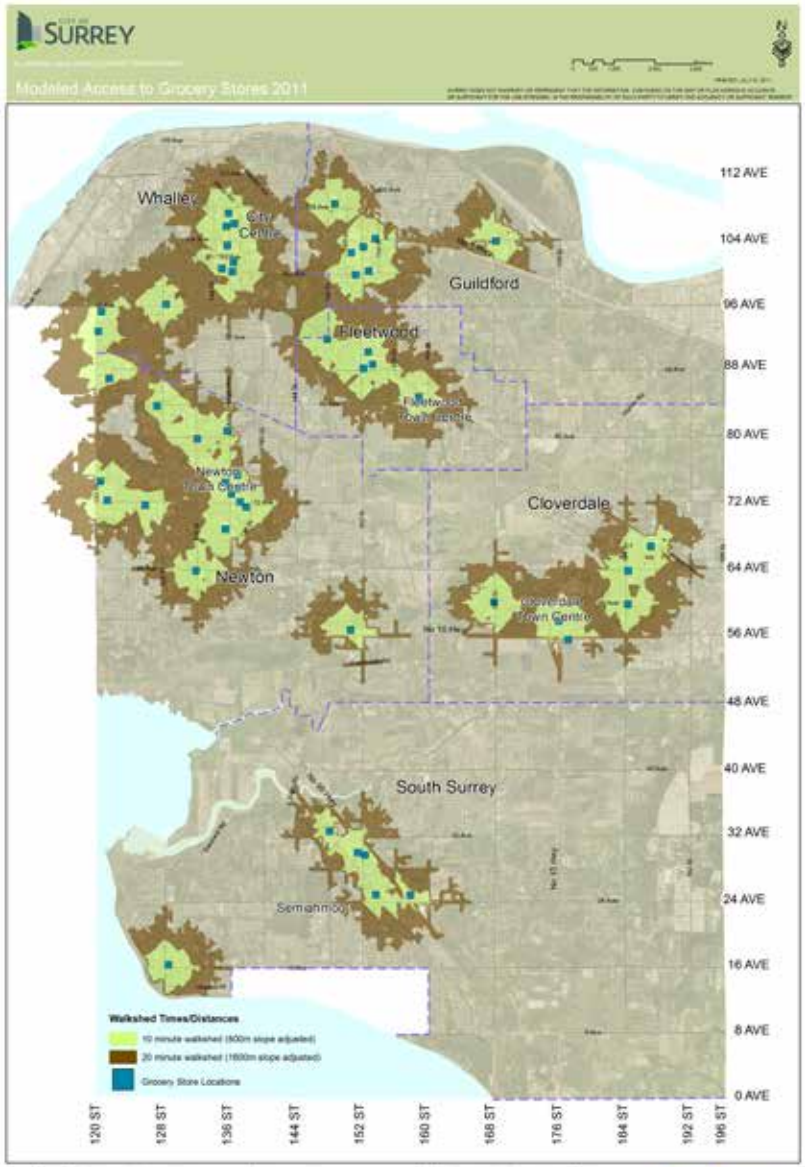

In 2011, 25% of households live within a one-way 10 minute walk to a grocery store, and 60% of households live within a 20 minute one-way walk to a grocery store.

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

HB LANARC
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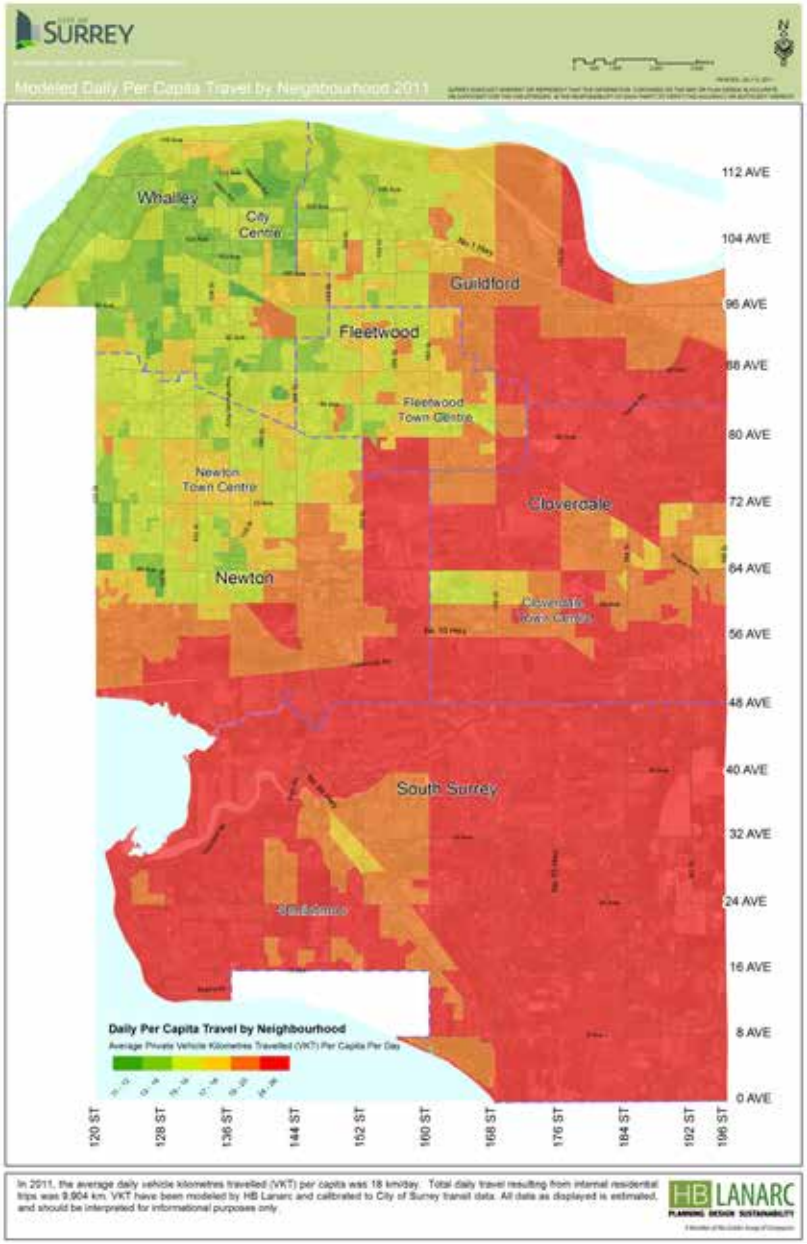
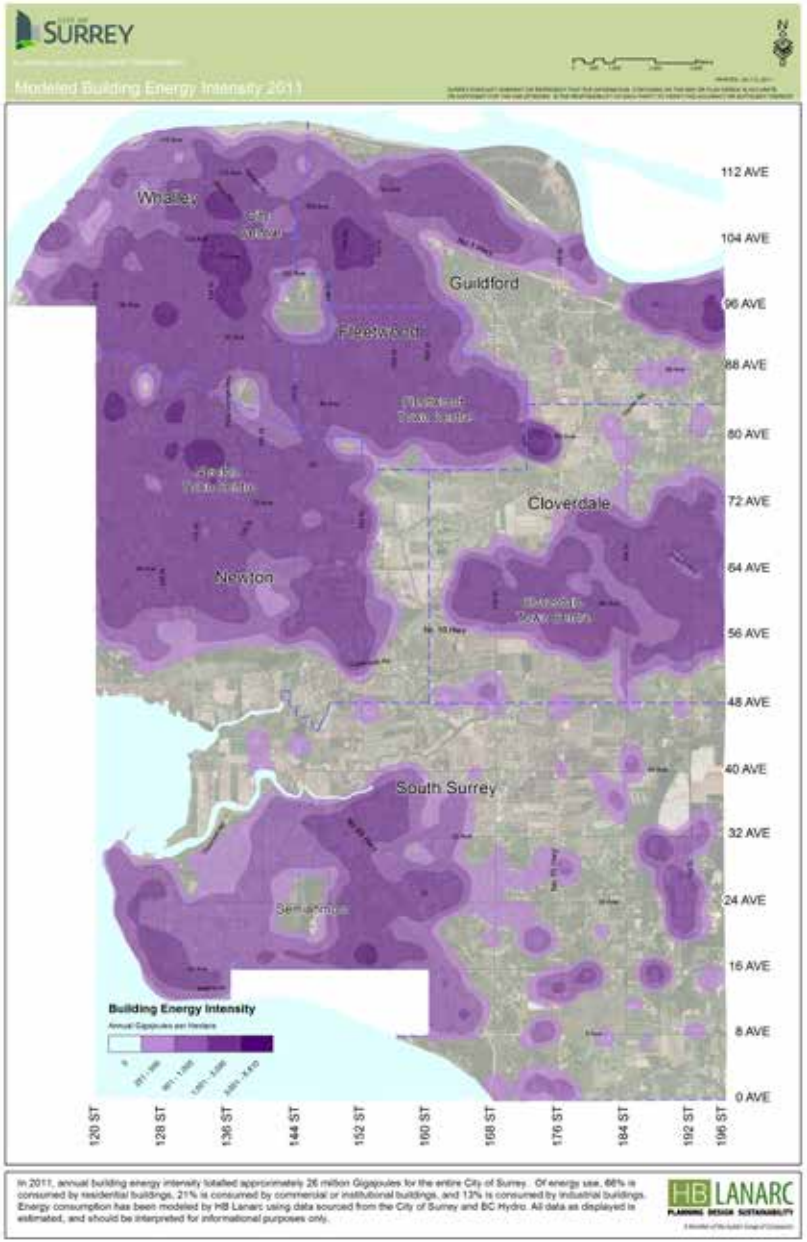

SURREY
Modeled Daily Per Capita Travel by Neighbourhood 2011
Whalley
City Centre
Guildford
Fleetwood
Fleetwood Town Centre
Newton Town Centre
Cloverdale
Newton
Cloverdale Town Centre
South Surrey
Semiahmoo
112 AVE
104 AVE
96 AVE
88 AVE
80 AVE
72 AVE
64 AVE
56 AVE
48 AVE
40 AVE
32 AVE
24 AVE
16 AVE
8 AVE
0 AVE
120 ST
128 ST
136 ST
144 ST
152 ST
160 ST
168 ST
176 ST
184 ST
192 ST
196 ST
Daily Per Capita Travel by Neighbourhood
Average Private Vehicle Kilometres Travelled (VKT) Per Capita Per Day
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.
HB LANARC
PLANNING DESIGN SUSTAINABILITY


SURREY
Modeled Building Energy Intensity 2011
Whalley
Guildford
Cloverdale
Newton
South Surrey
112 AVE
104 AVE
96 AVE
88 AVE
80 AVE
72 AVE
64 AVE
56 AVE
48 AVE
40 AVE
32 AVE
24 AVE
16 AVE
8 AVE
0 AVE
120 ST
128 ST
136 ST
144 ST
152 ST
160 ST
168 ST
176 ST
184 ST
192 ST
196 ST
Building Energy Intensity
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.
HB LANARC
PLANNING DESIGN SUSTAINABILITY

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COUNCILLOR
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November 2013 – FINAL

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